

Design-Build Request For Proposal



**US Army Corps
of Engineers**
Louisville District

**SOF MH-47 Hangar
PN 76374, FY2012**

Ft. Campbell, Kentucky

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CERTIFIED FINAL (RTA)

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1.0 PROJECT OBJECTIVES

1.0.1 The project objective is to design and construct facilities for the military that are consistent with the design and construction practices used for civilian sector projects that perform similar functions to the military projects. For example, a Company Operations Facility has the similar function as an office/warehouse in the civilian sector; therefore the design and construction practices for a company operations facility should be consistent with the design and construction of an office/warehouse building.

Comparison of Military Facilities to Civilian Facilities

Military Facility	Civilian Facility
SOF Helicopter Maintenance Hangar	Aircraft Maintenance Hangar

1.0.2 It is the Army's objective that these buildings will have a 50 year useful life. The design and construction should provide an appropriate level of quality to ensure the continued use of the facility over that time period with the application of reasonable preventive maintenance and repairs that would be industry-acceptable to a major civilian sector project OWNER. The facility design should consider that the Army may repurpose the use of the facility over the 50 year life. The Army's intent is to install products and materials of good quality that meet industry standard average life that corresponds with the period of performance expected before a major renovation or repurpose. The design should be flexible and adaptable to possible future uses different than the current to the extent practical while still meeting the operational and functional requirements defined within. Flexibility is achieved through design of more flexible structural load-bearing wall and column system arrangements. The site infrastructure will have at least a 50-year life expectancy with industry-accepted maintenance and repair cycles. Develop the project site for efficiency and to convey a sense of unity or connectivity with the adjacent buildings and with the Installation as a whole.

1.0.3 Requirements stated in this contract are minimums. Innovative, creative, and life cycle cost effective solutions, which meet or exceed these requirements are encouraged. Further, the OFFEROR is encouraged to seek solutions that will expedite construction (panelization, pre-engineered, etc.) and shorten the schedule. **The intent of the Government is to emphasize the placement of funds into functional/operational requirements. Materials and methods should reflect this by choosing the most economical Type of Construction allowed by code for this occupancy/project allowing the funding to be reflected in the quality of interior/exterior finishes and systems selected.**

1.1. SECTION ORGANIZATION

This Section is organized under 6 major "paragraphs".

- (1) Paragraph 1 is intended to define the project objectives and to provide a comparison between the military facility(ies) and comparable "civilian" type buildings.
- (2) Paragraph 2 describes the scope of the project.
- (3) Paragraph 3 provides the functional, operational and facility specific design criteria for the specific facility type(s) included in this contract or task order.
- (4) Paragraph 4 lists applicable industry and government design criteria, generally applicable to all facility types, unless otherwise indicated in the Section. It is not intended to be all-inclusive. Other industry and government standards may also be used, where necessary to produce professional designs, unless they conflict with those listed.
- (5) Paragraph 5 contains Army Standard Design Criteria, generally applicable to all facility types, unless otherwise indicated in the Section.

(6) Paragraph 6 contains installation and project specific criteria supplementing the other 5 paragraphs.

2.0 SCOPE

2.1 PROJECT SUMMARY

The design build construction project consists of the construction of a SOF MH47 Hangar at Fort Campbell, Kentucky. Included in the project will be the construction of the maintenance hangar, parking ramps, a C-17 loading facility, and all necessary site improvements, utilities, SDD and EPAAct05 compliance measures, antiterrorism measures, and Building Information Systems. The construction of this MH-47 aviation maintenance hangar, aircraft parking ramp, and C-17 loading facility for the 1/160th Special Operations Aviation Regiment (1/160th SOAR).

The work includes construction of an MH-47 aviation maintenance hangar including maintenance bays, shops, company administration, platoon offices, aviation operations, locker room and storage areas. Includes an MH-47 parking ramp, C-17 unloading ramp, existing TACAN relocation, information systems, fire protection/alarm systems, Energy Monitoring and Control Systems (EMCS) connection, protected distribution system (PDS), intrusion detection, surveillance, and electronic access control. Supporting facilities include all related site-work and utilities (electrical, water, gas, sanitary sewer, and information systems distribution), lighting, parking, curb and gutter, sidewalks, storm drainage, landscaping, and other site improvements. Special construction includes sustainable construction features complying with Leadership in Energy and Environmental Design (LEED) "Silver". Access for persons with disabilities will be provided. Comprehensive building and furnishings related interior design and audio visual services are included.

This contract covers all services required to design and construct a hangar and support facilities consistent with this RFP (Request for Proposal (D/B RFP), and other supporting documents and references necessary for construction of the SOF MH47 Hangar at Fort Campbell, Kentucky.

Antiterrorism/force protection measures will be included in accordance with Unified Facilities Criteria (UFC) 4-010-01, DOD Minimum Anti-Terrorism Standards for Buildings dated 8 October 2003 and updates as applicable. Sustainable engineering principles will be integrated into the design, development, and construction of the project in accordance with the EPAAct2005, EISA 2007 and Executive Order 13423. This project will comply with U.S. Army Corps of Engineer's Technical Instructions 800-01; 5th SFG(A) Architectural Compatibility Plan; International Building Code; NFPA 101, Life Safety Code; Unified Facility Code 3-600-01, Design: Fire Protection for Facilities; and U.S. Army's Military Construction Transformation/MILCON Business Process principles.

2.2 SOF HELICOPTER MAINTENANCE HANGAR:

Provide one rotary-wing aircraft operations and maintenance hangar. This project type is to provide facilities for the purpose of maintaining and repairing rotary-wing aircraft, complete with parts and tool storage, administrative operations, aviation (Support) operations, and all support equipment and facilities. It is intended for these facilities to be similar to aviation operations and maintenance hangars in the private sector community with the addition of administrative spaces.

This project is designated as an SOF Helicopter Maintenance Hangar (SOF MH-47 Hangar). This hangar statement of work is based on a modified Army Standard Design Attack or Assault Battalion, or Cavalry Squadron (AAC) Maintenance Hangar to support the 1st Battalion of the SOF 160th Special Operations Aviation Regiment (Airborne); 1/160th SOAR(A). Table 2.1 shows the number of aircraft and personnel assigned to the facility.

The facility shall be designed to permit occupancy 24 hours per day when necessary.

The maximum gross square footage (GSF) for the Hangar facility shall not exceed 104,900 square feet.

The Government has provided design drawings in Appendix J Drawings and Specifications in Appendix AA Technical Specifications. These documents should be considered 90% complete and are the minimum standard for design of the project. The Contractor shall complete all engineering required to provide a design in compliance with the requirements of the RFP and other requirements.

The Government has provided design drawings and specifications in Appendix RR for electrical work. These documents are 100% complete and no modifications are allowed to these documents.

Additional security requirements are in place for the work identified in this RFP. See Appendix GG Security Requirements.

Additional Ft. Campbell specific requirements are included in Appendix HH Ft. Campbell Environmental Requirements.

Table 2.1 160th Special Operations Aviation Regiment (Airborne), 1st Battalion

Unit	Unit Type	Aircraft	Unit Total Personnel
Assault Companies (3)	AVN	MH-47	
Aviation Support Company	AVUM		
Total			300 PN
Notes: AVN – Aviation (Flying) AVUM – Aviation Unit Maintenance			

2.2. SITE:

Provide all site improvements necessary to support the new building facilities. Refer to Paragraph 6.

Approximate area available 22.20 acres

2.3. GOVERNMENT-FURNISHED GOVERNMENT-INSTALLED EQUIPMENT (GFGI)

Coordinate with Government on GFGI item requirements and provide suitable structural support, brackets for projectors/VCRs/TVs, all utility connections and space with required clearances for all GFGI items. Fire extinguishers are GF/GI personal property, while fire extinguisher brackets and cabinets are Contractor furnished and installed CF/CI. All Computers and related hardware, copiers, faxes, printers, video projectors, VCRs and TVs are GFGI.

The following are also GFGI items: Personnel Harnesses for Fall Arrest System

2.4. FURNITURE REQUIREMENTS

Provide furniture design for all spaces listed in Chapter 3 and including any existing furniture and equipment to be re-used. Coordinate with the user to define requirements for furniture systems, movable furniture, storage systems, equipment, any existing items to be reused, etc. Early coordination of furniture design is required for a complete and usable facility.

The procurement and installation of furniture is NOT included in this contract. Furniture will be provided and installed under a separate furniture vendor/installer contract. The general contractor shall accommodate that effort with allowance for entry of the furniture vendor/installer onto this project site at the appropriate time to permit completion of the furniture installation for a complete and usable facility to coincide with the Beneficial Occupancy Date (BOD) of this project. The furniture vendor/installer contract will include all electrical pre-wiring and the whips for final connection to the building electrical systems however; the general contractor shall make the final connections to the building electrical systems under this contract. Furthermore, the general contractor shall provide all Information/Technology (IT) wiring (i.e. LAN, phone, etc.) up to and including the face plate of all freestanding and/or systems furniture desk tops as applicable, the services to install the cable and face plates in the furniture, the coordination with the furniture vendor/installer to accomplish the installation at the appropriate time, and all the final IT connections to the building systems under this contract.

The Government reserves the right to change the method for procurement of and installation of furniture to Contractor Furnished/Contractor Installed (CF/CI). CF/CI furniture will require competitive open market procurement by the Contractor using the Furniture, Fixtures and Equipment (FF&E) package. Reference applicable appendix for Preliminary FF&E Information including furniture dimensions sizes as shown in the Standard Design.

2.5. NOT USED

3.0 FUNCTIONAL AND AREA REQUIREMENTS FOR AIRCRAFT MAINTENANCE HANGAR

3.1. GENERAL REQUIREMENTS

This SOF MH-47 Hangar shall include maintenance and administrative areas co-located within one facility. This Hangar consists of the following functional areas.

- Aircraft Maintenance Area: Maintenance Bay (Hangar floor), Maintenance Shop Spaces, and Maintenance Support Spaces (Paragraph 3.3.1)
- Administrative Core: Aviation Unit Operations, Company Administration and Readiness Area, and Support Spaces (Paragraph 3.3.2)

3.2. AIRCRAFT MAINTENANCE HANGAR REQUIREMENTS:

Size aircraft repair parking module sizes for hangar floor space based on UFC 3-260-01. Table 3.1 summarizes parking module requirements for this hangar. Safety lanes are in addition to the module sizes indicated. Use the MH-47 module size to accommodate the MH-47 aircraft. The utilization of a single module for these aircraft facilitates future changes of mission and aircraft at all facilities. Where requirements of this RFP refer to a specific aircraft model, an MH-47 shall be considered comparable in size to a CH-47.

Table 3.1 Hangar Modules and Sizes

AIRCRAFT GROUP	MODULE LENGTH	MODULE WIDTH	NO. OF MODULES AAC
TYPE	LENGTH	WIDTH	
Chinook (MH-47)	110'	'70	3

3.2.1. ACCESSIBILITY REQUIREMENTS

The Hangar facility shall be handicap accessible for Army personnel and visitors that may be assigned in accordance with the Architectural Barriers Act (ABA) Standard for Department of Defense Facilities.

3.2.2 GROSS BUILDING AREA

Gross areas of facilities shall be computed according to Appendix Q. Maximum gross area limits indicated in Paragraph 2.0, SCOPE, may not be exceeded. A smaller overall gross area is permissible if all established net area program requirements and functional adjacencies are met.

3.2.3 UTILITY AND SUPPORT SPACE

Provide mechanical, electrical and communications rooms. Mechanical rooms shall accommodate space for equipment maintenance/repair access without having to remove other equipment. Key mechanical, electrical and communications rooms separately for access by Installation maintenance personnel. Exterior access is required for main mechanical rooms on the first floor as shown in Attachment A Room Data Sheets and Attachment B Conceptual Drawings. All communications rooms shall be conditioned space equivalent to office space with access from the interior of the building. Design drawings shall show minimum 1/4"=1'-0" scale plans and cross-sectional views of mechanical and electrical equipment rooms showing layout, dimensions and clearances for equipment and systems.

3.2.3.1 MAINTENANCE ACCESS:

System maintainability is a critical aspect of this facility. The contractor is to ensure that all equipment, including filters, controls, control valves, backflow preventers, and coils are easily accessible and have ample room for servicing, inspection, and cleaning.

- Isolation valves shall be provided for each terminal unit, zone, branch, long runs, etc. as necessary for proper isolation and maintenance.
- Coils shall be fully removable without requiring demolition of any building components.
- Piping configuration at all coils shall include unions to facilitate easy removal.
- The design-build contractor shall ensure that all maintenance and repair activities can be performed safely and efficiently without needing to bring in extensive material handling (e.g. A-frames) or access equipment (e.g. ladders).
- All valves, pumps, strainers, controls, sensors, and other items requiring regular service are to be located such that they may be maintained from floor level when possible. If not accessible from floor level, then permanent maintenance access shall be provided.
- All above ceiling utilities (cable trays, ductwork, junction boxes, utility piping, etc.) shall be accessible for a worker to reach two sides plus the service side with a minimum 3'-3" clearance (greater if required for component maintenance/disassembly). Permanent maintenance access shall be provided for all suspended mechanical equipment.
- Where ever possible, HVAC equipment requiring service (such as VAV boxes, fans and heat pump units) are to be located in accessible areas such as corridors, lobbies and common areas of the buildings. The intent is to be able to access and service the equipment without disturbing or disrupting building users and to minimize any damage to user desks or equipment from potential equipment leaks.
- Water treatment systems for boilers/chillers (if provided) shall be designed and installed such that chemical handling is accomplished at the floor level.
- Ft. Campbell prefers to not have HVAC equipment located on the buildings roof.

3.2.4 FURNITURE, FIXTURE AND EQUIPMENT

See Furniture, Fixture and Equipment (FFE) listing in Table 3.2 for loose item requirements and related design considerations for individual spaces. Table 3.2 lists GFGL items around which the Contractor is to design individual spaces. Each required workstation unless noted is to include appropriate work surface area, upper cabinets or shelves, file cabinet(s), pencil drawer, space for computer and monitor, telephone, ergonomic administrative chair, task lights, power, and data (network, internet including NIPR and SIPR where required, and required Logistics STAMIS) connections. Provide centralized areas for photocopier, laser printer and fax machine with waste and paper recycling receptacles and supply cabinet for paper storage as required in each office area.

Where a workstation is specified, provide 110 VAC receptacles, voice and data receptacle in addition to that specified in Attachment A Room Data Sheets.

Where individual spaces require shelving, and a minimum quantity of shelving is not indicated, maximize the linear feet of shelving within the space and show on proposal drawings.

CFCI shelving, cabinets and lockers shall be anchored to prevent unwanted movement.

Furniture, fixture and equipment listed in Table 3.2 shall be coordinated with the installation and shall be incorporated into the FFE design and package. Reference Section 01 33 16 for FFE design and package requirements.

3.2.4.1 MARKER BOARDS AND FLAT SCREEN DISPLAYS

Dry erase marker boards and/or flat screen displays are indicated as user requirements at various locations. Where dry erase marker boards are required, provide demountable wall connections. Where flat screen displays are required, provide space and wall mount supports with power and data connections.

3.2.5 CONFERENCE, BRIEFING, AND CLASSROOMS

Provide, as a minimum, a dry-erase marker board, a motor operated projector screen, a ceiling-mounted projector bracket, and ceiling mounted 110 VAC receptacle and data receptacle for digital projector in each conference, briefing, and classroom.

3.2.6 RESTROOMS

Except where indicated otherwise, provide restrooms on each floor with fixture counts per IPC with fixture distribution calculated for 90% male and 10% female.

(a) Ground Floor: At a minimum, provide toilets, lavatories, 111 double tier lockers, showers and electric water coolers as indicated. Refer to room data sheets for locker requirements. Provide dressing benches as indicated.

(b) Second Floor: At a minimum, provide toilets, lavatories, 43 lockers, showers and electric water coolers as indicated. Refer to room data sheets for locker requirements. Provide dressing benches as indicated..

3.2.7 JANITOR CLOSET

Provide janitor closets on each floor of the facility. Each janitor closet shall have a mop sink, mop rack and space for buckets, vacuum and storage for janitorial supplies.

3.2.8 OIL-WATER SEPARATOR SYSTEM

The design of the separator system will account for the operational effects of the wash racks. Provide a minimum 5000 gallon oil/water separator.

3.2.9 UTILITY PEDESTALS

3.2.9.1 GENERAL REQUIREMENTS

Utility pedestals shall be provided in the maintenance and wash bays to elevate power, data, compressed air, and water utilities above the floor level. Pedestals shall be located inside the marked walk-way zone in each maintenance bay or wash bay. Route all utilities below slab to the pedestal locations.

Refer to Appendix LL for an example of a standard utility pedestal. The contractor shall modify the standard design to include the type and quantity of utilities noted below. The final pedestal layout shall be approved by the users during design. Pedestal main frame construction shall not be fabricated from "Uni-strut" or similar materials.

3.2.9.2 TYPE "A" PEDESTAL

Provide utility pedestal with the following utilities. (2) Compressed air Station, (1) 28 VDC receptacle, (2) 110 VAC/ 60 Hz receptacle, (1) 115 VAC 3ph 400 Hz receptacle, (1) 220 VAC receptacle and (4) data ports.

3.2.9.3 TYPE "B" PEDESTAL

Provide utility pedestal with the following utilities. (2) Compressed air Station, (1) 110 VAC/ 60 Hz receptacle and (1) 220 VAC receptacle and (1) 1.25" Conduit for future Data Cabling.

3.2.9.4 TYPE "C" PEDESTAL

Provide utility pedestal with the following utilities. (2) Compressed air Station, (2) 110 VAC/ 60 hz receptacle, and (1) 220 VAC receptacle and (1) 1.25" Conduit for future Data Cabling.

3.2.9.5 TYPE "D" PEDESTAL (WASH BAY)

Provide utility pedestal with the following utilities. (1) non-potable water hose bibb.

3.2.9.6 FLOOR MOUNTED UTILITY BOX

Provide floor box with (2) compressed air connection stations located at the center of each maintenance bay inside of the marked walk-way. The floor box shall have an aircraft rated access door. Box shall be sized to accommodate the compressed air stations. Route compressed air piping below slab to the utility box.

3.3 FUNCTIONAL AND AREA REQUIREMENTS

Hangar facility functional requirements and net and gross area limitations are summarized in Attachment A Room Data Sheets.

3.3.1 AIRCRAFT MAINTENANCE AREA

A consolidated multi-purpose space for the maintenance, repairs, and major overhaul of military aircraft and includes maintenance bays, tech supply, shop space, production control, and quality control areas directly related to the maintenance and supervision of aircraft, component and assembly rebuilding, and quality control of aviation maintenance. The area can be broken down into two primary functions, aircraft maintenance bay and shop space.

3.3.1.1 AIRCRAFT MAINTENANCE BAY

Size and provide required functions for the hangar floor space based on UFC 3-260-01 and Attachment A Room Data Sheets. Attachment A Room Data Sheets summarizes aircraft parking module requirements for the hangar. Safety lanes are in addition to the module sizes indicated.

Required structural support and other features shall not reduce the maintenance bay areas or safety lane requirements below those indicated in Attachment A Room Data Sheets. The Aircraft Maintenance Bay shall be column free, clear structural spans over all aircraft modules as indicated on the plan. No columns are allowed within the Aircraft Maintenance Bays.

The height of the hangar bay shall meet the minimum clearance requirements in UFC 3-260-01, Table 8.2. A minimum 10' clearance is required from the bottom of the bridge crane hook cradle to the aircraft element.

Hangar grounding points shall be provided per UFC 3-260-01.

Meet all clearance requirements of UFC 3-260-01 based on MH-47 aircraft. Provide hangar doors to meet and operate under anticipated climatic conditions.

Structural framing for the hangar shall provide for overhead fall protection / fall arrest system over each aircraft module. The fall arrest system will consist of support rails, enclosed tracks with a sealed bearing trolley, rated for eight simultaneous users per bay. Fall arrest system shall consist of two (2) Flexible Lifelines Twin FlexRail Trolley Systems with eight (8) Reload Self Retracting Lifelines and (8) Aircraft Tagline Management systems, per bay, or equal. In addition, two (2) Single Point Anchor fall arrest systems shall be provided in each bay. Coordinate the location of the Single Point Anchor systems in each bay with the user to provide fall arrest coverage for areas not covered by the trolley system.

Painting of aircraft does not occur in the Aircraft Maintenance Bays.

3.3.1.2 AIRCRAFT MAINTENANCE SHOP SPACE

Size and provide required functions for the aircraft maintenance shop spaces based on Attachment A Room Data Sheets.

3.3.1.2.1 PAINT SHOP

Paint shop shall house GFGI fully enclosed paint booth for small parts prep and painting. Paint booth shall be Garmat Series 3000 or equal, approximate exterior dimensions of 13'-6" W x 27'-2" L x 10'-10" H. Contractor shall provide power and natural gas utility connections as well as intake and exhaust duct connections to the building exterior. Intake and exhaust ducts shall extend to the roof. Coordinate routing through second floor spaces to minimize disruption to storage areas. Contractor shall coordinate final room layout and utility connections with users during design after award.

3.3.1.3 AIRCRAFT MAINTENANCE SUPPORT SPACE

Maintenance support spaces generally include storage rooms for maintenance tools, parts and POL materials. Maintenance support space functions and size requirements shall be as indicated in Attachment A Room Data Sheets.

3.3.2 ADMINISTRATIVE CORE

Company Operations (CO) in hangar facilities required below vary from Company Operations Facilities (COF) defined in separate standard designs. Hangar CO provides administration, operations, readiness and supply functions. COFs provide administration and readiness modules.

3.3.2.1 AVIATION UNIT OPERATIONS AREA

Provide areas for pilots and air crews to prepare flight plans, conduct mission planning and briefings, and debriefings. Aviation Unit Operations space functions and size requirements shall be as indicated in Attachment A Room Data Sheets.

3.3.2.2 COMPANY ADMINISTRATION AND READINESS AREA

The company administration and readiness area consists of offices, storage, etc., to accommodate designated personnel within the battalion. See Attachment A Room Data Sheets for specific hangar function/space requirements.

This facility will accommodate a total of 4 companies to include: 3 flying companies and 1 aviation support company.

3.3.2.3 SUPPORT SPACES

Provide support spaces as required for the hangar facility to include but not limited to showers, restrooms, mechanical, electrical, communications, janitor closet(s), and hallways.

Provide required utility connections and mounting connections for all equipment and furniture listed in Attachment A Room Data Sheets and Table 3.2. Unless otherwise noted, equipment and furniture listed in Attachment A Room Data Sheets is CFCL. Reference Table 3.2 for FFE listing.

COMSEC Storage Room: Design to meet AR 380-5 Secure Room Standards.

3.3.3 HANGAR FUNCTIONAL AND SPACE REQUIREMENTS

See Attachment A Room Data Sheets following this Section.

Provide required utility connections and mounting connections for equipment and furniture listed in Attachment A Room Data Sheets. Unless otherwise noted, equipment and furniture listed in Attachment A Room Data Sheets is CFCI. Reference Table 3.2 for FFE listing.

Table 3.2 Furniture, Fixture and Equipment Listing

AIRCRAFT MAINTENANCE AREA		
AIRCRAFT MAINTENANCE BAY		
(#1)AIRCRAFT MAINTENANCE BAY HANGAR FLOOR	8	L-shaped Technical Workbench with ESD worktop and grounding points, wrist straps, 2 overhead shelves, task lighting, and metal powerstrip with minimum 6 receptacles
	8	Operable Stools with hard surface casters
AIRCRAFT MAINTENANCE SHOP SPACE		
(#2)PRODUCTION CONTROL	2	Private office with U-Shaped workstations. Overhead storage with task lighting; center drawer; Box/Box File, & File/File Storage.
	6	L-shaped Admin Workstations. Center drawer; Box/Box File & File/File Storage; Overhead Storage & task lighting
	20	Conference Chairs
	10	Ergonomic Task Chairs
	1	Conference Table
	3	Lockable metal storage cabinet 72" h x 30" w x 30" d with shelves
	2	2 High Lateral File Cabinets
	1	4-Drawer Safe for COMSEC
(#3)QUALITY CONTROL/QUALITY ASSURANCE	1	Private office with U-Shaped workstation. Overhead storage with task lighting; center drawer; Box/Box File, & File/File Storage.
	6	L-shaped Admin Workstations. Center drawer; Box/Box File & File/File Storage; Overhead Storage & task lighting
	7	Ergonomic Task Chairs
	4	Lockable metal storage cabinet 72" w x 30" d x 30" h with shelves
(#4?)AIRCRAFT MAINT PLATOON HQ	3	Private/Semi-private U-Shaped workstation. Overhead storage w/ task lighting; center drawer; Box/Box File, & File/File Storage
	3	Ergonomic Task Chair
	3	4' H Bookcases
	1	Printer storage cabinet 72" w x 30"d x 30"h
	3	4' H Lateral Files
(#5)REPAIR SECTION	4	Private Office with U-Shaped workstations. Overhead storage w/ task lighting; center drawer; Box/Box File, & File/File Storage
	14	Conference Chairs
	1	10' Conference Table
	14	Technical Workbench with ESD worktop and grounding points, wrist straps, 2 overhead shelves and task lighting, metal powerstrip with minimum 6 receptacles
	4	Ergonomic Task Chair
	14	Operable Stools with hard surface casters
	4	Lockable Tool Storage Cabinet with Drawers 30"Wx57"H
	4	Lockable Tool Storage Shelving 60" W x 57"H

(#6)AIRCRAFT COMPONENT REPAIR PLATOON	3	Private Office with U-Shaped workstations. Provide: Overhead storage with task lighting; center drawer; Box/Box File, & File/File Storage
	3	Ergonomic Task Chair
	3	4' H Bookcases
	1	Printer storage cabinet 72" w x 30"d x 30"h
	3	4' H Lateral Files
(#7)POWER PLANT	1	U-Shaped Admin workstation in Semi-Private Office. Overhead storage with task lighting; center drawer; Box/Box File, & File/File Storage.
	2	Technical Workbench with ESD worktop and grounding points, wrist straps, 2 overhead shelves and task lighting, metal powerstrip with minimum 6 receptacles
	4	Lockable Tool Storage Cabinet with Drawers 30"Wx57"H
	1	Ergonomic Task Chair
	2	Operable Stools with hard surface casters
(#8)POWERTRAIN	1	U-Shaped Admin workstation in Semi-Private Office. Overhead storage with task lighting; center drawer; Box/Box File, & File/File Storage.
	2	Technical Workbench with ESD worktop and grounding points, wrist straps, 2 overhead shelves and task lighting, metal powerstrip with minimum 6 receptacles
	4	Lockable Tool Storage Cabinet with Drawers 30"Wx57"H
	1	Ergonomic Task Chair
	2	Ergonomic Operable Stools with hard surface casters
(#9)STRUCTURAL REPAIR (AIRFRAME)	1	L-Shaped Admin workstation. Overhead storage w/ task lighting; center drawer; Box/Box File, & File/File Storage.
	3	Technical Workbench with ESD worktop and grounding points, wrist straps, 2 overhead shelves and task lighting, metal powerstrip w/minimum 6 receptacles
	3	Operable Stools with hard surface casters
	1	Ergonomic Task Chair
	2	Lockable Tool Storage Cabinet with Drawers 30"Wx57"H
	2	Storage cabinets; 36"w x 18"d x 68"h
	1	Top Mount Freezer/Refrigerator with Icemaker 21.7 Cu. Ft.
	1	Conventional Oven
(#10)PNEUDRAULICS REPAIR	1	L-Shaped Admin workstation. Overhead storage w/ task lighting; center drawer; Box/Box File, & File/File Storage.
	2	Technical Workbench with ESD worktop and grounding points, wrist straps, metal powerstrip w/minimum 6 receptacles
	2	Operable Stools with hard surface casters
	1	Ergonomic Task Chair

(#11)SYSTEMS REPAIR SECTION (AVIONICS/ELECTRICAL REPAIR)	1	L-Shaped Admin workstation. Overhead storage w/ task lighting; center drawer; Box/Box File, & File/File Storage.
	24	Technical Workbench with ESD worktop and grounding points, wrist straps, 2 overhead shelves and task lighting
	24	Operable Stools with hard surface casters
	4	Rubber Mats at Workbenches
	2	NiCad battery charging banks
	1	Ergonomic Task Chair
AIRCRAFT MAINTENANCE SUPPORT SPACE		
(#13)HANGAR PARTS STORAGE (Tech Supply)	2	U-Shaped Admin workstation in Private Office with adjoining Common Workspace. Overhead storage with task lighting; center drawer; Box/Box File, & File/File Storage.
	2	Ergonomic Task Chair
(#14)BREAK ROOM	2	Microwave
	1	Coffee Maker
	1	Top Mount Freezer/Refrigerator w/Icemaker 21.7 Cu. Ft.
	5	Table 36"square x 30" h
	20	Side Chairs
-add ice machine	1	Television
ADMINISTRATIVE CORE		
AVIATION UNIT OPERATIONS AREA		
(#16)FLIGHT OPERATIONS	5	L-Shaped Admin workstation in Common Area. Overhead storage with task lighting; center drawer; Box/Box File, & File/File Storage.
	8	Ergonomic Task Chair
	6	Flat Screen Monitors
	3	Wall Mounted Digital Clocks
	3	Lockable metal storage cabinet 72" w x 30" d x 30" h with shelves
	1	Television
(#17)BRIEFING ROOM	120	Stacking/Ganging chair
	4	Folding Tables 2' w x 8' l
	3	Wall Mounted Digital Clocks
	2	Digital Projectors
	1	Television
(#18)CREW CHIEF WORKROOM	10	Technical Workbench with ESD worktop and grounding points, 2 overhead shelves and worklight (equal to 60 lf of 24"D bench height w storage peds every 3 ft.), metal powerstrip with minimum 6 receptacles per workbench
	10	Operable Stools with hard surface casters
	1	4'x8' Work Table with Metal Surface
	8	Lockable Tool Storage Cabinet w/Drawers 60"Wx57"H
	4	Lockable Tool Storage Shelving 60" W x 57"H
	10	Small Parts Storage Cabinets placed at workbenches
	1	Laptop Charging Cabinet

(#19)MAINTENANCE TEST PILOTS	6	U-Shaped Admin workstation. Provide: Overhead storage with task lighting; center drawer; Box/Box File, & File/File Storage.
	6	Ergonomic Task Chair
COMPANY ADMINISTRATION AND READINESS AREA		
(#20)COMMANDER	4	U-Shaped Admin workstation in Private Office. Wardrobe storage, Overhead storage with task lighting; center drawer; Box/Box File, & File/File Storage.
	4	Executive Ergonomic Task Chair
	1	Television
(#21)1ST SGT	1	U-Shaped Admin workstation. Wardrobe storage, Overhead storage with task lighting; center drawer; Box/Box File, & File/File Storage.
	1	Ergonomic Task Chair
(#4)AVIATION SAFETY OFFICER	3	U-Shaped Admin workstation in Private Office. Wardrobe storage, Overhead storage with task lighting; center drawer; Box/Box File, & File/File Storage.
	3	Ergonomic Task Chair
	6	Guest Chairs
	3	Five drawer lockable file cabinets
(#4)AVIATION STANDARDIZATION OFFICER	3	U-Shaped Admin workstation in Private Office. Wardrobe storage, Overhead storage with task lighting; center drawer; Box/Box File, & File/File Storage.
	3	Ergonomic Task Chair
	6	Guest Chairs
	3	Five drawer lockable file cabinets
(#22)AVIATION TAC OPS OFFICER	3	U-Shaped Admin workstation in Private Office. Wardrobe storage, Overhead storage with task lighting; center drawer; Box/Box File, & File/File Storage.
	3	Ergonomic Task Chair
	3	Five drawer lockable file cabinets
(#23)MULTIPURPOSE/BREAK/CONFERENCE	12	Heavy Duty Training Tables with T-Leg Folding with dolly
	40	Seminar Chair on Casters (Nesting; seat folds up)
	2	36"D Break Table
	8	Side Chair
	1	Top Mount Freezer/Refrigerator w/Icemaker 21.7 Cu. Ft.
	1	Microwave
	1	Coffee Maker
ARMS VAULT INDIVIDUAL WEAPONS	2	L-Shaped workstation: Overhead storage with task lighting; center drawer; Box/Box File, & File/File Storage.
	2	Ergonomic Task Chair
	4	4-High Bookcase
	4	4-Drawer File Cabinet
	2	Technical Workbench with ESD worktop and grounding points, 2 overhead shelves and worklight (equal to 60 lf of 24"D bench height w storage peds

		every 3 ft.), metal powerstrip with minimum 6 receptacles
	4	Operational Task Stool with hard surface casters
	TBD	Weapons Racks
SECURE STORAGE/ NBC STORAGE/ COMM EQUIPMENT/ CONSUMABLE UNIT EQUIPMENT	4	L-Shaped workstation. Overhead Storage, Task Lighting, center drawer, Box/Box File, & File/File Storage.
	4	4-Drawer File Cabinet
	56	Lockable Metal Cabinet with Shelves
	4	Single pedestal desk.
	4	4-Drawer File Cabinet
	8	Ergonomic Task Chair

3.4 FUNCTIONAL ADJACENCIES

Refer to Attachment A Room Data Sheets and Attachment B Conceptual Drawings for Functional Adjacency requirements of spaces.

3.5 SITE

3.5.1 FUNCTIONAL AREAS

Site selection and real property master planning for all Active Component Hangar Complexes shall comply with all safety, obstruction, and airspace boundaries as stipulated by AR 95-2 and implemented by the Transportation Systems Mandatory Center of Expertise (TS MCX) for DCS G-3, HQDA. The major components of a HGR Complex and minimum sitting requirement for any hangar project include the primary facility, Hangar Access Apron. All other hangar complex space is contained within the confines of these facility categories. The outer boundary of the hangar complex (outside the five-foot line) abuts the Aircraft Parking Apron, Hover Taxi lanes, and Taxiways. This assures safe and efficient transition from the power-on components of an AAF/AHP (primary landing surface (i.e., runway or helipad) and aircraft parking) to non-power ingress/egress into the hangar.

3.6 WASH RACK

3.6.1 INTERIOR WASH RACK

Each Maintenance Bay shall be capable of operation as a wash rack. Each wash rack shall be comprised of a single wash bay sized to accommodate a single MH-47 helicopter. Provide a trench drain located at the centerline of the aircraft. The trench drain shall discharge to the building oil/water separator system.

Provide Type “D” utility pedestals as shown on floor plan drawings. A total of four Type “D” pedestals are required. See Paragraph 3.2.9 for pedestal requirements.

3.6.2 WASH RACK UTILITIES

The wash rack shall be supply water from the building non-potable water system. Route piping under the floor slab to each of the Utility Connection Pedestals.

3.6.3 WASH RACK EQUIPMENT

Provide water heating equipment, detergent injection equipment and system distribution piping. Hose bibs shall deliver wash water at the building water pressure (25-50 psi)

a) Provide water heating system to serve wash equipment. Heater shall be capable of generating 120 degree F wash water. Heating source shall be electric or natural gas. Contractor shall determine which fuel source is Life Cycle Cost Effective as part of the overall building evaluation. Locate heating equipment in mechanical equipment room.

b) Provide detergent injection system for wash equipment. System shall be capable to draw detergent from GFGI wash solution drums. Locate injection equipment in hangar bay, downstream, of hose bibb connection point. Coordinate with the user during design for wash solution products.

3.6.4 WASH RACK WATER QUALITY

Water used at the wash rack shall comply with the water quality requirements of paragraph 2.4 of NAVAIR 01-1A-509-1/TM 1-1500-344-23-1/TO 1-1-689-1. See Appendix EE.

3.7 ARCHITECTURAL MATERIALS AND FINISHES

3.7.1 FLOORS

- (a) Epoxy: Resilient Epoxy slip-resistant resin flooring system.
- (b) Dry Shake Hardener: Ferrosilicon, nonoxidizing metallic-aggregate surface hardener. Surface hardener shall be nondusting, abrasion resistant, impact resistant with slip-resistant finish and light reflectance.
- (c) Sealed Concrete: Clear slip-resistant concrete sealer.
- (d) Ceramic tile: Eased edges.
- (e) Unglazed ceramic tile: Slip resistant
- (f) Carpet: Direct glue; heavy traffic.
- (g) Vinyl Composition Tile: Premium grade, non-asbestos vinyl composition tile
- (h) Non Conductive Vinyl: Non conductive – anti-static resilient vinyl sheet flooring with appropriate adhesive for anti-static use.

3.7.2 BASES

- (a) Rubber: 4" Rubber w/ standard base toe
- (b) Ceramic Cove: Ceramic cove base

3.7.3 WALLS

- (a) Ceramic tile: 6" x 6" porcelain ceramic tile w/ 1/2" cement board backer board.
- (b) Glazed Ceramic tile: 2" x 2" glazed ceramic tile on 1/2" cement backer board.
- (c) Gypsum Board/Gyp. Bd. (GWB): Painted
- (d) Fire resistant Gyp. Bd.: Painted
- (e) Moisture resistant Gyp. Bd. (GWB): Mold and moisture resistant gypsum board, painted
- (f) Abuse resistant Gyp. Bd.: Painted
- (g) Concrete masonry unit (CMU): Painted
- (h) Insulated CMU: Exterior concrete masonry units – decorative normal weight units; integral finish with cavity filled foam insulation for thermal resistance; Interior concrete masonry units – smooth faced; Painted with cavity filled foam insulation for sound attenuation where required.
- (i) Pre-finished metal liner panels in aircraft maintenance bays for all exposed vertical surfaces.

3.7.4 CEILINGS

Aircraft Maintenance Shop and Support spaces shall have a minimum 12-foot clear height from finished floor to all equipment.

- (a) Exposed structure: Paint all elements w/ exception of exposed vinyl faced insulation.
- (b) Acoustical Ceiling Tile: Suspended metal grid ceiling system.
- (c) Moisture Resistant Acoustical Tile: Moisture resistant acoustical ceiling tile in suspended metal grid ceiling system.
- (d) Moisture Resistant Gyp. Bd (GWB): Mold and moisture resistant gypsum board.
- (e) Pre-finished metal liner panels in Aircraft Maintenance Bay.

3.7.5 DOORS AND FRAMES (STC and fire rated where required)

- (a) Exterior Hollow metal doors: Insulated galvanized Hollow Metal with corrosive resistant painted finish.
- (b) Aluminum Entrance System: Color PVF finish.
- (c) Wood Doors: Solid core meeting AWI quality standards. Low gloss factory applied transparent polyurethane sheen.
- (d) Hangar Doors: Motorized Insulated Metal Horizontal Sliding – color to complement other exterior finishes.
- (e) Roll-up exterior Doors: Exterior coiling doors - Insulated, metal, motorized overhead coiling w/ manual override operation. Interior coiling doors – insulated, metal, motorized overhead coiling w/ manual override operation.
- (f) Vault Doors: GSA Class 5 Armory Door per Fed Spec AA-D-600D with Day Gates

3.7.6 WINDOWS AND GLAZING (Fire rated where required)

- (a) Hangar Floor or Shop Space: Fixed High-Bay windows, clerestory windows, or insulated translucent wall system to provide daylighting with a minimum 2% glazing factor, providing a minimum of 25-footcandles of natural light over at least 75% of the work space. Provide controls and meet "Dark-Sky" requirements. During commissioning provide tests utilizing a 10-foot by 10-foot grid demonstrating that a minimum of 25-footcandles is provided from natural daylight.
- (b) Offices, exterior and Vestibule interior: Aluminum, insulated windows, fixed, color PVF finish. Meet UFC 4-010-01 requirements.
- (c) Interior Windows: Hollow core metal with fire or safety glazing as required.
- (d) Insulated Glazing Units: Meet UFC 4-010-01 requirements for AFTP, Min 0.06mm poly butyl film on interior pane of insulated glazing units. Reflective film / tinting shall be on interior of exterior pane of insulated glazing units.

3.7.7 DOOR HARDWARE

3.7.7.1 GENERAL

- (a) Full width panic bars on perimeter egress doors, no exterior trim w/ exception of Mechanical Rooms, Elec. Room, Exterior Storage etc... Main building entry door is only exterior door with B.A.S.I.S. G electronic access control system, key by-pass.
- (b) Non-handed, non-sized closers on egress and fire rated doors
- (c) Removable cylinder locksets
- (d) Coordinate all hardware, locksets and keying schedule to meet Base Standards
- (e) Interior doors w/ lever trim, Cylinders and keying shall match Base standards.

3.7.7.2 KEYING AND LOCKS

- (a) Only the main entrance door to the hangar and doors with no interior access shall be provided with entrance hardware. All other doors will be provided with exit only hardware.
- (b) Fort Campbell utilizes an "I/C - 7 pin Insta-Key" integrated master keying system. Interchangeable cores provided shall be compatible with the existing "I/C - 7 pin Insta-Key" system. Four blank keys are to be provided with each change key.
- (c) Locks required to meet FF-L-2740 shall be S&G 2740 or Kaba Mas X-09 type.
- (d) SIPR rooms shall be provided with LKM-7003 and a lock meeting FF-L-2740. A pushbar for the inside is not required, as this area is a mechanical area & does not create a life safety issue. The optional

manual key over-ride for the LKM-7003 shall not be used nor will it be authorized. Refer to AR 380-5, Chapter 7 Section III.

- (e) Panic device hardware shall be touch pad type.
- (f) Install kick plates on doors in heavy use areas.
- (g) Door stops are required at all interior and exterior locations.
- (h) Mechanical/ Electrical room doors shall be equipped with Insta-Key 5DPW.1 as the keying standard.
- (i) Communication room doors shall be equipped with Insta-Key 1FZ.1 as the keying standard.
- (j) Electrical Pad-mounted Transformer locks shall be included in the contract.

3.7.8 SPECIALTIES

- (a) Marker boards: Dry erase Liquid writing marker boards.
- (b) Bulletin boards: Bulletin boards shall consist of a natural cork tack board, and aluminum tubular frame.
- (c) Signage: Comply with requirements of ADA and ABA, Accessibility Guidelines. Fully integrate interior signage as a design element with the architecture and interior design.
- (d) Fire Extinguisher Cabinets and fire extinguisher bracket supports.
- (e) Millwork: Built-in components and accessories for worktops, counters, cabinets, work benches, shelving.
- (f) Audiovisual Supports: Brackets. Provide above ceiling mounted electrical and data outlets.
- (g) Window Treatments: Interior window treatments with adjustable control shall be provided in all exterior window locations for the control of daylight coming in windows or privacy at night. Uniformity of color and material shall be maintained to the maximum extent possible within a building.
- (h) Exterior Signage; Signs shall be permanently attached on two faces of the building indicating the assigned building number or address. Building number signage details and locations shall conform to base standards, per Fort Campbell, Kentucky Technical Design Guide in Appendix H.

3.7.9 ROOFING

- (a) Gutters and Downspouts: Provide continuous gutter guards designed to prevent leaves, debris and animals.

3.7.10 NON-SENSITIVE SECURE STORAGE

All secure storage for shop tools, special tools, and special equipment shall be constructed of material to prevent forcible entry and shall be designed to meet Risk Level II Analysis of AR 190-51 and AR 190-13. Provide provision for ICIDS (Internal Commercial Intrusion Detection System).

- (a) The minimum acceptable construction is expanded steel fabric behind impact resistant gypsum board at both walls and ceiling. In conjunction with this, it has been determined that a minimum exterior wall construction of 26 gauge metal wall panels with insulation and an interior metal liner panel extended to a height 8' above the finished floor will satisfy the minimum Risk Level II requirements of AR 190-51, Appendix B-2, paragraph c.
- (b) The door should provide an equivalent degree of security, and as a minimum should be constructed of sheet metal material not less than 16 gauge in thickness and be equipped with a high security lock.
- (c) The following rooms and those indicated in Attachment A Room Data Sheets shall be designed as Non-Sensitive Secure Storage: Engine Shop, prop. & Rotor, Avionics Vault, MH-47 Avionics – Elec. Repairs, Hydraulics, Tool Storage

3.7.11 ARMS VAULT

Arms vaults to accommodate storage of arms, ammunition and explosives (AA&E) shall be provided where indicated in Attachment A Room Data Sheets and Attachment B Conceptual Drawings. These vaults shall be designed in accordance with physical security requirements contained in AR 190-11,

Appendix G. Provide a GSA approved Class 5 Armory vault door with lock in accordance with Fed. Spec. AA-D-600D and a Dutch style day gate with issue port.

3.7.12 SOUND INSULATION

Provide sound insulation in all administration areas to meet a minimum rating of STC 42 at walls and floor/ceiling assemblies, and a rating of STC 33 for doors. In addition to the sound insulation required; conference, briefing and classroom areas shall meet a Noise Criteria (NC) 30 rating in accordance with ASHRAE Fundamentals Handbook.

3.7.13 LOCKERS

3.7.13.1 TA-50 GEAR LOCKERS

TA-50 lockers (CFCI) shall be provided as indicated in Attachment A Room Data Sheets with size and appearance similar to that shown below. TA-50 lockers shall not be located in the Aircraft Maintenance Bays. TA-50 lockers shall be single tier, heavy duty, all welded ventilated type, measuring 36"W x 22"D x 78"H and meet the following minimum requirements:

(a) All tops, bottoms and shelves shall be constructed of minimum 16 gauge thick cold rolled sheet steel. All sides, intermediate partitions and backs shall be constructed of minimum 14 gauge solid metal welded to angle iron frames. Frames shall be constructed of minimum 1" X 1" X 1/8" angle iron steel. Thickness of metal and details of assembly and supports shall provide strength and stiffness.

(b) Double doors shall have a three-point three-sided cremone latch and shall be padlockable. Doors shall be hinged with minimum five knuckle heavy duty steel pin butt hinges welded to both door and locker frame - provide three hinges per single tier door.

(c) Each locker shall include: one aluminum number plate (numbered in sequential order), one full width shelf located 12" from the top with clothes hanger rod and three locker hooks mounted below.

(d) Lockers shall be galvanized and coated with a high quality durable finish with color to be manufacturer's standard tan or gray.

(f) Locker shall be anchored to concrete floor in accordance with manufacturer's recommendations

3.8 PLUMBING

3.8.1 EXTERIOR WALL HYDRANTS

Provide wall hydrants around perimeter of building (except on the flight line side) as well as one inside of the Mechanical Room(s). Exterior spacing shall not exceed 150 ft.

3.8.2 DOMESTIC HOT WATER SYSTEM

Locate the main water heating equipment within a mechanical room, on the ground floor level only. Instantaneous water heaters are permissible when life cycle cost effective. Size system storage and recovery for delivery of hot water at every shower head over a continuous operation of all heads for a duration of 90 minutes. Usage diversity factor for the showers shall be one. Size water heater(s) based upon usage anticipated and accounting for this diversity factor. Determine the energy source for the domestic water heating system by Life Cycle Cost Analysis. Domestic hot water shall be stored at 140 degrees F. Domestic hot water delivered at the fixture shall be a maximum of 110 degrees F.

3.8.3 SINKS

Where sinks are required, provide hot and cold water service.

3.8.3.1 SHOP SERVICE SINKS

Provide stainless steel, stand-alone service sinks, minimum size of 24"x24"x12" deep, with a utility set faucet with vacuum breaker and thread hose connection in each shop area identified in the Attachment A Room Data Sheets.

3.8.3.2 HAND WASH BASIN

Provide a floor mounted stainless steel, semi-circular hand wash fountains in the hangar maintenance bay. Minimum size shall be 54" diameter. Provide foot operated controls. Fixture shall accommodate up to four simultaneous users.

3.8.4 TRENCH DRAINS

Design trench drain for easy cleaning. Provide basket strainers to facilitate trash removal where trench drains discharge to piping systems. Convey waste to oil/water separator prior to discharge to the sanitary sewer system. Provide removable covers to prevent loose items from entering drain when wash bays are used for aircraft maintenance.

3.8.5 EMERGENCY SHOWERS AND EYEWASHES

3.8.5.1 EMERGENCY SHOWERS / EYEWASH

Provide plumbed emergency showers/eyewash in accordance with OSHA standard 1910.151(c) and ANSI Z358.1 as required and as shown in Attachment A Room Data Sheets. Within the hangar bay floor area, provide plumbed emergency showers near walls and column lines; where required to maintain OSHA and ANSI standards, design shall identify suitable locations for future GFGI portable self-contained emergency shower units. Provide floor drain at each eyewash / shower unit and convey waste to oil/water separator prior to discharge to sanitary sewer system. Provide a water flow-initiated alarm for each emergency shower/eyewash unit. Alarm installation shall be waterproof and shall have local audible device with silencing switch and a flashing strobe light. The alarm audible signal and strobe light shall be distinct and different from other alarms in this and adjacent facilities. Mount audible alarm signal, silencing switch and strobe light on wall or on emergency shower/eyewash column immediately above the level of the showerhead. Provide tepid water to shower/eyewash fixture.

3.8.5.2 EMERGENCY EYEWASHES

Provide floor-mounted, pedestal type emergency eyewashes in accordance with OSHA standard 1910.151(c) and ANSI Z358.1 and as shown in Attachment A Room Data Sheets. Within the buildings shop areas, provide floor-mounted, pedestal type emergency eyewashes adjacent to walls; where required to maintain OSHA and ANSI standards, design shall identify suitable locations for future GFGI portable eyewash stations. Convey waste of plumbed emergency eyewashes to floor drains which discharge to sanitary sewer system. Provide a water flow-initiated alarm for each emergency eyewash unit. Alarm installation shall be waterproof and shall have local audible device with silencing switch and a flashing strobe light. The alarm audible signal and strobe light shall be distinct and different from other alarms in this and adjacent facilities. Mount audible alarm signal, silencing switch and strobe light on wall immediately above the level of the eyewash fixture. Provide tepid water to eyewash fixture.

3.8.6 COMPRESSED AIR

Provide the compressed air outlets with quick disconnect couplings where shown in the room information sheets. Each drop shall include an isolation valve, filter and pressure regulator, condensate trap with

drain cock. Provide rotary screw air compressor system with receiver, refrigerated air dryer, filtration and pressure regulation. Provide 100% back-up compressor. The air compressors shall be installed building equipment. Size air compressor for 30 SCFM per outlet, with a 60 percent diversity and 50% tool use factor, plus any additional compressed-air equipment in the facility. Unless otherwise indicated by the user requirements, provide compressed air at 125 psi with a maximum 5 psi pressure drop through the piping system. Compressed air distribution piping shall be looped in all spaces served by compressed air. Branch mains shall be sized for the spaces full flow capacity.

3.8.7 SUMP PUMP

Provide sump pump in elevator pit in accordance with ASME A-17.1. Provide sump pump with oil sensing alarm or discharge effluent to the oil / water separator.

3.8.8 NON-POTABLE WATER / RAINWATER HARVESTING SYSTEM

Provide a complete rain harvesting system to automatically capture roof storm water. All water harvesting equipment and treatment systems shall be provided through a single vendor with a minimum of five years experience in building similar systems. The supplying vendor shall have the responsibility of matching all components and provided a fully functional system. Minimum system requirements are a site rainwater storage tank, first flush device, final filtration system, chlorination system, day tank(s), re-pressurization pumps, transfer pumps, distribution piping and controls. The collected rainwater shall be used to flush toilets and urinals and be used as wash water for the building's interior and exterior wash racks.

Provide a minimum 45,000 gallon underground cistern for storage of collected rainwater. Tank system shall be capable of withstanding H-20 surface loads. Provide pre-filtration device to take the initial run-off from the roof and divert the flow away from the storage tank. Provide system final filtration as required to treat collected rainwater. Provide fully automatic chlorine addition system with dry chlorine pellet chlorinator and direct reading free (residual) chlorine sensor. Provide duplex variable speed booster pumps and bladder tank to deliver water to building system at 40 psi. Provide submersible transfer pump(s) to move water between the storage tank, filters, chlorination system and day tank.

Piping distribution systems for the non-potable water system shall be clearly identified and labeled as "NON-POTABLE WATER". All end connection points (i.e. hose bibs) shall be clearly labeled as "NON-POTABLE WATER – DO NOT DRINK"

Provide a connection to the domestic water system, protected by a reduced pressure principle backflow device to supply water to all fixtures in the event that the rainwater storage tank is empty. The change-over between rainwater and domestic water shall be automatic and require no input from the building occupants.

Provide a utility meter interfaced with the base wide EMCS to measure and record the non-potable water flow. The non-potable water system controls shall log when the system is fed by domestic water and for what duration.

The contractor shall include as part of the Building Commissioning plan to perform a dye-test to demonstrate that there is no cross contamination between the building non-potable water and domestic water systems.

3.9 ELECTRICAL

3.9.1 FACILITY POWER

Design facility power in accordance with NFPA 70. At a minimum provide with the following: 3-phase wye-connected, underground secondary service rated at 480Y/277VAC with sufficient capacity for future growth. Use 480VAC for mechanical equipment and larger building specific loads, such as 400HZ Converters and 28VDC Rectifiers. Generally, use 277VAC for lighting. Use dry type step down

transformers to provide 208Y/120VAC service for miscellaneous loads. Provide 200Y/115VAC, 400HZ Power converter(s) and 28VDC Rectifier(s) to support aircraft maintenance functions in the shop areas as well as in the hangar bay. Consider exterior loads, which may vary by site for each project for requirements fed from the hangar facility. Incorporate the following: exterior facility lighting, power for three current maintenance shelters, and power for as many as nine future maintenance shelters or trailers to be located at the exterior covered storage area each anticipated to require 208Y/120VAC, 100A, 3-phase service. Coordinate project specific requirements for the trailers and their load and connection requirements. Specific load requirements for the hangar and shop areas will vary by airframe type and specific shop equipment and will vary by specific hangar type design. Careful coordination will be required to size incoming service appropriately based upon the type and number of aircraft. Utilize a diversity factor of 0.8 for sizing 220V/200A/3-phase, 400Hz and 28VDC conversion equipment. Use Table 3.3 Service Baseline Requirements below. The hangar shall be capable of providing complete ground service to all aircraft listed in Table 3.3.

Table 3.3 Aviation Platform Ground Service Baseline Requirements

Ground Service	Aviation Platform Ground Service Baseline Requirements
400 Hz 200 / 115V	40KVA
28 VDC Start	none
28 VDC Servicing	200 A servicing

3.9.2 STANDBY POWER SYSTEMS

Standby Generator and UPS Back-Up Power Systems generally are not required for these facilities. Government Furnished – Government Installed (GFGI), UPS systems may be considered for communications and data systems but will generally not be large in nature and will not be provided by the design.

3.9.3 GROUNDING

- (a) Use a ground counterpoise around the building perimeter for grounding incoming service, building steel, telephone service, piping, lightning protection if required, aircraft static ground points, and facility internal grounding requirements (e.g. shop areas). Install ground straps where required by function, connected to the building grounding system. Provide a grounding point under each raised access floor. Provide additional grounding based on project-specific requirements and the US Army I3A Technical Criteria. Grounds shall have a resistance to earth of 10 ohms or less.
- (b) Perform a Lightning Risk Assessment of the facility based on NFPA 780 (2008) Annex L. If the assessment warrants the addition of a lightning protection system, furnish a UL Master Label Lightning Protection System complying with NFPA 780, LPI Standards, and all codes and specifications applicable to this project. Install system with mechanical fasteners on standing seam metal roofs.
- (c) Provide grounding, bonding and shielding as required for all facilities. Provide grounding points in vehicle and equipment parking areas on 20' centers maximum, and coordinated with power and data board units. Provide ground straps on walls and two (2) grounding points on each functional bay floor. Provide a bonding ground bar in oil storage room.

3.9.4 POWER DISTRIBUTION

Provide power receptacles per NFPA 70 and in conjunction with proposed equipment and furniture layouts. 110VAC Power is required at each work station in the office and shop areas. In addition, work stations in the hangar bay and shop areas will require 200Y/115VAC 400HZ, 28VDC as well as 110VAC/60HZ. Provide Utility connection stations (pedestals) for hangar maintenance bays. See Attachment A Room Data Sheets.

Power cords are not required to be provided by contractor. Contractor shall coordinate receptacle configuration for each power outlet to be compatible with user maintenance equipment.

Panelboards shall be specified in lieu of "Load Centers".

Areas of the Aircraft Maintenance Bays will be classified as Class I Hazardous locations per NFPA 70. All wiring and equipment used in these areas shall be rated for the application. Work in the Maintenance Bays shall conform to Article 513 of the National Electrical Code and work in the Paint Shop/Metal Storage area shall conform to Article 500.5 (B)(1) of the National Electrical Code.

Coordinate 480V 3-phase electrical connections to actual crane units provided as recommended by crane manufacturer.

Coordinate power and pathway requirements for all A/V (audio/video) equipment being provided by this project with Owner and with all disciplines.

3.9.5 LIGHTING

- (a) The exterior and hangar bay lighting shall be compatible with any future security cameras and security requirements as applicable. Provide interior lighting controls in accordance with ASHRAE 90.1. Supplement automatic controls in offices and specialized areas such as conference rooms with local manual controls. Provide occupancy sensor controls in restrooms, electrical rooms, telecommunication rooms and similar spaces. Interior ambient illumination shall provide a generally glare free, high quality lighting environment in conference rooms and training rooms. Illumination levels sufficient to support mission preparation of airframes, loading/unloading operations, egress/access to the hangar bays, and safe aircraft movement shall be provided for the Hangar Access Apron (flight line side of hangar extending not more 75') and sides of hangar where apron abuts the hangar. Illumination shall be provided by building-mounted light fixtures. Illumination levels at perimeter of the remainder of the building shall be sufficient for security purposes. Levels shall conform to the IESNA Lighting Handbook.
- (b) Provide exist signage and emergency lighting as required per NFPA 70, NFPA 101, and all codes pertaining to Exit and Emergency Lighting.

3.9.6 DARK-SKY REQUIREMENTS

- (a) Interior Lighting: All openings in the envelope (translucent or transparent) shall be shielded, closed or otherwise controlled to prevent light trespass from any interior luminaires between sunset and sunrise. The method used to prevent light trespass shall be fixed or automatic with easily accessible manual override controls.
- (b) Provide drawings and calculations showing the light trespass and illumination levels of light trespassing from interior spaces to the exterior through transparent and translucent wall and roof surfaces.

3.9.7 LIGHTING CONTROLS

Automatic lighting controls are required in offices and classrooms. GFGI manually operated task lighting will be provided as part of the FFE package, in addition to high bay lighting in the maintenance bays. Provide automatic lighting controls (photoelectric cells, switches, etc.) to operate in conjunction with day lighting for optimal lighting control and energy savings in maintenance bays.

3.9.8 AIRFIELD ELECTRICAL

- (a) Submit certification containing names and qualifications of persons recommended to perform the splicing and termination of medium voltage cables approved for installation under this contract. Refer to UFGS 26 56 20.00 10 Section 1.4.2 Qualifications for additional information.
- (b) In addition to the Qualifications listed in UFGS 26 56 20.00 10 Section 1.4.2, the following qualifications are required: Airfield Lighting Designer – minimum experience of six airfield lighting projects within the last three years. On-site Airfield Lighting Foreman - minimum experience of four airfield lighting projects within the last three years and must be a licensed electrician. On-site Licensed Electrician - minimum experience of four airfield lighting projects within the last three years. This person is in addition to the Airfield Lighting Foreman.
- (c) Specifications for airfield lighting, navigational aids, airfield grounding, mooring, and 400 Hz power shall be in accordance with the contract. These specifications shall be used verbatim and shall not be edited by the contractor.
- (d) Refer to UFC 3-535-02 Figure 9 and as required for lighting equipment installation details.

3.10 TELECOMMUNICATIONS

3.10.1 GENERAL

- (a) Connect the facility to the Installation wide area network system (WAN) and telephone system. Allocate communications system resources IAW the I3A Technical Criteria and the RFP Room Data Sheets regarding outlet amounts based on the functionality of the facility's various component floor spaces. Design in accordance with the I3A and the Fort Campbell Design Guide.
- (b) An acceptable building telecommunications cabling system encompasses, but is not limited to, copper and fiber optic (FO) entrance cable, termination equipment, copper and fiber riser cable, copper and/or fiber horizontal distribution cable, workstation outlets, racks, cable management, patch panels, cable tray, cable ladder, grounding, labeling, and testing. Provide telecommunications outlets per the I3A and room data sheets based on functional purpose of the various spaces within the facility as modified by user special operational requirements. Electrical Power must be provided adjacent to each network outlet.
- (c) USASOC G-6 must be informed of required inspections before walls are closed or ceilings are closed that house class pathways. At least a minimum 5 business days must be given for scheduling purposes.
- (d) An electronic copy of the cabling (fiber optic and copper) test results shall be provided to NEC and USASOC G-6. An As-Built copy of communications pathways must be turned over at the time the building is turned over in order to accommodate the accreditation process as a deliverable.
- (e) The communication systems must be designed IAW the most current versions of the following criteria: AR 380-5, AR 380-40, I3A TC, NSTISSAM TEMPEST 2-95, NSTISSAM TEMPEST 2-95A, NSTISSI 7003, SIPRNET Technical Criteria, TIA 606A, USASOC Label Schema, USASOC Regulation 380-40, NFPA 70, NFPA 75, NFPA 76 and TIA 569B for pathways.
- (f) Documents that refer to NFPA 70 Article 800.52 are referencing an invalid number as it has been re-numbered to NFPA 70 Article 800.133 per direction from NFPA Sr. Electrical Engineer Mark Cloutier.
- (g) A Communications QA must be assigned to the project to provide with assisting in the Quality Assurance. The COE will assume responsibility for ensuring that the communications systems to include the classified networks shall be constructed IAW all applicable criteria listed in the military criteria list.

3.10.2 OUTSIDE PLANT

3.10.2.1 Existing Utilities

- (a) All existing telecommunications utilities which will be impacted or disturbed as part of the project demolition or new construction shall be identified, coordinated with the FTC NEC and re-routed prior to construction. Please coordinate with NEC at least four weeks prior to cut over of any OSP Fiber Optic or Copper Cabling that is part of this project. This cutover will result in a major scheduled outage which must be coordinated through NETCOM channels.
- (b) Re-route of existing utilities shall include new underground pathways and manholes, re-routed cabling sections spliced into existing cabling infrastructure, testing and labeling.
- (c) The DOR shall be responsible for generating final site utility plans indicating telecommunications infrastructure being disturbed, proposed re-rout of site telecommunications and tie-in points for the re-routed sections of telecommunications cabling. All work shall be coordinated with and approved by the NEC.
- (d) Re-route of existing utilities includes demolition of manholes MH45A-1 and MH45A, underground duct bank from MH46A thru MH45A-1, MH45A, MH44A, and removal of OSP cabling (12SM FOC, 12SM FOC, 12SM FOC, 600 pr. CU, exact quantities to be verified with the FTC NEC) from MH46A thru MH45A-1, MH45A, MH44A, MH43A, MH42A.
- (e) Provide new underground, concrete encased, 6-way 4" duct bank from existing MH42A, routed around new site construction (as shown on the Electrical Site Drawings) and tie back in to existing manhole MH46A. Provide type 38Y manholes no further than 500' spacing in conformance to I3A and Ft. Campbell NEC Communications standards. 3-Way 4" Maxcell Fabric Mesh Innerduct shall be placed in (3) of the (6) 4" Conduits.
- (f) Extend new cabling through new U/G route and splice back in at existing MH42A and existing MH46A utilizing new splicing containers and hardware. Fiber shall utilize core alignment fusion splices. Cabling to be 100% re-tested from source to destination.
- (g) Re-route of existing utilities shall be accomplished with minimal disruption to existing services. This will require complete construction of new underground infrastructure and cabling sections prior to demolition of existing

3.10.2.2 New Building Service

- (a) Connect the project's facilities to the Installation telecommunications (voice and data) system through the outside plant (OSP) underground infrastructure per I3A requirements. Connect to the OSP cabling system from each facility main cross connect located in the main telecommunications room or telecommunications equipment room to the closest OSP available access point. Components include the physical cable plant and the supporting structures. Items included under OSP infrastructure encompass, but are not limited to, maintenance hole and duct infrastructure, copper cable, fiber optic cable, cross connects, terminations, splices, cable vaults, and copper and FO entrance facilities.
- (b) Provide 3-4" conduits, concrete encased from an existing manhole into the Main Communications Room in the New Hangar. Extend new 12 strand SM fiber (NEC NIPR) from the Main Telecommunications Room in the New Hangar back to the RSU (bldg. 7277), new 12 strand SM fiber (USASOC) from the Main Telecommunications Room in the New Hangar back to the RSU (bldg. 7277), and CAT 3 multipair copper from the Main Communications Room in the New Hangar back to the RSU (bldg. 7277). Copper voice service to be sized at 1.5 pairs per wired telephone outlet within the new building, minimum of 25 pair and rounded up to the nearest logical standard cable size.
- (c) Fiber to terminate in rack mounted fiber termination cabinet on both ends.
- (d) Copper to terminate on UL listed Primary Protection Building Entrance Terminal (BET) with gas block modules on both ends.
- (e) Cable TV plant is located on pole line running beside Night Stalker Road. Tie point will be at pole closest to hangar. Provide 1-2" conduit underground from CATV service provider tie-in point to building Main Telecommunications Room. Coordinate with Comcast.
- (f) The existing TACAN (Tactical Air Navigation) system equipment located at the south end of the existing apron shall be relocated by the Government to either base bid location or Bid Option location (Refer to Site Utility Plan ES-101, exact location to be field determined by owner and Contractor). The existing TACAN utilities will be removed. New OSP Pathways (2 way 4" concrete encased conduit, pullboxes, etc.) to the new TACAN location as well as OSP fiber optic (12 strand SM and 25 Pair OSP Category 3 Copper Cabling) will be provided by the D/B Contractor as coordinated with Ft. Campbell NEC.

3.10.3 TELECOMMUNICATIONS ROOMS (TR)

- (a) Provide telecommunications rooms and telecommunications entrance facilities for unclassified network and voice equipment and cabling infrastructure throughout the facilities. There shall be a minimum of one telecommunications room on each floor, located near the center of the building, and stacked between floors where possible. Provide one telecommunications entrance capability for each facility. The telecommunications entrance shall be collocated with the main TR for the facility. Size TR's for the area supported.
- (b) Telecommunications Rooms shall be located, sized and equipped per I3A and Fort Campbell Design Guidelines.
- (c) Telecommunications Rooms shall be provided with 19" wide, full height relay racks with vertical and horizontal cable management for all equipment served including service entrance fiber optic cabling, riser fiber optic cabling, Voice riser tie cables, voice and data station cabling, and GFGI network electronics.
- (d) A minimum of four dedicated 20 ampere, 110 volt AC outlets will be installed with each equipment rack or cabinet to provide power for installed equipment. Each communication rack will have a 1000 VA UPS installed. Electrician will coordinate with appropriate contractor for location and type of outlet.
- (e) A dedicated electrical panel shall be installed for each TR/COMM Room with the following minimum requirements: 120/208V 3-Phase, 30 space, 100 Amp capacity. 110V 20 Amp convenience receptacles placed at 6 foot intervals shall also be provided around perimeter walls of the TR/COMM Room.
- (f) Telecommunications Rooms shall be provided with required cable management system per I3A including ladder rack, conduit sleeves, backboard D-Rings, etc.
- (g) Provide telecommunications riser cabling from the main communications room to each remote telecommunications room. Each data riser shall consist of a 12 Strand Single Mode Fiber terminated in a rack mounted fiber termination cabinet. Each data riser (unclassified and classified) shall be installed in conduit as well as 3-Cell Maxcell Fabric Innerduct. Each voice riser shall consist of Category 3 multipair copper terminated on wall mounted 110 blocks backboard mounted. Voice pairs shall be per I3A requirements of 2 pairs per voice outlet served from the TR. Fiber Optic and Copper Backbone Cabling must each be installed between TR's in a minimum 2" Conduit (Fiber 1-2" and Copper 1-2") and must not exceed a 40% initial fill ratio. 2-2" Conduits must be provided between the Main Telecommunications Room and the SIPRNET Room.
- (h) Provide complete testing and labeling of data (fiber) and voice (Cat 3) riser cabling.
- (i) Provide additional voice tie cables in each Telecommunications room (including the main telecommunications room) consisting of a 50 pair CAT 3 cables from the voice wall backboard to the voice/data rack, terminated on a 48 port CAT 6 patch panel (2 pairs per port with pairs 49,50 folded back). Provide quantity of cables to match quantity of voice station cable patch panels.
- (j) Provide a Telecommunications Main Ground Bar (TMGB) in the Main Telecommunications Room, bonded to the Main Electrical Service Grounding Electrode System. Each Telecommunications Room to be provided with a Telecommunications Ground Bar (TGB) and bonded to the TMGB and to building steel in accordance with I3A. Provide bonding of all equipment (including racks, conduit, cable management, PET, etc.) to grounding system within each TR. The Telecommunications Grounding System shall have a resistance to earth of 10 ohms or less.
- (k) Provide a coaxial CATV riser from the Main Telecommunications Room to any remote CATV demarks required for CATV station cabling which exceeds 200', consisting of quad shielded RG-11 with type "F" connectors on each end.
- (l) All riser cabling shall be provided with adequate service loops on each end, properly spooled and managed, in accordance with I3A and Fort Campbell Design Guidelines.
- (m) Provide a SIPRNET room adjacent to primary communications room. Refer to the USAISEC Technical Criteria for the Integration of Secret Internet Protocol Router Network (SIPRNET) V6 for detailed information and references regarding SIPRNET. Construct the SIPRNET room in accordance with AR 380-5, Chapter 7, Section III. SIPR TR shall be sized IAW the I3A and TIA 569B. The room requires infrastructure for a GFGI intrusion detection system. Provide a minimum door width of 42" to accommodate a cabinet. Connect the SIPRNET room to the main telecommunications room via a single 2" trade size steel conduit. Bar all ventilation ducts per security requirements of AR

190-11 App G. Extend 12 strand SM fiber from Main Telecommunications Room. The use of wireless to serve SIPR drops is NOT acceptable. SIPR distribution system shall be sized and located as required to serve CAT 6 SIPR drops within the CAT 6 cable distance limitations.

- (n) SIPRNET is not to be installed in areas in which the Wireless equipment will be operating for example the Hangar bays are not to have SIPR installed.
- (o) SIPR systems must be constructed to pass accreditation and certification process & inspection.
- (p) SIPR systems must be designed in accordance with the SIPRnet Technical Criteria Version 6 2010, NSTISSI 7003, NSTISSAM TEMPEST 2-95, NSTISSAM TEMPEST 2-95A, AR 380-5, AR 380-40, USASOC REG 380-40, TIA 569-B, TIA 606A and the I3A TC February 2010.
- (q) SIPR designs that deviate from the referenced criteria must meet NEC and USASOC G-6 approval and be installed IAW the guidelines.
- (r) SIPR clearances are non-negotiable & must be maintained at all times IAW NSTISSAM Tempest 2-95, at a minimum it will follow TEMPEST Guidance and Recommendation.
- (s) Separate drawings with the SIPRNET Protective Distribution System design shall be provided.
- (t) Outlets are to be labeled IAW USASOC Labeling Schema, which is IAW I3A & TIA 606A. Pathways are to be labeled IAW TIA 606A.

3.10.4 TELECOMMUNICATIONS PATHWAYS

- (a) Provide a building wide cable tray system for conveyance of station cabling from work area outlets to the serving TR. Cable tray shall be sized, located and designed in accordance with I3A and Fort Campbell Design Guidelines. Label pathways IAW TIA 606A.
- (b) Provide 4-11/16" square outlet boxes for wall mounted telecommunications outlets. Provide 1" conduit from each outlet box to within 4" of local cable tray or piped directly to the serving TR where cable tray is not provided or allowed.
- (c) Provide minimum 4" diameter conduit sleeves to transition from cable tray to telecommunications rooms with appropriate fire stop assemblies.
- (d) Provide a Protective Distribution System (PDS) from each SIPR outlet to the SIPRNET room in accordance with Technical Criteria for the Integration of the Secret Internet Protocol Router Network (SIPRNET) Version 6.
- (e) Provide conduits from TR on second floor with access to roof and to roof top mounted equipment for flight ops radio equipment. The GFGI Antenna will connect to the Second Floor Telecommunications Room. SIPRNET cannot be installed in the Second Floor Telecommunications Room since Antenna Cabling will be located within this room.

3.10.5 TELECOMMUNICATIONS WORK AREA OUTLETS

- (a) Provide voice, data and CATV work area outlets in quantity, configuration and locations in accordance with I3A, Fort Campbell Design Guide, RFP and Room Data sheets.
- (b) Voice and data cabling shall be Category 6 rated.
- (c) NIPR – Each Voice/data outlets to consist of 1-voice/2-data in modular faceplate at a density of no less than 1 outlet per workstation (**THIS REQUIREMENT TAKES PRECEDENCE OVER THE QUANTITY REQUIREMENTS OF 6.10.1**).. Refer to room data sheets for additional requirements. Terminate voice and data in separate CAT 6 rack mounted patch panels in TR racks. Provide a Power Outlet adjacent to each NIPR outlet.
- (d) SIPR – Install SIPR drops where indicated in the Room Data Sheets. Each SIPR Drops shall consist of 1-voice/2-data. Rooms indicated are not authorized for open storage. Provide SIPR data drop in surface mount secure outlet lockable PDS complaint assembly, connected to PDS. SIPR drops to consist of CAT 6 in quantities as required by the number of secure workstations. Terminate in cabinet mounted CAT 6 patch panels in SIPR cabinet.
- (e) A separate drawing shall be provided showing the Protective Distribution System Design.
- (f) Appendix H of the SIPRNET Technical Criteria Version 6 must be followed for the installation of the SIPRNET Infrastructure.
- (g) Provide each utility space, such as mechanical, electrical and telecommunications rooms with at least one wall mounted telecommunications outlet, with a wall mounting lug face plate near the entrance door.
- (h) Provide complete testing and certification of CAT 6 cabling.

- (i) Any telecommunications outlet to be fed below slab on grade shall utilize OSP rated cabling. If a dedicated conduit is not provided from the Work Area Outlet then a Transition Point shall be provided.
- (j) In addition to providing standard voice/data outlet configuration throughout the facility per the I3A, provide wireless access point (WAP) outlets in the hangar bay areas with one-Cat 6, unshielded twisted pair (UTP) cable, each to a standard 8-pin modular connector for each wireless WAP outlet. Provide a minimum of one WAP outlet in each aircraft module. WLAN system including access points are GFGI.
- (k) Provide data drop at ceiling mounted projector locations in Conference rooms and Classrooms.

3.10.6 CABLE TV (CATV):

- (a) Provide a CATV cabling system including, but not limited to, all necessary raceways, cabling, terminations, jacks and faceplates. The horizontal cable for the CATV system will be RG-6 with "F" type connectors on the terminal end and will be no longer than 200'. Terminate the CATV cabling at the main demark, or on a remote demark if the cabling distance is greater than 200'. Homerun all CATV horizontal cabling between CATV jacks and the CATV main demark backboard. Coordinate service requirements to the building with the local CATV service provider. CATV shall be provided where indicated in Room Data Sheets.
- (b) Interior cable runs shall not exceed 200'. If drops exceed 200' provide additional demark points with 2" conduit in cable tray between demark points.

3.10.7 MISCELLANEOUS SYSTEMS:

3.10.7.1 Intercom System

A one-way Intercom System that will allow the Production Control Office to communicate with the Hangar Maintenance Bay will be provided. Full Speaker Coverage of the Hangar Maintenance Bay is required.

3.10.7.2 Access Control

An access control system will be provided for the main entrance door. The System will be the Stanley Security Solutions B.A.S.I.S. G System.

System shall be complete with card swipe door hardware, software, programming cable, Mag stripe cards and Mag stripe encoder.

3.10.7.3 Intrusion Detection Systems Infrastructure

Infrastructure (box, conduit, power and signal cabling) will be provided to support Government Furnished Government Installed Intrusion Detection Systems per the Room Data Sheets, I3A and Fort Campbell Design Guide and shall include Arms Vault, SIPR Room, COMSEC Rooms, etc.

Coordinate anticipated locations of devices and provide raceways and back boxes for installation of a secure access system.

3.10.7.4 Closed Circuit Television System

Infrastructure (box, conduit, power and signal cabling) will be provided to support a GFGI Closed Circuit Television System in the Hangar Maintenance Bay and Production Control Office.

System shall include a minimum of twelve (12) camera locations in the Hangar Maintenance Bay and exterior cameras for coverage at each entry and the Aircraft Apron. Main system will be located in the Production Control Office. Provide power supplies and wiring for cameras from this location.

Coordinate anticipated locations of devices required for a complete CCTV system. Design raceways and back boxes for installation of a complete system.

3.10.7.5 Audio Visual

Provide rough-ins and mounting equipment for Government Furnished Government Installed Audio Visual equipment where indicated in the room data sheets.

Wall mounted TV – Provide wall mounted bracket for TV and CATV outlet at mounting height to support new TV.

Ceiling mounted projector – Provide ceiling mount projector hardware and audio visual cabling (RGBHV, HDMI, composite video, RS-232 and stereo audio) to local wall outlet in same room including AV connectors in local wall outlet.

Wall mount projector/Interactive Whiteboard (Smart board) – Provide wall mount assembly for Interactive board and wall mount short throw projector over interactive whiteboard. Include outlet at projector with audio visual cabling (RGBHV, HDMI, composite video, RS-232 and stereo audio) to local wall outlet in same room including AV connectors in local wall outlet,

3.10.7.6 Roof Mounted Antenna

There will be a Government Furnished Government Installed Roof Mounted Antenna as part of this project. Infrastructure (box, conduit, power and grounding) will be Contractor Furnished Contractor Installed. Provide box, conduit and power to support Government Furnished Government Installed Antenna Cabling. Provide (1) 6" Conduit from the Antenna Platform to the Second Floor Communications Room (or where the radios are placed). The conduit must have removable access panels at each bend to allow for access of the cables and to assist with pulling the cables. Provide (1) 6" Conduit from the Second Floor Communications Room (or where the radios are placed) to the Second Floor Flight Operations Room and (1) 6" Conduit from the Second Floor Communications Room (or where the radios are placed) to the First Floor Avionics Room (the conduit must have removable access panels at each bend to allow for access of the cables and assist with pulling the cables). The Contractor Furnished Contractor Installed Antenna Grounding Systems must be designed/installed per TIA/EIA J-STD-607-A as well as the Antenna Manufacturer's Grounding Requirements. Where conflicts arise between TIA/EIA J-STD-607-A and the Antenna Manufacturer's Grounding Requirements the most stringent will apply. The GFGI Antenna Rack will be located in the Second Floor Communications Room.

3.11 HEATING, VENTILATING AND AIR CONDITIONING

3.11.1 HANGAR AREAS

For hangar bay areas, consider heating and ventilating units, radiant heating, or some combination of the two. In colder climates, consider supplemental heating at the floor level of repair shops and maintenance shops. Coordinate system selection with the installation. Base the system selection on energy usage and life cycle cost, reliability and operating considerations, and the maintenance capabilities and resources of the user.

3.11.2 ADMINISTRATIVE AND SHOP AREAS

(a) See Attachment A Room Data Sheets for heating and cooling of administrative areas. HVAC system design should consider including flexibility in zoning to where it can address future changes in occupant densities. Administrative areas shall be temperature-controlled by the DDC system. Accomplish temperature set point adjustment via DDC System by authorized personnel. Consider all viable alternative systems meeting the functional requirements of the hangar bays. Shops shall be mechanically ventilated, heated, and air conditioned. Consider packaged equipment, split systems or systems utilizing chilled/heating water from either a central plant or decentralized sources. Provide independent and dedicated packaged A/C units for the Arms Vaults and Non-Sensitive Secure Storage Areas. Do not use

floor space to mount air handling unit system(s) within the actual spaces served. Condition administrative-type areas located within the shops per Paragraph 5 requirements.

(b) Communications and SIPRNet rooms will each be served by an independent and dedicated air-handling system. Air handling unit system(s) shall not be floor-spaced mounted within the actual space served. Rooms shall be maintained at 72 degrees F and 50 percent relative humidity year round. Assume 1775 BTU per hour for the equipment heat dissipation. Contractor shall verify this load during the design stage.

(c) The contractor may consider use of a ground source heat exchanger well field to serve the building HVAC systems. Refer to Appendix KK for information on a site test well. The contractor shall evaluate the provided test well information in determining if a ground source heat exchanger well field is life cycle cost effective for this project. If determined to be cost effective, locate the well field under the new apron area adjacent to the hangar.

3.11.3 BUILDING EXHAUST SYSTEMS

Provide exhaust systems at heat sources, restrooms, solvent tanks, welding benches, soldering benches and contamination sources. Exhaust systems will operate continuously while the building is occupied. Exhaust systems shall be in accordance with NFPA 30 and 30A. Design capture hoods in accordance with ACGIH Industrial Ventilation – A Manual of Recommended Practice Handbook. Provide slot type capture hood along the side or back of solvent tank. Provide bench level exhaust capture for welding and solder benches.

3.11.4 DESIGN CONDITIONS

3.11.4.1 Outdoor and indoor design conditions shall be in accordance with UFC 3-410-01FA. Indoor design conditions shall conform to Attachment A Room Data Sheets. If information is not provided in Attachment A Room Data Sheets Table 3.4 shall be used for Indoor design conditions. Indoor air quality shall conform with the current ASHRAE Standard 62.1 and OSHA requirements.

TABLE 3.4 – INDOOR DESIGN DATA

HEATING:

Indoor Design Temperature 68°F

Unoccupied Space Design Temperature 55°F

COOLING:

Indoor Design Temperature 77°F

Unoccupied Space Design Temperature 85°F

3.11.4.2 In geographical areas of high humidity, take appropriate measures to control moisture. In areas of high humidity, provisions will be made for cure rooms/spaces to have dehumidification procedures to bring ambient relative humidity in the cure rooms/spaces down to 40 percent relative humidity to allow for acceptable cure times.

3.11.5 RADON MITIGATION

Provide Radon mitigation in accordance with Specification Section 31 21 13 – RADON MITIGATION and shall comply with the requirements set forth in the Ft. Campbell radon mitigation standards. A radon test was performed for this site and the test results are included in Appendix A. Contractor shall use this test information in the design of the radon mitigation system. The radon system shall be included with the building commissioning plan. All final radon testing shall be included in the commissioning reports.

3.12 FIRE PROTECTION

3.12.1 STANDARDS AND CODES

Fire protection and life safety features shall be in accordance with UFC 3-600-01 and the criteria referenced therein. Hangars shall be considered major projects and classified as mission essential. The Army's first priority after life safety is to minimize collateral damage to aircraft which would affect full "mission ready" status after a fire incident. The hangar facility shall comply with the requirements of all references, NFPA 409 and NFPA 11 except as modified herein. The aircraft storage and service areas (hangar bays) shall be protected with a fire suppression system that is a combination of an automatic closed head sprinkler system and an automatic, low-level high-expansion foam system. The hangar bay shall be designed as a Group II Aircraft Hangar except that draft curtains shall be provided as required for a Group I hangar. The building construction shall be Type I or II, and the area limits of NFPA 409 and IBC shall not apply. The allowable area of the hangar shall be considered unlimited. Hangar bay floors and trench drains shall be arranged to prevent a liquid spill from flowing into adjacent areas. Trench drain system is not required to be sized for full discharge of automatic suppression systems and hose streams.

3.12.2 REGULATORY REQUIREMENTS

Compliance with referenced NFPA standards is mandatory, except as modified herein. This includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. In the event of a conflict between specific provisions of this document and applicable NFPA standards, this document shall govern. All equipment and material shall be listed by Underwriters Laboratory (UL) or Factory Mutual (FM) approved for the purpose it is used. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

3.12.3 QUALIFICATIONS OF FIRE PROTECTION ENGINEER (FPE)

In addition to FPE requirements specified elsewhere, the FPE shall have five (5) years experience in the design of aircraft hangar fire protection systems of similar complexity.

3.12.4 FIRE PROTECTION AND LIFE SAFETY ANALYSIS

Perform a fire protection and life safety design analysis for all buildings in the project conforming to the requirements of UFC 1-200-01 and UFC 3-600-01 at the interim submittal. Include a life safety floor plan for all buildings in the project showing occupant loading, occupancy classifications and construction type, egress travel distances, exit capacities, areas with sprinkler protection, fire extinguisher locations, ratings of fire-resistive assemblies, and other data including hazard classification plans and sections in accordance with NFPA 70 necessary to exhibit compliance with life safety code requirements. Calculations shall include hydraulic calculations, foam calculations, seismic calculations, voltage drop calculations and battery calculations.

3.12.5 FIRE PROTECTION DRAWINGS

Fire protection drawings shall comply with the requirements for working drawings and shall include foam liquid travel time and foam spread diagrams, riser/piping diagrams, conduit layout diagrams, complete point to point wiring diagrams (typical point to point wiring diagram in lieu of complete wiring diagrams are not acceptable). Include a legible enlarged plan fire protection equipment room. Show all equipment, piping and associated components. Provide sections and details as needed to clearly show the system.

3.12.6 PROTECTION OF PIPING AND EQUIPMENT AGAINST EARTHQUAKE DAMAGE

All equipment and materials, including piping and tanks shall be protected against damage from earthquakes in accordance with applicable NFPA requirements. All piping must be protected against earthquake damage as specified in NFPA 13.

3.12.7 FIRE WATER SUPPLY

3.12.7.1 The fire water supply shall be in accordance with UFC 3-600-01, NFPA 409 and NFPA 24 except as modified in this document. The contractor shall perform a detailed water supply and demand analysis and determine variations in fire water supply. Fire pump data is provided in Appendix D for bidding purposes. The Contractor shall verify the fire flow data by conducting necessary fire flow tests in accordance with NFPA 291 at the project site during project design and shall base the design of fire protection system on the results of this test. Fire pump test shall be performed in accordance with NFPA 20. The Fire Protection Engineer of record shall witness these flow tests. The test shall be coordinated with CH2MHill (water supply manager at Fort Campbell). A 10 PSI safety margin shall be included in hydraulic calculations to account for fire water supply and installation variations.

3.12.7.2 Water must be available in sufficient quantity and pressure to supply the total water demand including the maximum hydraulically calculated system demand, and the exterior hose streams. Exterior hose stream demand shall be in accordance with UFC 3-600-01. Note that exterior hose streams will be fed from the domestic water supply system while the fire suppression systems will be fed from a dedicated fire line fed by existing fire pumps and existing water storage tanks.

3.12.7.3 A dedicated fire main will be used to feed the hangar fire protection systems.

3.12.8 BACKFLOW PREVENTION

Install backflow prevention devices at connections to domestic water distribution systems. Connections between potable water systems and systems containing chemical fire suppression agents or additives will use reduced-pressure backflow preventers. Connections between potable water systems and water only fire protection systems may use double check backflow preventers where permitted by the local health and water authorities. Provide permanent means to perform forward flow test on the backflow prevention assembly.

3.12.9 UNDERGROUND PIPING

Install all underground piping systems in accordance with NFPA 24 and the following:

3.12.9.1 Provide ductile iron pipe or other pipe listed for buried fire service application for all underground uses.

3.12.9.2 Fire water service entrance to the hangar shall be installed in a pit. Do not install any fire protection piping under the floor slab. Use flanged or welded fittings to transition the fire protection water service entrance from horizontal to vertical as it enters the building. Do not use gasketed compression fittings (including locking type) or flanged fittings with set screws. Minimize piping under paved operational surfaces (taxiways and aircraft parking).

3.12.9.3 Size underground mains to ensure the maximum flow velocity does not exceed 3 meters per second.

3.12.9.4 Do not install piping carrying foam concentrate or foam-water solution underground.

3.12.10 FIRE PROTECTION WATER STORAGE SYSTEM

It is anticipated that the existing water storage system contains enough water to supply the new hangar.

3.12.10.1 The requirement for a fire water storage tank installation shall be determined by the Contractor based on fire flow test data from the project site and fire protection system design requirements for the project. If required, a complete fire water storage system shall be provided for the facility. Water storage tank shall comply with the requirements of UFC 3-600-01 and NFPA 22 and NFPA 409 as modified herein. Corrosion protection shall be provided when steel water tanks and associated piping are used.

3.12.10.2 Storage capacity shall be a minimum of 120 percent of the highest calculated fire water demand. The water supply for high expansion foam systems must have a minimum duration of 30 minutes.

3.12.11 FIRE PUMPS

3.12.11.1 It is anticipated that the existing, centralized fire pump system is adequate to supply the new fire suppression systems.

3.12.11.2 The requirement for a fire pump installation shall be determined by the Contractor based on fire flow test data from the project site and fire protection system design requirements for the project. If required, fire pumps shall comply with all requirements of UFC 3-600-01, NFPA 20, NFPA 70 and NFPA 72 including all recommendations and advisory portions, which shall be considered mandatory; this includes advisory provisions listed in the appendices of such standards, as though the word "shall" has been substituted for the word "should" wherever it appears. Pumps shall be selected at a flow not exceeding 120% of fire pump rated flow. The system pressure at no time shall exceed 175 PSI. Use of pressure regulating valve to control discharge pressure is not permitted. Use of pressure relief valve to control discharge pressure of electrical fire pumps is not permitted. If there is a potential of system pressure exceeding 175 PSI, variable speed fire pumps must be used.

3.12.11.3 The contractor shall determine and document the reliability of the existing power sources.

3.12.11.4 The maximum rated pump size must be limited to 9,463 Lpm (2500 gpm).

3.12.11.5 The pumping system shall be able to meet the maximum demand with the largest capacity pump out of service.

3.12.11.6 Provide pressure maintenance pumps to maintain normal operating pressure in accordance with NFPA 20.

3.12.11.7 The starting sequence will begin automatically as follows:

- a) Pump start signal transmitted from the foam system control panel in the protected facility.
- b) Drop in system water pressure in accordance with NFPA 20.

3.12.11.8 Required monitoring of fire pumps shall be monitored through the fire alarm panel and transmitted to the fire department. Transmitter shall transmit separate supervisory pump running and pump trouble signals to the fire department for each pump.

3.12.11.9 Contractor shall provide a minimum of one UL listed surge arrester on the discharge side of each pump. Contractor shall perform a surge analysis to determine size of the surge arresters, but in no case shall the surge arrester at each pump be less than 100 gallon. Surge arresters shall be listed for fire protection service and have a minimum pressure rating of 250 psi. Each surge arrester shall be provided with an indicating valve to isolate it from the system.

3.12.12 INTERIOR FIRE SUPPRESSION SYSTEMS

3.12.12.1 Protect the hangar bay areas in accordance with NFPA 409 except as modified herein.

3.12.12.2 Route all sprinkler system drains, including main drains, test drains, and auxiliary drains to a 2-foot by 2-foot splash block at exterior grade.

3.12.12.3 In geographic locations having a 99.6% dry bulb temperature less than 0 °F a pre-action automatic sprinkler system, activated by a roof- or ceiling level thermal detection system, must be provided in the aircraft servicing area in lieu of the wet pipe sprinkler system.

3.12.12.4 For all hangar areas the design density from sprinkler system shall be a minimum of 0.17 gpm/ft² over any 7,500 ft² area, including the hydraulically most demanding area as defined in NFPA 13.

3.12.12.5 In hangar areas, use upright quick-response sprinklers at the roof or ceiling level with temperature ratings of 175 °F.

3.12.12.6 Provide the following features:

- (a) Risers with riser check valves and vane-type water flow switches (0 to 90 second delay).
- (b) Pressure relief trim devices above the riser check valve.
- (c) When multiple systems are required in an aircraft servicing area, all overhead systems must cover essentially equal floor areas.
- (d) Surge arrester not less than 10-gallon capacity must be provided for each separate pre-action riser below the riser-indicating valve. Provide a surge arrester of not less than 25-gallon capacity for each set of multiple pre-action risers below the riser indicating valves on the header. All tanks must be Listed/Approved as a surge arrester with a rated working pressure of not less than 275 psi. Sizing calculations prepared by the manufacturer must be provided.
- (e) Automatic water control (deluge) valves for pre-action and water-foam systems must be externally resettable. The maximum valve size must be 6 inches.
- (f) For water and foam-water systems, piping shall be standard-weight or schedule 40. Shop fabricated or field fabricated fittings, fittings which require making a hole in the pipe are not permitted.
- (g) For facilities with multiple floors, provide with floor control valves for each floor.
- (h) Valves 65 mm and larger shall be flanged outside screw and yoke (OS&Y) type. Butterfly valves are not permitted.
- (i) Foam concentrate pipe shall be either stainless steel, grooved, welded, or flanged; or filament-wound fiberglass conforming to ASTM D2996, designation code "RTRP-11 FF-3121," installed in accordance with ASME/ANSI B31.4-1996, Process Piping.

3.12.13 LOW-LEVEL HIGH EXPANSION FOAM SYSTEM

3.12.13.1 INSTALLATION

Locate low-level high-expansion foam generators so that foam discharge falls close to, but not directly on, the aircraft. Initial discharge of foam must protect the under aircraft area and then spread to the remaining hangar floor area. Foam generators are allowed to use air from inside or outside the hangar facility. Air exhausters are not permitted in high expansion foam systems.

3.12.13.2 Provide a surge arrester of not less than 10- gallon capacity for each separate high-expansion riser below the deluge valve. Tanks must be listed / approved as a surge arrester with a rated working pressure of not less than 275 psi. Sizing calculations prepared by the manufacturer must be provided.

Provide a Listed/Approved strainer in the water supply for all foam systems. Strainers must be capable of removing all solids of a size that would obstruct system components.

3.12.14 PERFORMANCE REQUIREMENTS

Performance requirements shall be demonstrated during final acceptance testing.

3.12.14.1 For rotary wing aircraft hangars, Low-level high-expansion foam systems must cover 100 percent of the of the aircraft parking stalls in one minute or less from the activation of a manual foam discharge station.

3.12.14.2 Low-level high-expansion foam systems must cover the aircraft servicing area and adjacent accessible areas to a depth of one meter (3.2 feet) in four minutes or less.

3.12.14.3 RATE OF DISCHARGE

The minimum rate of discharge or total generator capacity will be calculated in accordance with NFPA 11 and 409.

For Calculating the Volume, the Area shall equal the Area of the aircraft servicing floor and adjacent floor areas not cut off from the aircraft servicing floor and the depth shall equal 3.2 feet. Submergence time shall equal 4 minutes.

Compensation for leakage shall not be less than 2.0 for hangars less than 15,000 square feet, 2.5 for hangars less than 30,000 square feet, and 3.0 for all other hangars.

3.12.15 FOAM CONCENTRATE PUMPS

3.12.15.1 If provided, foam concentrate pumps shall be listed and of the positive displacement rotary gear or vane type.

3.12.15.2 Connection must be provided through the installation fire reporting system to notify the fire department of required monitoring signals.

3.12.16 FOAM CONCENTRATE TANKS

3.12.16.1 Atmospheric foam storage tanks must be either plastic or fiberglass. Bladder tank systems are not acceptable.

3.12.16.2 Concentrate Storage Tank shall be sized to permit continuous operation of the system to generate four times the submergence volume, but for not less than 15 minutes. No additional foam is required for maintenance of the submergence volume beyond 15 minutes. A back-up supply of foam is not required. Foam concentrate and fire water supply shall be calculated based on supply calculation method. The Foam concentrate supply will be verified at final acceptance test by displacement test method in accordance with NFPA 11.

3.12.16.3 All foam tanks must be provided with a minimum six-inch curb.

3.12.17 FOAM PROPORTIONING SYSTEMS

3.12.17.1 Maximum size of proportioners shall be 6 inches.

3.12.17.2 Use in-line balanced-pressure (ILBP) proportioners on all pumped concentrate systems. ILBP proportioners must be factory assembled and tested by the manufacturer, and the entire ILBP proportioner assembly must be listed. Disassembly, reassembly, and or modification by the installing contractor will be prohibited.

3.12.17.3 Provide water-powered ball valves as foam concentrate control valves. Provide a retard chamber in the line to the water-powered ball valve on wet pipe foam water systems.

3.12.17.4 Manual Foam-Water/Water Fire Hose Stations are not required.

3.12.17.5 Do not provide fire department connections on foam-water systems.

3.12.17.6 Foam System Test Header: Provide a test header for all overhead foam-water systems. Locate the header inside the aircraft servicing area as near as practicable to an outside door. Configure the test header to permit each proportioner to be individually tested. Connection shall be standard fire hose connection.

3.12.17.7 Sprinkler System Simulation Test Header: Provide sprinkler system simulation test headers for simulating hangar sprinkler system maximum flow based on supply calculations during the foam system discharge test.

3.12.18 MASS NOTIFICATION SYSTEMS (MNS)

Provide a Mass Notification System in accordance with UFC- 4-021-01 in the hangar facility. The hangar bay shall comply with the audibility for exterior spaces.

3.12.19 DETECTION AND ACTUATION SYSTEMS

3.12.19.1 FACILITY FIRE DETECTION AND ALARM SYSTEM (FACP)

Provide a complete single fire alarm and detection panel for all detection and alarm functions in the facility not part of the foam-water fire suppression system. The system shall be able to interface with all facility fire protection systems; including, but not limited to the Hangar suppression system, fire pumps (where necessary), mass notification system, and installation monitoring system. Provide a 20% capacity for future modifications. All control valves shall be supervised by FACP.

3.12.19.2 FOAM SYSTEM DETECTION AND CONTROL (FSCP)

Provide one or more fire suppression system control panels for control of the fire suppression systems in the hangar bay. This panel shall not be part of the building fire alarm panel. Fire panels controlling the fire suppression system shall be listed for releasing service and compatible with the releasing devices. Provide a 20% capacity for future modifications.

3.12.19.2.1 The FSCP must be monitored by, and capable of communicating with the installation supervising station.

3.12.19.2.2 A separate and distinct fire signal shall be transmitted to the fire department upon activation of any portion of a foam system.

3.12.19.2.3 Separate fire alarm transmitters/receivers are permitted.

3.12.19.2.4 Provide a switch within the lockable control panel to disable the releasing functions of the panel while leaving all detection and other functions of the panel operational. Activation of this switch will transmit a distinct trouble signal to the installation monitoring system.

3.12.19.2.5 In addition to standard fire alarm actions, the following initiating devices must activate the low-level foam fire suppression systems, transmit a pump start signal, divert flow from oil water separator, and activate blue foam discharge strobes:

- (a) Manual foam discharge stations.
- (b) Water flow signal from hangar overhead sprinkler systems.

3.12.19.2.6 Manual activation stations shall be provided at each means of egress from the hangar bay for activation of the fire suppression system. Manual activation stations shall be yellow, and shall be clearly labeled for suppression system activation. Manual activation stations must be the locking type that when activated, require a key to be reset. Manual activation stations will have distinctive signage at each device stating "START FOAM SYSTEM" in red lettering not less than 3 inches high on a yellow or lime-yellow background. Manual foam discharge stations must be housed within a clear plastic tamper cover that must be lifted prior to actuating the station.

3.12.19.2.7 Blue visual alarm signals shall be provided within the aircraft servicing area to indicate foam system activation. Signals shall be visible from all parts of the aircraft maintenance and servicing area.

3.12.19.2.8 Transient Voltage Surge Suppression (TVSS) must be provided for the fire control panels and MNS on all fire alarm and MNS circuits entering and leaving the facility, including, but not limited to, the power supply circuits to the control panels, circuits interfacing with fire pumping stations outside the facility, and circuits interfacing with the fire alarm receiving station. Other TVSS required elsewhere may not provide complete protection from transient voltage surges. A comprehensive evaluation of other transient voltage entry points must be conducted and appropriate TVSS installed where needed.

3.12.19.2.9 Alternating Current (AC) Power TVSS Devices must be tested in accordance with UL 1449, Standard for Safety Transient Voltage Surge Suppressors, Second Edition, and UL 1283, Electromagnetic Interference Filters, latest edition, by a nationally recognized testing laboratory. The TVSS devices must provide normal sine wave tracking, with Category A1 ring wave suppression of less than 50 V for nominal 120 V alternating current legs. The TVSS will provide independent, distinct, and dedicated circuitry for each possible protection mode. TVSS device circuitry must be fully encapsulated for protection of the circuitry and to provide longer life expectancy.

3.12.19.2.10 Data, Signal, and Control Wire TVSS Devices must be designed by the same manufacturer as the AC power TVSS devices to ensure overall compatibility and system reliability. The TVSS manufacturer must provide the TVSS devices based on evaluation of individual system parameters. TVSS device circuitry must be fully encapsulated for protection of the circuitry and to provide longer life expectancy.

3.12.20 MANUAL FIRE ALARM PULL STATIONS

As a minimum manual pull stations must be provided throughout the facility at all exit doors.

3.12.21 WIRING FOR FSCP, FACP AND MNS

All wiring for foam control and fire alarm system shall be Class A. All conductor connections shall be made under screw terminals. Provide insulated barrier type terminal strips at junction points. Use of wire nuts, crimped connectors, or twisting of conductors is prohibited. All conduits and junction boxes connected to FSCP, FACP and MNS shall be painted red (or prefinished red from the factory).

3.12.22 FIRE ALARM SYSTEM MATRIX

All alarm signals to be transmitted must be defined and presented in a system matrix.

3.12.23 FIRE PROTECTION EQUIPMENT ROOM

- (a) Locate foam concentrate storage, foam proportioning, foam injection, and system risers in a dedicated fire protection equipment room isolated from the aircraft servicing area by construction rated for at least one hour. Fire protection rooms must be large enough to accommodate all required equipment. All equipment will be fully accessible for inspection, testing, maintenance, and removal/replacement without the removal of any other equipment. Equipment must be located to permit removal of tanks/valves, pumps, and motors without the removal of other components.
- (b) If any equipment and or valves requiring access for maintenance, periodic testing, or re-servicing are located more than 8 feet above the floor, provide an open steel grate mezzanine, with a permanent ladder, at that equipment level. All platforms and ladders must be in compliance with Occupational Safety & Health Administration (OSHA) requirements. Valves over 8 feet may be provided with a chain operator accessible from the floor, rather than access by platforms.

3.12.24 FIRE PUMP BUILDING OR ROOM

If determined to be required by the contractor, the pump facility will house the pumps, drivers, controllers, fuel tanks, fire pump test headers, altitude valve if provided and associated equipment. The configuration of the equipment space should consider the need to test, maintain and even replace major components of the system.

3.12.25 INSPECTION AND TESTING

The entire fire protection system must be tested in accordance with specifications and NFPA requirements to ensure that all equipment, components, and subsystems function as intended.

The Fire Protection Engineer of Record shall witness preliminary and final testing. The Fire Protection Engineer of Record shall perform monthly inspections of fire protection and life safety construction and provide a monthly inspection report. The Mechanical and Electrical QC individuals shall have the education and/or experience to perform QC duties during installation of fire protection systems. This requirement replaces 01 45 04/3.4.4.1.9.

3.12.25.1 TEST PLAN AND PROCEDURE

The contractor shall provide an initial test plan with test procedures 60 days prior to final acceptance test. Include the following information:

- a. A schedule of tests for each day, List of tests.
- b. Blank forms for recording test data for each test.
- c. Test procedure for each test.
- d. List of equipment required for each test.
- e. Calibration certificate for testing equipment

3.12.25.2 PRELIMINARY ACCEPTANCE TEST

Preliminary acceptance tests must be performed for the entire fire protection system in accordance with the contract and references. In addition to written test reports, all preliminary tests will be video taped by a professional videographer to record the methods and equipment employed to conduct the test Preliminary test shall include megger test and loop resistance tests. Complete foam discharge test shall be performed

3.12.25.2.1 THE Hi-Expansion hangar fire suppression system flow tests will include the following:

- (a) Simultaneous flow of simulated overhead sprinkler system maximum demand and foam generators flowing water only.
- (b) Simultaneous flow of simulated overhead sprinkler system maximum demand and foam generators flowing foam. The test shall demonstrate compliance with the one minute coverage of the aircraft parking stalls, and compliance with the coverage of the entire hangar bay to depth of 3.2 feet in less than 4 minutes. Time required demonstrating compliance shall be recorded. Take foam tank level readings at beginning and at end. Overhead sprinkler system maximum demand shall be simulated by using a simulation test header.
- (c) Only foam generators flowing foam for one minute. Foam tank level readings shall be recorded at the beginning and at the end.

3.12.25.3 SAFETY PLAN

Provide a safety plan for conducting test of High Expansion Foam System.

3.12.25.4 CONTAINMENT AND DISPOSAL OF FOAM SOLUTION

Provide containment system for containing the test flow for foam discharge solution. Minimum capacity should provide for containment of the test flow of foam solution from the system proportioner with the greatest design flow rate for the duration of flow. Provide calculations to determine volume of foam solution discharge. Contractor shall provide foam containment and disposal plan and procedures for government approval. Plan shall demonstrate compliance with local, state or US environmental regulations. Contractor shall obtain any required permits.

3.12.25.5 PRELIMINARY ACCEPTANCE TEST REPORT

The contractor shall provide preliminary acceptance test report, megger test and loop resistance test results, videotape of preliminary test, list of deficiencies and corrective actions. Preliminary acceptance test report must be submitted to the government prior to making a request for a final acceptance test.

3.12.25.6 FINAL ACCEPTANCE TEST

Final acceptance test shall begin only when the preliminary test report has been approved. The final test will be a repeat of all preliminary tests, except that flushing and hydrostatic and megger tests will not be repeated. The Fire Protection Specialist and manufacturer's representatives shall conduct the Final Acceptance Test and shall provide a complete demonstration of the operation of the system. Tests must be witnessed by a USACE Fire Protection Engineer. All final acceptance tests will be video taped by a professional videographer. All system failures or other deficiencies identified during the testing must be corrected and retested in the presence of the USACE Fire Protection Engineer.

3.12.25.7 FINAL ACCEPTANCE TEST REPORT

Provide final acceptance test reports including in booklet form, showing field tests performed with video of final test to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall document readings, test results and indicate the final position of controls valves. The report shall include all NFPA forms with the appropriate test reports.

3.12.26 TRAINING

The appropriate representatives shall conduct training courses for operating and maintenance personnel. Lesson plans, operating instructions, maintenance procedures, and training data, shall be furnished for the training courses. The operations training shall familiarize designated government personnel with proper operation of the fire protection systems. The maintenance training course shall provide the designated government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system. Training sessions shall start after the fire protection systems are functionally complete and after the completion of the preliminary test. The field instruction shall cover all of the items contained in the approved O&M manual.

3.12.27 SPARE PARTS

The Contractor shall submit spare parts data for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1, 5 and 10 years of service. A list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor shall be included.

3.13 10-TON CRANE

3.13.1 CONTROLS

Provide static reversing, adjustable frequency controllers for the hoist, bridge and trolley electric drives. Provide dynamic braking for all electric drives. Speed control must be infinitely variable type for the hoist function and infinitely variable type for the bridge and trolley functions. The hoist, trolley and bridge brakes must set only after the associated controller decelerates the motor to a controlled stop. All motors must run smoothly, without torque pulsations at the lowest speed and be energized at a frequency not exceeding 60 HZ at the highest speed. The hoist controller must enable the drive motor to develop full torque continuously at zero speed.

On deceleration, resistors or reactors must be inserted into the motor's high speed leads prior to de-

energization of the high speed contactor. Acceleration and deceleration must be smooth. Provide the bridge and trolley motor control systems with a drift point between OFF and the first speed control point in each direction. The use of definite purpose contactors is prohibited. All contactors must be NEMA rated. Feed control circuits from a single phase, air cooled, double wound transformer with a grounded metal screen between the primary and secondary windings of the transformer

Cranes shall be designed and constructed to CMAA 70 (Class C) or CMAA 74 (moderate requirements) for operation with hoist in accordance with ASME HST-1 or HST-4. The 10-ton crane shall have the following rated load speeds (plus or minus 15%):

- (a) Hoist – 20 fpm
- (b) Trolley – 65 fpm
- (c) Bridge – 125 fpm

Provide runway stops at limits of crane bridge travel.

3.13.2 RADIO CONTROL

Provide radio control system conforming to FCC Part 15 (unlicensed frequencies). The remote radio control system must be designed to meet the requirements of NEMA ICS 8, Part 9.

3.13.3 PENDANT PUSHBUTTON STATION

Suspend the pendant pushbutton station from an independent festooned messenger track system, operating the length of the bridge. Locate the pendant pushbutton station 4 feet above the finished floor. Clearly mark all controls for identification of functions. Provide directional contactors with both mechanical and electrical interlocks.

3.13.4 FLOODLIGHTS

Provide four US Lighting Tech Daytona Tunnel Lighting induction fixtures, 200W, 5,000 Kelvin (or equal), mounted evenly spaced along the bridge. Lights shall be switched on independently of the crane power, on a switch mounted on the crane column, near the crane disconnect, so that the lights can operate even when the crane power is turned off.

3.14 2-TON CRANE

Cranes shall be designed and constructed to CMAA 70 (Class C) or CMAA 74 (moderate requirements) for operation with hoist in accordance with ASME HST-1 or HST-4. The 2-ton crane shall have the following rated load speeds (plus or minus 15%):

- (a) Hoist – 20 fpm
- (b) Trolley – 65 fpm
- (c) Bridge – 125 fpm

Hoist motor control system shall provide one speed in each direction. Bridge and trolley main control systems shall provide one speed in each direction. Provide runway stops at limits of crane bridge travel.

3.15 REFERENCES:

In addition to general references in Paragraph 4, the following publications are applicable to this Hangar Facility RFP:

10 CFR 436, Sub Part A, Methodology and Procedures for Life Cycle Cost Analyses.

ANSI Z358.1, Standard for Emergency Eyewash and Shower Equipment

ANSI Z359.1, Requirements for Personal Fall Arrest Systems And Components

AR 95-2, Air Traffic Control, Airspace, Airfields, Flight Activities, and Navigational Aids

AR 190-11 Physical Security of Arms, Ammunition, and Explosives

AR 190-13 The Army Physical Security Program

AR 190-16 Physical Security AR 380-5, Army Information Security Program

AR 190-51, Security of Unclassified Army Property (Sensitive and Nonsensitive).

AR 380-5 Department of the Army Information Security Program

AR 380-40 Policy for Safeguarding and Controlling Communication Security Material

AR 525-13 Military Operations Antiterrorism

CAM Reg 190-1 Fort Campbell's Physical Security Program

CAM Reg 525-13 Fort Campbell Antiterrorism and Force Protection

DA Pam 190-51 Risk Analysis for Army Property

DoD 5200 08R Physical Security Program

Executive Order 12902: Energy Efficiency and Water Conservation at Federal Facilities.

Executive Order 13423: Strengthening Federal Environmental, Energy, and Transportation Management

FM 3-19.30 Physical Security

General Instruction Building (GIB) and Army Continuing Education System (ACES) Standard Design Criteria, Norfolk District, U.S. Army Corps of Engineers. (Document provides guidance on computer-based resource center for distributed / computer based training room (DT/CBT).)

NFPA 11, Standard for Low, Medium and High Expansion Foam

NFPA 291, Recommended Practice for Fire Flow Testing and Marking of Hydrants

NFPA 409, Standard on Aircraft Hangars

OSHA Standard 1910, Occupational Safety and Health Standards

OSHA 1926.502 Fall Prevention Systems and Criteria and Practices

UFC 1-200-01, General Building Requirements

UFC 3-260-01, Airfield and Heliport Planning and Design

UFC 3-310-04, Seismic Design for Buildings

USAISEC Lightning Protection, Power Quality analysis, Grounding, Bonding, and Shielding, V1.0, Nov 2006 or latest version.

3.16 GLOSSARY

ABA	Architectural Barriers Act
AMPS	Aviation Mission Planning System
AR	Army Regulation
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
AT/FP	Anti-Terrorism/ Force Protection
CATV	Cable Television
CBT	Computer-Based Training
CCTV	Closed-Circuit Television
CFCI	Contractor Furnished Contractor Installed
CLS	Contractor Logistics Support
COF	Company Operations Facility
COS	Center of Standardization
DA	Department of the Army
DA PAM	Department of Army Pamphlet
DDC	Direct Digital Control
DT/CBT	Distributed/Computer-Based Training Program is specified in the GENERAL INSTRUCTION BUILDING (GIB) and ARMY CONTINUING EDUCATION SYSTEM (ACES) Standard Design Criteria authored by the U. S. Corps of Engineers, Norfolk District at: https://eportal.usace.army.mil/sites/COS/CRXXI/Shared%20Documents/GIB%20Design%20Criteria-Update-Sep08.pdf .
ESD	Electrostatic Discharge
FACP	Fire Alarm Control Panel
FFE	Furniture, Fixtures and Equipment
FM	Frequency Modulation
FY	Fiscal Year
GFCI	Government Furnished Contractor Installed
GFGI	Government Furnished Government Installed.
HF	High Frequency
IAW	In Accordance With
IT	Information Technology
LARS	Logistics Assistance Representative
MNS	Mass Notification System
MILCON	Military Construction
NDI	Non-destructive Inspection
NFPA	National Fire Protection Agency
NIC	Not In Contract
NIPR	Non-Classified Internet Protocol Router
NSF	Net Square Footage
NTE	Not To Exceed
OS&Y	Outside stem & yoke (a type of plumbing gate valve)
PA	Public Address

PIV	Pressure Indicator Valve
POL	Petroleum, Oil and Lubricants
POV	Privately Owned Vehicle
RFP	Request for Proposal
RH	Relative humidity
SIPR	Secret Internet Protocol Router
SOW	Scope of Work
SPAM	Shelter Portable Air Mobile
STAMIS	Standard Army Management Information System
STC	Sound transmission coefficient
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
UFC	Unified Facilities Criteria
UHF	Ultra-high Frequency
UPS	Un-interrupted Power Supply
UTP	Unshielded Twisted Pair

3.15 ATTACHMENTS

Attachment A - Room Data Sheets

Attachment B - Conceptual Drawings

Attachment A
Room Data Sheets

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Engine Shop (Power Plant)

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Aircraft engine repair
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	16, 4 workstations

ARCHITECTURE	
Floor Material:	Epoxy on Concrete
Base Material:	Epoxy
Wall Finish:	Paint
Wall Construction:	CMU, per AR 190-51
Ceiling Finish:	Exposed Structure; Paint
Ceiling Height:	

DOORS	
Personnel Doors:	Steel HM; Single door to maint bay
Door Frames:	Steel HM
Door Hardware:	Interior key/Lockable, exterior exit only function
Overhead Doors	(2) 10'x10' Steel Coiling

ARCH. SPECIALTIES	
Millwork / Casework	(2) 18 LF Workbenches
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	(2) Flammable Storage Cabinets - GFGI
Storage	40 LF Parts Storage Cabinets - GFGI
	Tool Box Storage

EQUIPMENT	
Cranes	2 Ton Bridge crane, Class C, 12' hook ht
Emergency Fixture	Eyewash

ADDITIONAL REQUIREMENTS	
No threshold at exterior OH door	GFGI Equipment:
Provide side capture, slot type exhaust hood at solvent tank.	(1) Solvent tank
Provide 25 ft hose reel at CA drops.	(1) Laptop w/ External LCD Monitor per Workstation (GFGI)
AR 190-51 and AR 190-13 shall govern construction standards for space	(1) Printer
Exterior personnel door functions as exit only.	(4) 6'x6' engine repair stands

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	Hood at solvent tank
Room Pressurization:	Negative to adjacent spaces
Internal Loads	Standard
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	s.s. service sink connected to oil/water separator
Compressed Air:	2 drops per wall

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	Yes
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	50 footcandles
CO Detection	Yes
Exit Signs	No

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Prop and Rotor (Powertrain)

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Maint Shop
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	18 / 4 workstations

ARCHITECTURE	
Floor Material:	Epoxy on concrete
Base Material:	Epoxy
Wall Finish:	Paint
Wall Construction:	CMU, per AR 190-51
Ceiling Finish:	Exposed Structure; Paint
Ceiling Height:	12'-0"

DOORS	
Personnel Doors:	Steel HM; single door to maint bay
Door Frames:	Steel HM
Door Hardware:	Interior key/Lockable, exterior exit only function
Overhead door	(2) 10'x10' Steel coiling; to Maint bay and exterior

ARCH. SPECIALTIES	
Millwork / Casework	3'-0" high x 3' deep workbench at perimeter / sto below
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	1 Haz. Mat. Storage cabinet
Storage	Parts storage cabinets Tool box storage

EQUIPMENT	
Cranes	(1) 2 Ton mono-rail crane, Class C
Emergency Fixture	Eyewash

ADDITIONAL REQUIREMENTS	
No threshold at exterior OH door Provide side capture, slot type exhaust hood at solvent tank. AR 190-51 and AR 190-13 shall govern construction standards for this space Exterior personnel door functions as exit only.	<u>GFGI Equipment:</u> (1) Solvent tank (1) Laptop w/ External LCD Monitor per Workstation (1) Printer (1) 4'x4' rotar repair stands (1) Dry ice machine

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	Hood at solvent tank
Room Pressurization:	Negative to adjacent spaces
Internal Loads	See User Equipment below.
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	Stainless steel service sink connected to oil / water seperator
Compressed Air:	2 drops per wall

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	Yes
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	Yes
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	No

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: NDI Shop

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Non destructive testing
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	

ARCHITECTURE	
Floor Material:	Concrete
Base Material:	Rubber base
Wall Finish:	Painted
Wall Construction:	CMU
Ceiling Finish:	Exposed Paint
Ceiling Height:	12'-0"

DOORS	
Personnel Doors:	Steel H.M. - double
Door Frames:	Steel.
Door Hardware:	Interior key/Lockable, exterior exit only function
Overhead Door	(2) 10' x 10' Stl. Coiling; to Maint bay and exterior

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None
Storage	Parts storage cabinets
	Tool box storage

EQUIPMENT	
Cranes	None
Emergency Fixture	Eyewash

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces.
Internal Loads	See Equipment below.
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	Stainless Steel Service sink connected to sanitary waste
Compressed Air:	1 per wall

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	Yes
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS

Double doors required to Prop and Rotor shop
Exterior personnel door functions as exit only.

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: MH-47 QC Shop

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Quality Control Administration
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	6 workstations

ARCHITECTURE	
Floor Material:	VCT
Base Material:	Rubber
Wall Finish:	Paint
Wall Construction:	GWB
Ceiling Finish:	ACT
Ceiling Height:	9'-0

DOORS	
Personnel Doors:	Steel HM
Door Frames:	Steel HM
Door Hardware:	Interior key/Lockable, exterior exit only function

ARCH. SPECIALTIES	
Millwork / Casework	Customer Service Counter
Marker Boards:	(1) 5' x 8' wall mounted
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None
Storage	(4) metal storage cabinets (4) lat file cabinet

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces.
Internal Loads	See Equipment below.
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	Yes
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS	
Exterior personnel door functions as exit only.	GFGI Equipment: (1) Latop w/ external LCD monitor per workstation (1) Printer/Copier Unit

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Back Shop Avionics

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Electronics test/repair
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	25

ARCHITECTURE	
Floor Material:	Non-conductive vinyl tile
Base Material:	Rubber
Wall Finish:	Paint
Wall Construction:	CMU
Ceiling Finish:	ACT
Ceiling Height:	10'-0"

DOORS	
Personnel Doors:	Steel HM; Single
Door Frames:	Steel HM
Door Hardware:	Interior key/Lockable, exterior exit only function
Overhead door	(1) 10'x10' Steel coiling to exterior

ARCH. SPECIALTIES	
Millwork / Casework	Workbench stations
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	1 Haz. Mat. Storage cabinet

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacnet spaces.
Internal Loads	See Equipment below.
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 115 VAC/60 hz, 115VAC/400 hz, 28 VDC
GFCI Outlets:	Yes
Tamper Resistant Outlets:	No
Data:	one drop per bench
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	50 footcandles at bench height
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS	
Provide downdraft exhaust ventilation for benchtop soldering (6 total),	<u>GFGI Equipment</u>
Exterior personnel door functions as exit only.	(1) Laptop w/ External LCD monitor per workbench
(25) Workbenches	Electronic Test equipmetn at bench
(2) 60 A 28VDC breakers	(1) Printer/Copier
(2) 40A 115VAC/400 hz breakers	(6) Solder Stations
Surge protection on shop power.	(2) 50" LCD TV, wall mount
	(1) Refrigerator
	(1) Microwave

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Avionics vault

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Non-Sensitive Secure storage
SCIF Requirements:	None
No. Rooms:	(1) 400 s.f. Vault
Occupants per Room	

ARCHITECTURE	
Floor Material:	Non-conductive vinyl tile; Per AR 190-51
Base Material:	Rubber
Wall Finish:	Paint
Wall Construction:	CMU; Per AR 190-51
Ceiling Finish:	Paint; Per AR 190-51
Ceiling Height:	10'-0

DOORS	
Personnel Doors:	Steel Security grade; per AR 190-51
Door Frames:	Steel HM; Per AR 190-51
Door Hardware:	per Fed Spec FF-L-2940

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacnet spaces.
Internal Loads	Standard
Zoning:	May be combined with Back Avionics Shop

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	1 drop

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 115 VAC/60 hz, 115Y VAC/400 hz, 28 VDC
GFCI Outlets:	Yes
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	50 footcandles at bench height
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS	
Infrastructure (box, conduit, power and signal cabling) for a Government Furnished Government Installed Intrusion Detection System.	

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: MH-47 Avionics / Elec Repair

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Electronics test/repair
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	10

ARCHITECTURE	
Floor Material:	Non-Conductive Vinyl
Base Material:	Rubber
Wall Finish:	Paint
Wall Construction:	CMU, per AR 190-51
Ceiling Finish:	ACT
Ceiling Height:	10'-0

DOORS	
Personnel Doors:	Steel HM; double door access, per AR 190-51
Door Frames:	Steel
Door Hardware:	Lockable

ARCH. SPECIALTIES	
Millwork / Casework	Workbench stations
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	1 Haz. Mat. Storage cabinet

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacnet spaces.
Internal Loads	See Equipment below.
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V, 115Y/400Hz/3-Ph
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS	
AR 190-51 and AR 190-13 shall govern construction standards for this space	<p><u>GFGI Equipment</u></p> <ul style="list-style-type: none"> (1) Laptop w/ External LCD monitor per workbench (2) Printers (1) 50" LCD TV, wall mount (1) Refrigerator (1) Microwave

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Hydraulics (Pnedraulics Repair)

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Maint Shop
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	7 People / 4 Workstations

ARCHITECTURE	
Floor Material:	Epoxy on concrete - non slip
Base Material:	Epoxy
Wall Finish:	Paint
Wall Construction:	CMU, per AR 190-51
Ceiling Finish:	Exposed Structure; Paint
Ceiling Height:	12'-0

DOORS	
Personnel Doors:	Steel HM, per AR 190-51
Door Frames:	Steel HM
Door Hardware:	Interior key/Lockable, exterior exit only function
Overhead door	(2) 10' x 10' Steel Coiling

ARCH. SPECIALTIES	
Millwork / Casework	(2) 3' H x 8' L x 4' D workbenches
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	(1) Haz. Mat. Storage Cabinet
Storage	(8) rows of 16' L x 6" D Shelving

EQUIPMENT	
Cranes	None
Emergency Fixture	Eyewash

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	General
Room Pressurization:	Positive to adjacnet spaces.
Internal Loads	See Equipment below.
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	s.s. service sink connected to oil /water seperator
Compressed Air:	1 drop per wall, 4 overhead, dedicated connection for Pump unit and flaring too

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V, 220V 3-phase
GFCI Outlets:	Yes
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	Yes
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS	
Provide 25 ft hose reel with wall and overhead CA drops. (4) 230V/3ph power AR 190-51 and AR 190-13 shall govern construction standards for this space Exterior personnel door functions as exit only.	GFGI Equipment (1) Laptop w/ External LCD monitor per workbench (1) Printers Pump unit Flaring tool

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Tech Supply (Hangar Parts Storage)

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Parts Storage
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	17

ARCHITECTURE	
Floor Material:	Concrete
Base Material:	None
Wall Finish:	Paint
Wall Construction:	CMU
Ceiling Finish:	Exposed Structure; Paint
Ceiling Height:	12'-0"

DOORS	
Personnel Doors:	Steel HM; dbl or OHC to hangar bay
Door Frames:	Steel HM
Door Hardware:	Interior key/Lockable, exterior exit only function
Overhead door	(2) 10' x 10' steel coiling to Exterior & Hangar Bay

ARCH. SPECIALTIES	
Millwork / Casework	20 LF Service counter w/ base cabinets
Marker Boards:	(1) 5' x 8' wall mtd near wkstns
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None
Storage	G.F.G.I. open shelf and dwr storage

EQUIPMENT	
Cranes	None
Emergency Fixture	None

ADDITIONAL REQUIREMENTS	
Adjacent to exterior covered storage area	GFGI Equipment
Unbox / shipping and receiving area helpful	(1) Laptop w/ External LCD monitor per workstation
Open floor space for racked rotors for each aircraft type serviced.	(1) Printer
(12) Workstations	
All workstations within this room to have 2 data cables/ 1 voice cable.	
Provide data outlet for parts processing.	

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces.
Internal Loads	See Equipment below.
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	30 footcandles
CO Detection	No
Exit Signs	No

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Arms Room

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Armament maintenance
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	2

ARCHITECTURE	
Floor Material:	Sealed Concrete
Base Material:	Rubber Base
Wall Finish:	Paint
Wall Construction:	Reinf. CMU/Conc.
Ceiling Finish:	GWB
Ceiling Height:	9'-0"

DOORS	
Personnel Doors:	Steel HM; Single
Door Frames:	Steel HM
Door Hardware:	Interior key/Lockable, exterior exit only function

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	No

EQUIPMENT	
Cranes	None
Emergency Fixture	Eyewash

ADDITIONAL REQUIREMENTS	
(2) Workstations	<p>GFGI Equipment</p> <p>(1) Solvent tank</p> <p>(1) Laptop w/ External LCD monitor per workstation</p> <p>(1) Printer</p>

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	Hood at solvent tank
Room Pressurization:	Negative to adjacent spaces
Internal Loads	See User Equipment Below
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	1 SS service sink connected to sanitary
Compressed Air:	1 drop per wall, 1 at solvent tank

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Notification Appliance:	30 footcandles
CO Detection	No
Exit Signs	No
ICIDS	Yes

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Arms Vault

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Armament storage
SCIF Requirements:	None
No. Rooms:	(1) vault
Occupants per Room	

ARCHITECTURE	
Floor Material:	Concrete; Sealed; per AR 190-11
Base Material:	None
Wall Finish:	Paint
Wall Construction:	Reinf. CMU/Concrete; per AR 190-11
Ceiling Finish:	Concrete; Paint; per AR 190-11
Ceiling Height:	9'-0"

DOORS	
Vault Door:	GSA Class 5 Armory Door per Fed Spec AA-D-600D with Day Gate
Door Frames:	per AR 190-11
Door Hardware:	
Vault Door and Lock:	per Fed Spec FF-L-2937 and AR 190-11

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	No
Hazmat Sto.	No
Weapons Racks	GFGI
Metal Cages	GFGI Arms Lockers

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating Only
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Neutral
Internal Loads	None
Zoning:	Combine with Arms Shop

PLUMBING	
Fixture (Qty / Type):	Hub drain for dehumidifier drain.
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Notification Appliance:	30 footcandles
CO Detection	No
Exit Signs	No
ICIDS	Yes

ADDITIONAL REQUIREMENTS
Infrastructure (box, conduit, power and signal cabling) for a Government Furnished Government Installed Intrusion Detection System.
Access from Arms shop only
Provide Wall Mounted dehumidifier unit.
Provide double doors all along circulation path from Aircraft mounted Weapons Arms Vault to Hangar Bay.
Sub-divide vault in thirds with metal caging/gates for the flight companies.
Design per AR 190-11
Provide duct security bars if duct penetrations are greater than 96 sq. inches.

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Tool Storage

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Tool Storage
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	2

ARCHITECTURE	
Floor Material:	Concrete
Base Material:	None
Wall Finish:	Paint
Wall Construction:	CMU, per AR 190-51
Ceiling Finish:	Exposed Structure; Paint
Ceiling Height:	9'-0

DOORS	
Personnel Doors:	Steel HM; single
Door Frames:	Steel HM
Door Hardware:	Interior key/Lockable, exterior exit only function

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	(1) 5' X 8' wall mtd near wkstns
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None
Storage	GFGI open shelf and drawer storage

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacnet spaces.
Internal Loads	Standard
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	10 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS
Provide caged storage area for large tools and equipment (2) Workstations AR 190-51 and AR 190-13 shall govern construction standards for this space Exterior personnel door functions as exit only.

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: MH-47 Maintenance

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Aircraft Maintenance Crew room
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	60

ARCHITECTURE	
Floor Material:	VCT
Base Material:	Rubber
Wall Finish:	Painted
Wall Construction:	CMU
Ceiling Finish:	ACT
Ceiling Height:	12'-0"

DOORS	
Personnel Doors:	Steel HM; single
Door Frames:	Steel HM
Door Hardware:	Interior key/Lockable, exterior exit only function

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	None

ADDITIONAL REQUIREMENTS	
(2) hardwalled offices	<u>GFGI Equipment</u>
12 Tele/data drops - locations as specified by user.	(1) Laptop w/ external LCD monitor per workstation
Exterior personnel door functions as exit only.	(1) Printer/Copier Unit
Provide a SIPRNET outlet adjacent to all NIPRNET outlets within this room.	(1) Fax Machine

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces.
Internal Loads	See Equipment below.
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	Yes
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	Yes
Lighting Level:	50 footcandles
CO Detection	Yes
Exit Signs	No

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Hangar Maintenance Bay

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Rotary wing aircraft maintenance
SCIF Requirements:	None
No. Rooms:	(3) 70'-0" x 110'-0" bays
Occupants per Room	Varies

ARCHITECTURE	
Floor Material:	Dry-Shake Hardener
Base Material:	Rubber
Wall Finish:	Paint (light reflective)
Wall Construction:	CMU (18'H) Mtl panel above
Ceiling Finish:	Mtl liner panels (light reflective)
Ceiling Height:	TBD - 29'-0 min crane hook height

DOORS	
Personnel Doors:	Steel HM / Insul Steel HM
Door Frames:	Steel HM
Door Hardware:	key/Lockable
Hangar Doors	28' H x 210'-0" Motorized, capable of manual operation. Include (1) personnel door, center parting, pick up system

ARCH. SPECIALTIES	
Millwork / Casework	Wk benches - 40 LF per bay w/ pwr / data / lights / shelving
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	(6) GFGI Flammable Storage Lockers
Fall Arrest System:	Overhead Trolley system, Comply w/ OSHA requirements, synchronize w/ crane system

EQUIPMENT	
Cranes	(2) 10 T bridge crane W/ 29'-0 Hook Ht
Emergency Fixture	Shower/eyewashes

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 80 F Summer Vent.
Humidity Range:	N/A
Humidity Tolerance:	N/A
Final Filtration Requirement:	
Minimum Air Changes:	As required for ventilation.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	Per ASHRAE 62.1
Room Pressurization:	Negative
Internal Loads	Standard
Zoning:	No Special Requirements

PLUMBING	
Fixture (Qty / Type):	(2) Semi-circular wash basins
Compressed Air:	2 CA per Utility Pedestal A, B & C. (2) CA Per floor box

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler / Hi-Ex Foam
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits/Provide foam discharge stations
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01/Blue Foam Discharge Strobes -Appendix JJ

ELECTRICAL	
Power Requirements	277V, 110V, 208Y/3, 200V 3ph 400Hz
GFCI Outlets:	Yes
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	Yes
Emergency Lighting:	Yes
Multi-Level Switching:	Daylighting/adjustable via photocell
Lighting Level:	50 footcandles
CO Detection	Yes
Exit Signs	No

ADDITIONAL REQUIREMENTS
centered trench drain in each bay, trench drain across all hangar door, drain to oil/water separator. 5'-0" safety lane at perimeter of maintenance bays Utility Pedestals: (3)-Type "A", (3)-Type "B", (4)- Type "C", (4)-Type "D" Provide CA Floor box at center of each maintenance bay inside marked walkway. Total of (3). hangar grounding points per UFC 3-260-01 Both 10 T bridge cranes cover entire width of maint modules x Length less 8 feet at nose end of modules Fall restraint system needed for each module Speakers for the one-way intercom system originating in the Production Office. CCTV Infrastructure (box, conduit, cabling and power) for a Government Furnished Government Installed CCTV System. Hazardous location - all work shall adhere to Article 513 of NFPA 70.

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Production Control

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Office / Meeting
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	6

ARCHITECTURE	
Floor Material:	VCT
Base Material:	Rubber
Wall Finish:	Paint
Wall Construction:	GWB
Ceiling Finish:	ACT
Ceiling Height:	9'-0

DOORS	
Personnel Doors:	Steel HM
Door Frames:	Steel HM
Door Hardware:	Lockable

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	(2) 3' X 5' wall mounted
Tack Boards:	None
Wall & corner guards	None
Storage	(3) metal storage cabinets
	(2) lat file cabinet

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces.
Internal Loads	See Equipment below.
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	Yes
Emergency Lighting:	Yes
Multi-Level Switching:	Yes
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS	
Conf. table, seating and mtg space for 15-18 people (2) hardwalled offices (6) Workstations Provide a SIPRNET outlet adjacent to all NIPRNET outlets within this room. Microphone and Headend Equipment for the One-Way Intercom System between the Production Control Office and Hangar Maintenance Bay. CCTV Infrastructure (box, conduit, cabling and power) for a Government Furnished Government Installed CCTV System.	<u>GFGI Equipment</u> (1) Latop w/ external LCD monitor per workstation (1) Printer/Copier Unit (1) Fax Machine

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Air Frame Shop / Composite Shop

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Air frame repairs
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	25

ARCHITECTURE	
Floor Material:	concrete
Base Material:	None
Wall Finish:	Painted
Wall Construction:	CMU
Ceiling Finish:	Exposed Structure; Paint
Ceiling Height:	12'-0

DOORS	
Personnel Doors:	Steel HM; single
Door Frames:	Steel HM
Door Hardware:	Interior key/Lockable, exterior exit only function
Overhead Door	(4) 10' x 10' Steel OH coiling

ARCH. SPECIALTIES	
Millwork / Casework	3 wkbench style workstations
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	(2) GFGI flammable sto cabinets
	composites sto rm

EQUIPMENT	
Cranes	(1) 2 T mono-rail crane, Class C
Emergency Fixture	Eyewash

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacnet spaces.
Internal Loads	See User equipment list
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	1 ss service sink connected to sanitary
Compressed Air:	2 drops per wall, 6 overhead drops

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V, 220V 3Ph
GFCI Outlets:	Yes
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS	
(3) Workstations and (2) hardwalled offices OH doors to welding and paint shops required Exterior personnel door functions as exit only. Provide (2) 30A 240/3/60 receptacles Provide (2) 30A 220/1/60 receptacles Provide 110/1/60 receptacles at bench.	GFGI Equipment (1) Laptop w/ External LCD Monitor per Workstation

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Air Frame Open Office Area

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Air frame administration
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	3

ARCHITECTURE	
Floor Material:	VCT
Base Material:	Vinyl
Wall Finish:	Painted
Wall Construction:	CMU
Ceiling Finish:	A.C.T.
Ceiling Height:	10'-0

DOORS	
Personnel Doors:	Steel HM; single
Door Frames:	Steel HM
Door Hardware:	Lockable
Overhead Door	None

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	(1) 3'x 5' wall mounted
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces.
Internal Loads	See User equipment list
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V, 220V 3Ph
GFCI Outlets:	Yes
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS	
(3) Workstations Provide a SIPRNET outlet adjacent to all NIPRNET outlets within this room.	<u>GFGI Equipment</u> (1) Laptop w/ External LCD Monitor per Workstation

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Machine Welding Shop

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Welding
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	

ARCHITECTURE	
Floor Material:	concrete
Base Material:	None
Wall Finish:	Painted
Wall Construction:	CMU
Ceiling Finish:	Exposed Structure; Paint
Ceiling Height:	12'-0

DOORS	
Personnel Doors:	Steel HM; single
Door Frames:	Steel HM
Door Hardware:	Interior key/Lockable, exterior exit only function
Overhead Door	(1) 10' x 10' steel coiling to Maintenance Bay

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	Eyewash

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	Welding hood
Room Pressurization:	Negative to adjacent spaces.
Internal Loads	See User equipment list
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	1 ss service sink connected to sanitary
Compressed Air:	1 drop per wall

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01
Wall and Ceiling Rating:	One hour for wall and ceiling construction

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	Yes
Tamper Resistant Outlets:	No
Data:	No
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	Yes

ADDITIONAL REQUIREMENTS	
Provide exhaust capture hoods at welding bench Exterior personnel door functions as exit only.	<u>GFGI Equipment</u> (1) Mig welder (220VAC 3ph 100 A)

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Paint Shops / Metal Storage

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Painting, prep and metal storage
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	

ARCHITECTURE	
Floor Material:	Sealed Concrete
Base Material:	None
Wall Finish:	Paint
Wall Construction:	CMU
Ceiling Finish:	Exposed Structure; Paint
Ceiling Height:	12'-0"

DOORS	
Personnel Doors:	Steel HM
Door Frames:	Steel HM
Door Hardware:	Interior key/Lockable, exterior exit only function
Overhead Door	(1) 10' x 10' steel coiling to Exterior

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	GFGI Flammable Storage Lockers
Solvent tank	1

EQUIPMENT	
Cranes	None
Emergency Fixture	Eyewash

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	General & connection to booth
Room Pressurization:	Negative to adjacent spaces.
Internal Loads	See User equipment list
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	1 ss service sink connected to sanitary
Compressed Air:	2 drops

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	Yes
Tamper Resistant Outlets:	No
Data:	No
Phone:	No
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS
GFGI Paint Booth Provide exhaust duct from GFGI paint booth to exterior. Exterior personnel door functions as exit only. Hazardous location - all work shall adhere to Article 513 of NFPA 70.

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Platoon Sergeant

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Office
SCIF Requirements:	None
No. Rooms:	7
Occupants per Room	1

ARCHITECTURE	
Floor Material:	VCT
Base Material:	Rubber
Wall Finish:	Paint
Wall Construction:	GWB
Ceiling Finish:	ACT
Ceiling Height:	9'-0

DOORS	
Personnel Doors:	Steel HM
Door Frames:	Steel
Door Hardware:	Lockable

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	(1) 3' X 5' wall mounted
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces
Internal Loads	See User equipment list
Zoning:	No Special Requirements

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	Yes
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS	
(1) Workstation Provide a SIPRNET outlet adjacent to all NIPRNET outlets within this room.	<u>GFGI Equipment</u> (1) Laptop w/ external LCD monitor per workstation (1) Printer per Office

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Platoon Leader

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Office
SCIF Requirements:	None
No. Rooms:	6
Occupants per Room	1

ARCHITECTURE	
Floor Material:	VCT
Base Material:	Rubber
Wall Finish:	Paint
Wall Construction:	GWB
Ceiling Finish:	ACT
Ceiling Height:	9'-0

DOORS	
Personnel Doors:	Steel HM
Door Frames:	Steel
Door Hardware:	Lockable

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	(1) 3' X 5' wall mounted
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces
Internal Loads	See User equipment list
Zoning:	No Special Requirements

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	Yes
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS	
(1) Workstation Provide a SIPRNET outlet adjacent to all NIPRNET outlets within this room.	<u>GFGI Equipment</u> (1) Laptop w/ external LCD monitor per workstation (1) Printer per Office

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: First Sargeant

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Office
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	1

ARCHITECTURE	
Floor Material:	VCT
Base Material:	Rubber
Wall Finish:	Paint
Wall Construction:	GWB
Ceiling Finish:	ACT
Ceiling Height:	9'-0

DOORS	
Personnel Doors:	Steel HM
Door Frames:	Steel
Door Hardware:	Lockable

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	(1) 3' X 5' wall mounted
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces
Internal Loads	See User equipment list
Zoning:	No Special Requirements

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	Yes
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS	
(1) Workstation Provide a SIPRNET outlet adjacent to all NIPRNET outlets within this room.	<u>GFGI Equipment</u> (1) Laptop w/ external LCD monitor per workstation (1) Printer per Office

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Commander

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Office / Meeting
SCIF Requirements:	None
No. Rooms:	2
Occupants per Room	1

ARCHITECTURE	
Floor Material:	Carpet
Base Material:	Rubber
Wall Finish:	Paint
Wall Construction:	GWB
Ceiling Finish:	ACT
Ceiling Height:	9'-0

DOORS	
Personnel Doors:	Steel HM
Door Frames:	Steel
Door Hardware:	Lockable

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	(1) 3' X 5' wall mounted
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces
Internal Loads	See User equipment list
Zoning:	No Special Requirements

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	Yes
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS	
(1) Workstation Provide a SIPRNET outlet adjacent to all NIPRNET outlets within this room.	<u>GFGI Equipment</u> (1) Laptop w/ external LCD monitor per workstation (1) Printer per Office

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Safety NCO Office

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Office
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	1

ARCHITECTURE	
Floor Material:	Carpet
Base Material:	Rubber
Wall Finish:	Paint
Wall Construction:	GWB
Ceiling Finish:	ACT
Ceiling Height:	9'-0

DOORS	
Personnel Doors:	Steel HM
Door Frames:	Steel
Door Hardware:	Lockable

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	(1) 3'x 5' wall mounted
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces
Internal Loads	See User equipment list
Zoning:	No Special requirements

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	Yes
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS	
(1) Workstation Provide a SIPRNET outlet adjacent to all NIPRNET outlets within this room.	<u>GFGI Equipment</u> (1) Laptop w/ external LCD monitor per workstation (1) Printer per Office

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Safety OIC Office

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Office
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	1

ARCHITECTURE	
Floor Material:	Carpet
Base Material:	Rubber
Wall Finish:	Paint
Wall Construction:	GWB
Ceiling Finish:	ACT
Ceiling Height:	9'-0

DOORS	
Personnel Doors:	Steel HM
Door Frames:	Steel
Door Hardware:	Lockable

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	(1) 3'x 5' wall mounted
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces
Internal Loads	See User equipment list
Zoning:	No Special requirements

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	Yes
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS	
(1) Workstation Provide a SIPRNET outlet adjacent to all NIPRNET outlets within this room.	<u>GFGI Equipment</u> (1) Laptop w/ external LCD monitor per workstation (1) Printer per Office

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Safety Office

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Open office
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	3

ARCHITECTURE	
Floor Material:	Carpet
Base Material:	Rubber
Wall Finish:	Paint
Wall Construction:	GWB
Ceiling Finish:	ACT
Ceiling Height:	9'-0

DOORS	
Personnel Doors:	Steel HM
Door Frames:	Steel
Door Hardware:	Lockable

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	(1) 3'x 5' wall mounted
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces
Internal Loads	See User equipment list
Zoning:	No Special Requirements

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	Yes
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS	
(3) Workstations Provide a SIPRNET outlet adjacent to all NIPRNET outlets within this room.	<u>GFGI Equipment</u> (1) Laptop w/ external LCD monitor per workstation (1) Printer per Office

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Maintenance Office

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Office / Meeting
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	22

ARCHITECTURE	
Floor Material:	Carpet
Base Material:	Rubber
Wall Finish:	Paint
Wall Construction:	GWB
Ceiling Finish:	ACT
Ceiling Height:	9'-0

DOORS	
Personnel Doors:	Steel HM
Door Frames:	Steel
Door Hardware:	Lockable

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	(1) 3' X 5' wall mounted
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces
Internal Loads	See User equipment list
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	Yes
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS	
(2) hardwalled offices - Pltn Ldr and 1st Sgt Provide a SIPRNET outlet adjacent to all NIPRNET outlets within this room.	<u>GFGI Equipment</u> (1) Laptop w/ External LCD Monitor per Workstation (1) Printer

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Flight Operations

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Office
SCIF Requirements:	Yes
No. Rooms:	1
Occupants per Room	7

ARCHITECTURE	
Floor Material:	VCT
Base Material:	Rubber
Wall Finish:	Paint
Wall Construction:	GWB
Ceiling Finish:	ACT
Ceiling Height:	9'-0

DOORS	
Personnel Doors:	Steel HM
Door Frames:	Steel
Door Hardware:	Lockable

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	(1) 5'x 8' wall mounted
Tack Boards:	2
Wall & corner guards	None
Hazmat Sto.	None
TV Brackets	3

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces
Internal Loads	See User equipment list
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	Yes
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS	
(7) Workstations	<u>GFGI Equipment</u>
(3) GFCI outlets for wall mounted digital clocks	(1) Copier
Storage space for 30 night vision goggles	(2) Fax Machines
Locate adjacent to Briefing Room & Flight Planning Room	(1) Laser Printer
Provide a SIPRNET outlet adjacent to all NIPRNET outlets within this room.	(2) 50" LCD Monitors, wall mounted
	(1) Microwave
	(1) Refrigerator
	(1) Laptop w/ External LCD monitor per workstation

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME:

Aviation TACS OPS Office

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Office
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	1

ARCHITECTURE	
Floor Material:	Carpet
Base Material:	Rubber
Wall Finish:	Paint
Wall Construction:	GWB
Ceiling Finish:	ACT
Ceiling Height:	9'-0

DOORS	
Personnel Doors:	Steel HM
Door Frames:	Steel HM
Door Hardware:	Lockable

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	(1) 3'x 5' wall mounted
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces
Internal Loads	See User equipment list
Zoning:	No Special Requirements

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	Yes
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS

adjacent to Flight Ops area

(1) Workstation

Provide a SIPRNET outlet adjacent to all NIPRNET outlets within this room.

GFGI Equipment

(1) Laptop w/ External LCD Monitor per Workstation

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Conference / Mission Planning

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Office / Meeting
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	Varies

ARCHITECTURE	
Floor Material:	Carpet
Base Material:	Rubber
Wall Finish:	Paint
Wall Construction:	GWB
Ceiling Finish:	ACT
Ceiling Height:	9'-0

DOORS	
Personnel Doors:	Steel HM
Door Frames:	Steel
Door Hardware:	Lockable

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	(1) 3'x 5' wall mounted
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None
Projector Screen	Yes
folding partition	Yes

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces
Internal Loads	Standard
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	Yes
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS

Meeting table and seating for 12-15 ppl
Provide a SIPRNET outlet adjacent to all NIPRNET outlets within this room.

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Briefing Conf Room

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Office / Meeting
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	Varies

ARCHITECTURE	
Floor Material:	Carpet
Base Material:	Rubber
Wall Finish:	Paint
Wall Construction:	GWB
Ceiling Finish:	ACT
Ceiling Height:	9'-0

DOORS	
Personnel Doors:	Steel HM
Door Frames:	Steel
Door Hardware:	Lockable

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	(1) 5'x 8' wall mounted
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None
Projector Screen	Yes
folding partition	Yes

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces
Internal Loads	Standard
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	Yes
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS
Meeting table and seating for 12-15 ppl Provide a SIPRNET outlet adjacent to all NIPRNET outlets within this room.

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Maintenance Test Pilots

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Office / Meeting
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	6 workstations

ARCHITECTURE	
Floor Material:	Carpet
Base Material:	Rubber
Wall Finish:	Paint
Wall Construction:	GWB
Ceiling Finish:	ACT
Ceiling Height:	9'-0

DOORS	
Personnel Doors:	Steel HM
Door Frames:	Steel
Door Hardware:	Lockable

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	(2) 3'x 5' wall mounted
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces
Internal Loads	See User equipment list
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	Yes
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS	
Provide a SIPRNET outlet adjacent to all NIPRNET outlets within this room.	<p><u>GFGI Equipment</u></p> <p>(1) Laptop w/ External LCD monitor per workstation (GFGI)</p> <p>(1) Printer (GFGI)</p>

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Copier Station

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Office
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	

ARCHITECTURE	
Floor Material:	Carpet
Base Material:	Rubber
Wall Finish:	Paint
Wall Construction:	GWB
Ceiling Finish:	ACT
Ceiling Height:	9'-0

DOORS	
Personnel Doors:	
Door Frames:	
Door Hardware:	

ARCH. SPECIALTIES	
Millwork / Casework	storage cab / shelving
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces
Internal Loads	See User equipment list
Zoning:	No Special Requirement

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	Yes
Lighting Level:	20 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS	
	GFI Equipment (1) Copier (GFI)

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Crew Chief Work Rm

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Office / Meeting
SCIF Requirements:	
No. Rooms:	1
Occupants per Room	Varies

ARCHITECTURE	
Floor Material:	Carpet
Base Material:	Rubber
Wall Finish:	Paint
Wall Construction:	GWB
Ceiling Finish:	ACT
Ceiling Height:	9'-0

DOORS	
Personnel Doors:	Steel HM
Door Frames:	Steel
Door Hardware:	Lockable

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	(1) 5'x 8' wall mounted
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None
Projector Screen	Yes
folding partition	Yes

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces
Internal Loads	See User equipment list
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	Yes
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS
Meeting table and seating for 12-15 ppl Provide a SIPRNET outlet adjacent to all NIPRNET outlets within this room.

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Company Readiness Storage

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Gear storage locker room
SCIF Requirements:	None
No. Rooms:	2
Occupants per Room	

ARCHITECTURE	
Floor Material:	VCT
Base Material:	Rubber
Wall Finish:	Paint
Wall Construction:	GWB
Ceiling Finish:	Exposed Structure; Paint
Ceiling Height:	10'min - Varies

DOORS	
Personnel Doors:	Steel HM
Door Frames:	Steel
Door Hardware:	Lockable

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	None

ADDITIONAL REQUIREMENTS	
(369) 4'x4' lockers total	

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces
Internal Loads	Standard
Zoning:	No Special Requirements

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	Yes
Lighting Level:	10 footcandles
CO Detection	No
Exit Signs	No

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Mens Locker Room

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Locker / Shwr / toilet
SCIF Requirements:	None
No. Rooms:	2
Occupants per Room	Min. per drawings in Attachment B

ARCHITECTURE	
Floor Material:	Porcelain Tile / Unglazed tile in shower
Base Material:	Ceramic cove base
Wall Finish:	Ceramic tile / Glazed tile in shower
Wall Construction:	CMU
Ceiling Finish:	Moisture Resistant GWB
Ceiling Height:	9'-0

DOORS	
Personnel Doors:	Steel HM
Door Frames:	Steel
Door Hardware:	Push/pull w/ deadbolt

ARCH. SPECIALTIES	
Millwork / Casework	Laminate Countertops
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None
toilet accessories	Yes
Toilet Partitions	Yes
Lockers	(111) Double Tier 12" x 12" x 72" H
Dressing Benches	Yes
Full length mirror	2

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	Per ASHRAE 62.1
Room Pressurization:	Negative to adjacent spaces
Internal Loads	Standard
Zoning:	No Special Requirements

PLUMBING	
Fixture (Qty / Type):	See Below
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	Yes
Tamper Resistant Outlets:	No
Data:	No
Phone:	No
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	10 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS
<p>Fixtures: See plans for quantities</p> <p>Water closet, wall mounted</p> <p>Urinal</p> <p>Lavatory</p> <p>Shower</p> <p>Floor drain at shower vestibule, in locker area and near fixtures</p>

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Womens Locker Room

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Locker / Shower / Toilet Room
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	Min. per drawings in Attachment B

ARCHITECTURE	
Floor Material:	Porcelain Tile / Unglazed tile in showers
Base Material:	Ceramic cove base
Wall Finish:	Ceramic tile / Glazed tile in showers
Wall Construction:	CMU
Ceiling Finish:	Moisture Resistant GWB
Ceiling Height:	9'-0"

DOORS	
Personnel Doors:	Steel HM
Door Frames:	Steel
Door Hardware:	Push/pull w/ deadbolt

ARCH. SPECIALTIES	
Millwork / Casework	Laminate Countertops
Marker Boards:	
Tack Boards:	
Wall & corner guards	
Hazmat Sto.	
toilet accessories	Yes
Toilet Partitions	Yes
Lockers	(25) 12" x 12" x 72" H
Dressing Benches	Yes
Full length mirror	1

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	Per ASHRAE 62.1
Room Pressurization:	Negative to adjacent spaces
Internal Loads	Standard
Zoning:	No Special Requirements

PLUMBING	
Fixture (Qty / Type):	See Below
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	Yes
Tamper Resistant Outlets:	No
Data:	No
Phone:	No
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	10 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS
<p>Fixtures: See plans for quantities</p> <p>Water closet, wall mounted</p> <p>Lavatory</p> <p>Floor drains</p>

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Womens Restroom

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Toilet Room
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	Min. per drawings in Attachment B

ARCHITECTURE	
Floor Material:	Porcelain Tile
Base Material:	Ceramic cove base
Wall Finish:	Ceramic tile
Wall Construction:	CMU
Ceiling Finish:	Moisture Resistant ACT
Ceiling Height:	9'-0

DOORS	
Personnel Doors:	Steel HM
Door Frames:	Steel
Door Hardware:	Push/pull w/ deadbolt

ARCH. SPECIALTIES	
Millwork / Casework	Laminate countertops
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None
toilet accessories	Yes
Toilet Partitions	Yes
Lockers	None
Dressing Benches	None
Full length mirror	1

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	Per ASHRAE 62.1
Room Pressurization:	Negative to adjacent spaces
Internal Loads	Standard
Zoning:	No Special Requirements

PLUMBING	
Fixture (Qty / Type):	See Below
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	Yes
Tamper Resistant Outlets:	No
Data:	No
Phone:	No
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	5 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS
<p>Fixtures: See plans for quantities</p> <p>Water closet, wall mounted</p> <p>Lavatory</p> <p>Floor drains</p>

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Janitor Closet

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Maintenance
SCIF Requirements:	None
No. Rooms:	1 per floor
Occupants per Room	As dictated by code

ARCHITECTURE	
Floor Material:	VCT
Base Material:	Rubber Base
Wall Finish:	Paint
Wall Construction:	CMU
Ceiling Finish:	Acoustical Ceiling Tile
Ceiling Height:	9'-0

DOORS	
Personnel Doors:	Steel HM
Door Frames:	Steel
Door Hardware:	Key/Lockable

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	Per ASHRAE 62.1
Room Pressurization:	Negative to adjacent spaces
Internal Loads	Standard
Zoning:	No Special Requirements

PLUMBING	
Fixture (Qty / Type):	Janitor sink w/ utility faucet
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	Yes
Tamper Resistant Outlets:	No
Data:	No
Phone:	No
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	5 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS
Std Janitor rm accessories - shelving / mop rack

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: General Purpose Storage

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Office / Meeting
SCIF Requirements:	None
No. Rooms:	2
Occupants per Room	As dictated by code

ARCHITECTURE	
Floor Material:	VCT
Base Material:	Rubber
Wall Finish:	Paint
Wall Construction:	GWB
Ceiling Finish:	ACT
Ceiling Height:	9'-0

DOORS	
Personnel Doors:	Steel HM
Door Frames:	Steel
Door Hardware:	Key/Lockable

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces
Internal Loads	Standard
Zoning:	No Special Requirements

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	5 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Communications Room

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	communications equipment
SCIF Requirements:	
No. Rooms:	2 (first floor); (1) Second Floor
Occupants per Room	As dictated by code

ARCHITECTURE	
Floor Material:	VCT
Base Material:	Rubber Base
Wall Finish:	Paint
Wall Construction:	
Ceiling Finish:	Exposed Structure; Paint
Ceiling Height:	

DOORS	
Personnel Doors:	Steel HM / Insul Steel HM
Door Frames:	Steel
Door Hardware:	Lockable - cipher

ARCH. SPECIALTIES	
Millwork / Casework	
Marker Boards:	
Tack Boards:	
Wall & corner guards	
Hazmat Sto.	

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	Per ASHRAE 62.1
Room Pressurization:	Nuetural
Internal Loads	Communication Equipment
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	Yes
Tamper Resistant Outlets:	No
Data:	Yes
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	30 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS
4'-0" min.door width at SIPR room access.

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: SIPRNET Room

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Secure Communications equipment
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	As dictated by code

ARCHITECTURE	
Floor Material:	Sealed Concrete
Base Material:	Rubber Base
Wall Finish:	Paint
Wall Construction:	CMU, Min. STC 50 to deck above
Ceiling Finish:	painted
Ceiling Height:	Exposed

DOORS	
Personnel Doors:	Min. 3'-6" wide Insul HM Steel or S.C. wood
Door Frames:	Steel
Door Hardware:	LKM-7003 pedestrian door device w/ (1) Fed Spec FF-L-2740 Combination Lock
Door Sound rating:	STC=45, jamb, head and sill sound seals

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	Per ASHRAE 62.1
Room Pressurization:	Nuetral
Internal Loads	Communication Equipment
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Notification Appliance:	Per NFPA 101 / NFPA 72
Pull Stations	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors	Per NFPA 101 / NFPA 72
Mass Notification	Per UFC 4-021-01
Audible Notification	Per UFC 4-021-01 / UFC 3-600-01
Strobes	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	Yes
Tamper Resistant Outlets:	No
	Yes. Connect the SIPRNET room to the main telecommunications room via a single 2" trade size steel conduit
Data:	
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	50 footcandles
CO Detection	No
Exit Signs	No
ICIDS	Yes

ADDITIONAL REQUIREMENTS
Refer to USAISEC Technical Guide for the Integration of Secret Internet Protocol Router Network (SIPRNET) for detailed info. and references regarding SIPRNET. Racks and distribution for SIPRNET. Construct the SIPRNET room in accordance with AR 380-5, Section III, Chapter 7 Room is to be adjacent to Communications Room. (1) L6-30R receptacle at 208V 1-phase Infrastructure (box, conduit, power and signal cabling) for a Government Furnished Government Installed Intrusion Detection System. Bar all ventilation ducts per security requirements of AR 190-11 App G

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Electrical Room

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	electrical equipment
SCIF Requirements:	None
No. Rooms:	3
Occupants per Room	As dictated by code

ARCHITECTURE	
Floor Material:	Sealed Concrete
Base Material:	Rubber
Wall Finish:	Paint
Wall Construction:	CMU (1st floor) Gyp. Bd. (2nd floor)
Ceiling Finish:	Painted Gypsum Board
Ceiling Height:	9'-0

DOORS	
Personnel Doors:	Steel HM / Insul Steel HM
Door Frames:	Steel
Door Hardware:	Lockable - keyed separately

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	55 F Heating / 10 deg above ambient (summer vent)
Humidity Range:	N/A
Humidity Tolerance:	N/A
Final Filtration Requirement:	None
Minimum Air Changes:	4 air changes / hour.
Minimum Outside Air:	As required for ventilation
Exhaust Air Requirement:	As required for ventilation
Room Pressurization:	Positive to adjacent spaces
Internal Loads	Electrical Equipment
Zoning:	No Special Requirements

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	480V, 277V, 110V
GFCI Outlets:	Yes
Tamper Resistant Outlets:	No
Data:	No
Phone:	No
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	30 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Mechanical Room

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Mechanical equipment
SCIF Requirements:	None
No. Rooms:	2
Occupants per Room	As dictated by code

ARCHITECTURE	
Floor Material:	Sealed Conc.
Base Material:	None
Wall Finish:	Paint
Wall Construction:	CMU
Ceiling Finish:	Exposed Structure; Paint
Ceiling Height:	12'-0 min.

DOORS	
Personnel Doors:	Steel. H.M.- insulated
Door Frames:	Steel. H.M.
Door Hardware:	Key/Lockable

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	Eyewash where required

MECHANICAL	
Temp (Winter / Summer)	55 F Heating / 10 deg above ambient (Summer vent)
Humidity Range:	N/A
Humidity Tolerance:	N/A
Final Filtration Requirement:	None
Minimum Air Changes:	4 air changes / hour.
Minimum Outside Air:	As required for ventilation
Exhaust Air Requirement:	As required for ventilation
Room Pressurization:	Negative to adjacent spaces
Internal Loads	Mechanical Equipment
Zoning:	No Special Requirements

PLUMBING	
Fixture (Qty / Type):	Floor Drains
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V, other voltages as required
GFCI Outlets:	Yes
Tamper Resistant Outlets:	No
Data:	No
Phone:	No
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	30 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS
<p>1. Provide eyewash with floor drain when chemical treatment equipment is provided.</p> <p>2. provide floor drains as required to serve equipment.</p> <p>Provide concrete equipment pad as required by equipment</p> <p>Sound control material applied inside room and intergral with wall assembly to deck above.</p> <p>Include space for sprinkler systems components, with adequate space to service equipment.</p>

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Air Compressor Room

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Compressor Equipment Room
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	As dictated by code

ARCHITECTURE	
Floor Material:	Sealed Conc.
Base Material:	None
Wall Finish:	Paint
Wall Construction:	CMU
Ceiling Finish:	Exposed Structure; Paint
Ceiling Height:	12'-0 min.

DOORS	
Personnel Doors:	Steel. H.M.- insulated
Door Frames:	Steel. H.M.
Door Hardware:	Key/Lockable

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	Eyewash where required

MECHANICAL	
Temp (Winter / Summer)	55 F Heating / 10 deg above ambient (Summer vent)
Humidity Range:	N/A
Humidity Tolerance:	N/A
Final Filtration Requirement:	None
Minimum Air Changes:	4 air changes / hour.
Minimum Outside Air:	As required for ventilation
Exhaust Air Requirement:	As required for ventilation
Room Pressurization:	Negative to adjacent spaces
Internal Loads	Mechanical Equipment
Zoning:	No Special Requirements

PLUMBING	
Fixture (Qty / Type):	Floor Drains
Compressed Air:	Locate Compressor in space

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	Yes
Tamper Resistant Outlets:	No
Data:	No
Phone:	No
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	30 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS	
Provide eyewash with floor drain when chemical treatment equipment is provided.	
Sound control material applied inside room and intergral with wall assembly to deck above.	
Provide concrete equipment pad as required by equipment	

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Fire Protection Equipment Room

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Expandable foam equipment housing
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	As dictated by code

ARCHITECTURE	
Floor Material:	Sealed Conc.
Base Material:	None
Wall Finish:	Paint
Wall Construction:	CMU
Ceiling Finish:	Exposed Structure; Paint
Ceiling Height:	

DOORS	
Personnel Doors:	Steel. H.M.- insulated
Door Frames:	Steel. H.M.
Door Hardware:	Key/Lockable

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	Eyewash where required

MECHANICAL	
Temp (Winter / Summer)	55 F Heating / 10 deg above ambient (Summer vent)
Humidity Range:	N/A
Humidity Tolerance:	N/A
Final Filtration Requirement:	None
Minimum Air Changes:	4 air changes / hour.
Minimum Outside Air:	As required for ventilation
Exhaust Air Requirement:	As required for ventilation
Room Pressurization:	Negative to adjacent spaces
Internal Loads	Mechanical Equipment
Zoning:	No Special Requirements

PLUMBING	
Fixture (Qty / Type):	Floor Drains
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	Yes
Tamper Resistant Outlets:	No
Data:	No
Phone:	No
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	30 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS	
<ol style="list-style-type: none"> 1. Provide eyewash with floor drain when chemical treatment equipment is provided. 2. provide floor drains as required to serve equipment. 3. Sound control material applied inside room and intergral with wall assembly to deck above. 4. Provide concrete equipment pad as required by equipment 	

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Breakroom/Classroom

GENERAL INFO	
Functional Area	Per drawings in Attachment B
Primary Room Activity:	Breakroom/Classroom
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	20 ppl

ARCHITECTURE	
Floor Material:	VCT
Base Material:	Rubber
Wall Finish:	Paint
Wall Construction:	GWB
Ceiling Finish:	ACT
Ceiling Height:	10'-0"

DOORS	
Personnel Doors:	Steel HM - half glass
Door Frames:	Steel HM
Door Hardware:	Key/Lockable

ARCH. SPECIALTIES	
Millwork / Casework	8 LF wall and base cabinets w/ counter
Marker Boards:	(1) 4' x 8' wall mtd
Tack Boards:	(1) 4' x 8' wall mtd
Wall & corner guards	None
Hazmat Sto.	None
wall mounted TV Bracket	1

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	Exhaust near microwaves
Room Pressurization:	Negative to adjacent spaces
Internal Loads	See User equipment list
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	See Below
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	Yes
Tamper Resistant Outlets:	No
Data:	No
Phone:	Yes
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	30 footcandles
CO Detection	No
Exit Signs	No

ADDITIONAL REQUIREMENTS									
Provide with small kitchen Area w/ (1) stainless steel, double bowl countertop sink with garbage disposal, (1) countertop									
Water connection for coffee brewer, (1) water connection for ice machine, water connections for GFGL refrigerators.									
Provide 2" floor drain for ice machine									
<table border="0" style="width: 100%;"> <tr> <td colspan="2"><u>GFGL Equipment</u></td> </tr> <tr> <td>(3) refrigerators w/Ice mkr.</td> <td>(2) Microwaves</td> </tr> <tr> <td>(1) coffee brewer</td> <td>(3) Vending Machines</td> </tr> <tr> <td>(1) ice machine</td> <td>(1) wall mounted TV</td> </tr> </table>		<u>GFGL Equipment</u>		(3) refrigerators w/Ice mkr.	(2) Microwaves	(1) coffee brewer	(3) Vending Machines	(1) ice machine	(1) wall mounted TV
<u>GFGL Equipment</u>									
(3) refrigerators w/Ice mkr.	(2) Microwaves								
(1) coffee brewer	(3) Vending Machines								
(1) ice machine	(1) wall mounted TV								

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Corridors

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	circulation
SCIF Requirements:	None
No. Rooms:	Per drawings in Attachment B
Occupants per Room	As dictated by code

ARCHITECTURE	
Floor Material:	VCT
Base Material:	Rubber Base
Wall Finish:	Paint
Wall Construction:	CMU/ Abuse Resistant Gypsum Board
Ceiling Finish:	Acoustical Ceiling Tile
Ceiling Height:	10'-0"

DOORS	
Personnel Doors:	Alum./Glass - Exterior
Door Frames:	Aluminum - Exterior/ HM Interior
Door Hardware:	Exit only hardware at perimeter doors*

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	Yes
Hazmat Sto.	No

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces
Internal Loads	Standard
Zoning:	No Special Requirements

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V,110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	No
Phone:	No
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	5 footcandles
CO Detection	No
Exit Signs	Yes

ADDITIONAL REQUIREMENTS
*B.A.S.I.S. G lock system w/ magnetic stripe card reader at main entrance door near Locker Room

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Stairwell

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	circulation
SCIF Requirements:	None
No. Rooms:	Per drawings in Attachment B
Occupants per Room	As dictated by code

ARCHITECTURE	
Floor Material:	VCT/ rubber nosings
Base Material:	Rubber Base
Wall Finish:	Paint
Wall Construction:	CMU/ Abuse resistant Gypsum Board
Ceiling Finish:	Acoustical Ceiling Tile
Ceiling Height:	10'-0"

DOORS	
Personnel Doors:	Alum./Glass - Exterior , HM Interior
Door Frames:	Aluminum - Exterior/ HM Interior
Door Hardware:	Panic Bar (egress) / Lever Handle (interior access)

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	No

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating
Humidity Range:	N/A
Humidity Tolerance:	N/A
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces
Internal Loads	Standard
Zoning:	No Special Requirements

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	No
Phone:	No
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	5 footcandles
CO Detection	No
Exit Signs	Yes

ADDITIONAL REQUIREMENTS
48" min clear width OSHA compliant steel ladder from second floor to roof hatch above in airfield side stairwell only.

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Elevator Machine Room

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	Elevator Equipment Room
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	As dictated by code

ARCHITECTURE	
Floor Material:	Sealed Concrete
Base Material:	None
Wall Finish:	Painted
Wall Construction:	CMU
Ceiling Finish:	Exposed Structure, Painted
Ceiling Height:	9'-0"

DOORS	
Personnel Doors:	Insul. Steel. HM width per code
Door Frames:	Steel - gasketed
Door Hardware:	Key/Lockable

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	None

ADDITIONAL REQUIREMENTS	
Concrete equipment pad as required for equipment.	
STC - Walls 54 / Door 35	

MECHANICAL	
Temp (Winter / Summer)	55 F Heating / 10 deg. Above ambient (Summer vent)
Humidity Range:	NA
Humidity Tolerance:	NA
Final Filtration Requirement:	None
Minimum Air Changes:	4 air changes / hour
Minimum Outside Air:	As required for ventilation
Exhaust Air Requirement:	As required for ventilation
Room Pressurization:	Negative to adjacent spaces
Internal Loads	Mechanical Equipment
Zoning:	Separate Zone

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V, 110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	No
Phone:	No
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	30 footcandles
CO Detection	No
Exit Signs	No

ROOM DATA SHEET

ROOM NUMBER:

ROOM NAME: Unfinished Floor Space

GENERAL INFO	
Functional Area (NSF)	Per drawings in Attachment B
Primary Room Activity:	circulation
SCIF Requirements:	None
No. Rooms:	1
Occupants per Room	As dictated by code

ARCHITECTURE	
Floor Material:	Sealed Concrete
Base Material:	None
Wall Finish:	None
Wall Construction:	Gypsum Board
Ceiling Finish:	Exposed
Ceiling Height:	Varies

DOORS	
Personnel Doors:	Steel HM
Door Frames:	Steel
Door Hardware:	Key/Lockable

ARCH. SPECIALTIES	
Millwork / Casework	None
Marker Boards:	None
Tack Boards:	None
Wall & corner guards	None
Hazmat Sto.	None

EQUIPMENT	
Cranes	None
Emergency Fixture	None

MECHANICAL	
Temp (Winter / Summer)	68 F Heating / 77 F Cooling
Humidity Range:	50%
Humidity Tolerance:	5% +/-
Final Filtration Requirement:	Per LEED Requirements
Minimum Air Changes:	As required.
Minimum Outside Air:	Per ASHRAE 62.1
Exhaust Air Requirement:	None
Room Pressurization:	Positive to adjacent spaces
Internal Loads	Standard
Zoning:	No Special Requirement

PLUMBING	
Fixture (Qty / Type):	None
Compressed Air:	None

FIRE PROTECTION	
Suppression Type:	Automatic fire sprinkler
Pull Stations:	Per NFPA 101 / NFPA 72/All Exits
Smoke Detectors:	Per NFPA 101 / NFPA 72 (where required)
Mass Notification:	Per UFC 4-021-01
Audible Notification:	Per UFC 4-021-01 / UFC 3-600-01
Strobes:	Per UFC 4-021-01 / UFC 3-600-01

ELECTRICAL	
Power Requirements	277V,110V
GFCI Outlets:	No
Tamper Resistant Outlets:	No
Data:	No
Phone:	No
Intercom:	No
Emergency Lighting:	Yes
Multi-Level Switching:	No
Lighting Level:	10 footcandles
CO Detection	No
Exit Signs	Yes

ADDITIONAL REQUIREMENTS

Attachment B
Conceptual Drawings

4.0 APPLICABLE CRITERIA

Unless a specific document version or date is indicated, use criteria from the most current references, including any applicable addenda, unless otherwise stated in the contract or task order, as of the date of the Contractor's latest accepted proposal or date of issue of the contract or task order solicitation, whichever is later. In the event of conflict between References and/or Applicable Military Criteria, apply the most stringent requirement, unless otherwise specifically noted in the contract or task order.

4.1. INDUSTRY CRITERIA

Applicable design and construction criteria references are listed in Table 1 below. This list is not intended to include all criteria that may apply or to restrict design and construction to only those references listed. See also Paragraph 3 for additional facility-specific applicable criteria.

Table 1: Industry Criteria

Air Conditioning and Refrigeration Institute (ARI)	
ARI 310/380	Packaged Terminal Air-Conditioners and Heat Pumps
ARI 440	Room Fan-Coil and Unit Ventilator
ANSI/ARI 430-99	Central Station Air Handling Units
ARI 445	Room Air-Induction Units
ARI 880	Air Terminals
Air Movement and Control Association (AMCA)	
AMCA 210	Laboratory Methods of Testing Fans for Rating
American Architectural Manufacturers Association (AAMA)	
AAMA 605	Voluntary Specification Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels
AAMA 607.1	Voluntary Guide Specifications and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum
AAMA 1503	Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors, and Glazed Wall Sections
American Association of State Highway and Transportation Officials (AASHTO)	

	Roadside Design Guide [guardrails, roadside safety devices]
	Standard Specifications for Transportation Materials and Methods of Sampling and Testing [Road Construction Materials]
	Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals
	Guide for Design of Pavement Structures, Volumes 1 and 2 [pavement design guide]
	A Policy of Geometric Design of Highways and Streets
American Bearing Manufacturers Association (AFBMA)	
AFBMA Std. 9	Load Ratings and Fatigue Life for Ball Bearings
AFBMA Std. 11	Load Ratings and Fatigue Life for Roller Bearings
American Boiler Manufacturers Association (ABMA)	
ABMA ISEI	Industry Standards and Engineering Information
American Concrete Institute	
ACI 302.2R	Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials
ACI 318	Building Code Requirements for Structural Concrete
ACI SP-66	ACI Detailing Manual
ACI 530	Building Code Requirements for Masonry Structures
ADA Standards for Accessible Design	
See US Access Board	ADA and ABA Accessibility Guidelines for Buildings and Facilities, Chapters 3-10.
American Institute of Steel Construction (AISC)	
	Manual of Steel Construction – 13 th Edition (or latest version)

American Iron and Steel Institute	
AISI S100	North American Specification for the Design of Cold-Formed Steel Structural Members
American National Standards Institute 11 (ANSI)	
ANSI Z21.10.1	Gas Water Heaters Vol. 1, Storage water Heaters with Input Ratings of 75,000 Btu per Hour or less
ANSI Z124.3	American National Standard for Plastic Lavatories
ANSI Z124.6	Plastic Sinks
ANSI Z21.45	Flexible Connectors of Other Than All-Metal Construction for Gas Appliances
ANSI/IEEE C2	National Electrical Safety Code
ANSI/AF&PA NDS	National Design Specification for Wood Construction
American Society of Civil Engineers (ASCE)	
ASCE 7	Minimum Design Loads for Buildings and Other Structures
ASCE 37	Design and Construction of Sanitary and Storm Sewers, Manuals and Reports on Engineering Practice [sanitary sewer and storm drain design criteria]
ASCE/SEI 31-03	Seismic Evaluation of Existing Buildings [Existing Building Alteration/Renovation]
ASCE/SEI 41-06	Seismic Rehabilitation of Existing Buildings [Existing Building Alteration/Renovation]
American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)	
ASHRAE 90.1	ANSI/ASHRAE/IESNA 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings
ASHRAE Guideline 0	The Commissioning Process
ASHRAE Guideline 1.1	The HVAC Commissioning Process

ASHRAE Handbooks	Fundamentals, HVAC Applications, Systems and Equipment, Refrigeration (Applicable, except as otherwise specified)
ASHRAE Standard 15	Safety Standard for Refrigeration Systems
ASHRAE Standard 62.1	Ventilation for Acceptable Indoor Air Quality
ASHRAE Standard 55	Thermal Environmental Conditions for Human Occupancy (Design portion is applicable, except where precluded by other project requirements.)
ASHRAE Standard 189.1	Standard for the Design of High-Performance Green Buildings (ANSI Approved; USGBC and IES Co-sponsored) , - (APPLICABLE TO THE EXTENT SPECIFICALLY CALLED OUT IN THE CONTRACT)
American Society of Mechanical Engineers International (ASME)	
ASME BPVC SEC VII	Boiler and Pressure Vessel Code: Section VII Recommended Guidelines for the Care of Power Boilers
ASME A17.1	Safety Code for Elevators and Escalators
ASME B 31 (Series)	Piping Codes
American Water Works Association (AWWA)	
	Standards [standards for water line materials and construction]
American Welding Society	
	Welding Handbook
	Welding Codes and Specifications (as applicable to application, see International Building Code for example)
Architectural Woodwork Institute (AWI)	
Latest Version	AWI Quality Standards
Associated Air Balance Council (AABC)	
AABC MN-1	National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems

	AABC Associated Air Balance Council Testing and Balance Procedures
ASTM International	
ASTM C1060-90(Standard Practice for Thermographic Inspection of Insulation Installations in Envelope Cavities of Frame Buildings
ASTM E 779	Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
ASTM E1827-96	Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door
Builders Hardware Manufacturers Association (BHMA)	
ANSI/BHMA	The Various BHMA American National Standards
Building Industry Consulting Service International	
	Telecommunications Distribution Methods Manual (TDMM)
	Customer-Owned Outside Plant Design Manual (CO-OSP)
Code of Federal Regulations (CFR)	
49 CFR 192	Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards
10 CFR 430	Energy Conservation Program for Consumer Products
Consumer Electronics Association	
CEA 709.1B	Control Network Protocol Specification
CEA 709.3	Free-Topology Twisted-Pair Channel Specification
CEA 852	Tunneling Component Network Protocols Over Internet Protocol Channels
Electronic Industries Association (EIA)	
ANSI/EIA/TIA 568	Structured Cabling Series

ANSI/EIA/TIA 569	Commercial Building Standard for Telecommunications Pathways and Spaces (includes ADDENDA)
ANSI/TIA/EIA-606	Administrative Standard for the Telecommunications Infrastructure of Commercial Buildings
J-STD EIA/TIA 607	Commercial Building Grounding and Bonding Requirements for Telecommunications
Federal Highway Administration (FHWA)	
	Manual on Uniform Traffic Control Devices for Streets and Highways [signage and pavement markings for streets and highways]
FHWA-NHI-01-021	Hydraulic Engineering Circular No. 22, Second Edition, URBAN DRAINAGE DESIGN MANUAL
Illuminating Engineering Society of North America (IESNA)	
IESNA RP-1	Office Lighting
IESNA RP-8	Roadway Lighting
IESNA Lighting Handbook	Reference and Application
Institute of Electrical and Electronics Engineers Inc. (IEEE)	
	Standard for Use of the International System of Units (SI): the Modern Metric System
Standard 1100	Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
International Code Council (ICC)	
IBC	<p>International Building Code</p> <p>Note: All references in the International Building Code to the International Electrical Code shall be considered to be references to NFPA 70.</p> <p>All references in the International Building Code to the International Fuel Gas Code shall be considered to be references to NFPA 54 and NFPA 58.</p> <p>All references in the International Building Code to the International Fire</p>

	Code and Chapter 9 shall be considered to be references to Unified Facilities Criteria (UFC) 3-600-01.
IMC	International Mechanical Code – Note: For all references to “HEATING AND COOLING LOAD CALCULATIONS”, follow ASHRAE 90.1 Note: For all references to “VENTILATION”, follow ASHRAE 62.1
IRC	International Residential Code
IPC	International Plumbing Code
IEC	Energy Conservation Code (IEC) –Applicable only to the extent specifically referenced herein. Refer to Paragraph 5, ENERGY CONSERVATION requirements.
IGC	International Gas Code - not applicable. Follow NFPA 54, National Fuel Gas Code and NFPA 58, Liquefied Petroleum Gas Code.
International Organization for Standardization (ISO)	
ISO 6781:1983	Qualitative detection of thermal irregularities in building envelopes – infrared method
LonMark International (LonMark)	
LonMark Interoperability Guidelines	(available at www.lonmark.org), including: Application Layer Guidelines, Layer 1-6 Guidelines, and External Interface File (XIF) Reference Guide
LonMark Resource Files	(available at www.lonmark.org), including Standard Network Variable Type (SNVT) definitions
Metal Building Manufacturers Association (MBMA)	
	Metal Building Systems Manual
Midwest Insulation Contractors Association (MICA)	
	National Commercial and Industrial Insulation Standards Manual
National Association of Corrosion Engineers International (NACE)	

NACE RP0169	Control of External Corrosion on Underground or Submerged Metallic Piping Systems
NACE RP0185	Extruded, Polyolefin Resin Coating Systems with Adhesives for Underground or Submerged Pipe
NACE RP0285	Corrosion Control of Underground Storage Tank Systems by Cathodic Protection
NACE RP0286	Electrical Isolation of Cathodically Protected Pipelines
National Electrical Manufacturers Association (NEMA)	
National Environmental Balancing Bureau (NEBB)	
	Procedural Standards Procedural Standards for Testing Adjusting Balancing of Environmental Systems
National Fire Protection Association (NFPA)	
NFPA 10	Standard for Portable Fire Extinguishers
NFPA 13	Installation of Sprinkler Systems
NFPA 13R	Residential Occupancies up to and Including Four Stories in Height Sprinkler Systems
NFPA 14	Standard for the Installation of Standpipes and Hose Systems
NFPA 20	Installation of Centrifugal Fire Pumps
NFPA 24 NFPA 25	Standard for the Installation of Private Fire Service Mains and Their Appurtenances [underground fire protection system design] Inspection, Testing And Maintenance Of Water-Based Fire Protection Systems
NFPA 30	Flammable and Combustible Liquids Code
NFPA 30A	Motor Fuel Dispensing Facilities and Repair Garages
NFPA 31	Installation of Oil Burning Equipment
NFPA 54	National Fuel Gas Code

NFPA 58	Liquefied Petroleum Gas Code
NFPA 70	National Electrical Code
NFPA 70E	Standard for Electrical Safety in the Workplace
NFPA 72	National Fire Alarm Code
NFPA 76	Fire Protection of Telecommunications Facilities
NFPA 80	Standard for Fire Doors and Fire Windows
NFPA 90a	Installation of Air Conditioning and Ventilating Systems
NFPA 96	Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations
NFPA 101	Life Safety Code
NFPA 780	Standard for the Installation of Lightning Protection Systems
National Roofing Contractor's Association (NRCA)	
	Roofing and Waterproofing Manual
National Sanitation Foundation, International	
NSF/ANSI Std. 2, 3, 4, 5, 6, 7, 8, 12, 13, 18, 20, 21, 25, 29, 35, 36, 37, 51, 52, 59, 169	Food Equipment Standards
ANSI/UL Std. 73, 197, 471, 621, 763	Food Equipment Standards
CSA Std. C22.2 No. 109, 120, 195	Food Equipment Standards
Occupational Safety and Health Administration (OSHA)	
Title 29, Part 1926	OSHA Construction Industry Standards, Title 29, Code of Federal Regulations, Part 1926, Safety and Health Regulations for Construction

Plumbing and Drainage Institute (PDI)	
PDI G 101	Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data
PDI WH201	Water Hammer Arrestors
Precast Concrete Institute	
PCI Design Handbook	Precast and Prestressed Concrete
Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)	
SMACNA HVAC Duct Construction Standards	HVAC Duct Construction Standards - Metal and Flexible
SMACNA Architectural Manual	Architectural Sheet Metal Manual
SMACNA HVAC TAB	HVAC Systems - Testing, Adjusting and Balancing
State/Local Regulations	
	State Department of Transportation Standard Specifications for Highway and Bridge Construction
	Sedimentation and Erosion Control Design Requirements
	Environmental Control Requirements
	Storm Water Management Requirements
Steel Door Institute (SDI)	
ANSI A250.8/SDI 100	Standard Steel Doors and Frames
Steel Deck Institute	
	SDI Diaphragm Design Manual
Steel Joist Institute	
	Catalog of Standard Specifications and Load Tables for Steel Joists and

	Joist Girders
Underwriters Laboratories (UL)	
UL 96A	Installation Requirements for Lightning Protection Systems
UL 300	Standard for Safety for Fire Testing of Fire Extinguishing Systems for Protection of Restaurant Cooking Areas
UNITED STATES ACCESS BOARD: U.S. ARCHITECTURAL AND TRANSPORTATION BARRIERS COMPLIANCE BOARD	
ADA and ABA Accessibility Guidelines for Buildings and Facilities	<p>ABA Accessibility Standard for DoD Facilities</p> <p>Derived from the ADA and ABA Accessibility Guidelines: Specifically includes: ABA Chapters 1 and 2 and Chapters 3 through 10.</p> <p>Use this reference in lieu of IBC Chapter 11.</p> <p>Excluded are:</p> <p>(a) Facilities, or portions of facilities, on a military installation that are designed and constructed for use exclusively by able-bodied military personnel (See Paragraph 3 for any reference to this exclusion).</p> <p>(b) Reserve and National Guard facilities, or portions of such facilities, owned by or under the control of the Department of Defense, that are designed and constructed for use exclusively by able-bodied military personnel. (See paragraph 3 for any reference to this exclusion).</p>
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES	
	FDA National Food Code
U.S. GREEN BUILDING COUNCIL (USGBC)	
LEED-NC	Green Building Rating System for New Construction & Major Renovations
	Application Guide for Multiple Buildings and On-Campus Building Projects

4.2. MILITARY CRITERIA

The project shall conform to the following criteria. Certain design impacts and features due to these criteria are noted for the benefit of the offeror. However, all requirements of the referenced criteria will be applicable, whether noted or not, unless otherwise specified herein.

4.2.1. Energy Policy Act of 2005 (Public Law 109-58) (applies only to the extent specifically implemented in the contract, which may or may not directly cite or reference EPACT)

4.2.2. Executive Order 12770: Metric Usage In Federal Government

(a) Metric design and construction is required except when it increases construction cost. Offeror to determine most cost efficient system of measurement to be used for the project.

4.2.3. TB MED 530: Occupational and Environmental Health Food Sanitation

4.2.4. Unified Facilities Criteria (UFC) 3-410-01FA: Heating, Ventilating, and Air Conditioning - applicable only to the extent specified in paragraph 5, herein.

4.2.5. Deleted.

4.2.6. UFC 3-600-01 Design: Fire Protection Engineering for Facilities. Use the latest edition of the IBC in coordination with this UFC. Use Chapters 3, 6, 7, 33 and UFC 3-600-01. If any conflict occurs between these Chapters and UFC 3-600-01, the requirements of UFC 3-600-01 take precedence. Use UFC 3-600-01 in lieu of IBC Chapters 4, 8,9,10.

4.2.7. UFC 4-010-01 DoD Minimum Antiterrorism Standards for Buildings

4.2.8. UFC 4-023-03 Design of Buildings to Resist Progressive Collapse (Use most recent version, regardless of references thereto in other publications)

(a) Note the option to use tie force method or alternate path design for Occupancy Category II.

4.2.9. UFC 4-021-01 Design and O&M: Mass Notification Systems

4.2.10. Technical Criteria for Installation Information Infrastructure Architecture (I3A)

(a) Email: DetrickISECI3Aguide@conus.army.mil

4.2.11. U.S. Army Information Systems Engineering Command (USAISEC) SECRET Internet Protocol (IP) Router Network (SIPRNET) Technical Implementation Criteria (STIC).. See Paragraph 3 for applicability to specific facility type. May not apply to every facility. This is mandatory criteria for those facilities with SIPRNET.

4.2.11.1. Draft Guide Specification for Section 27 05 28 PROTECTIVE DISTRIBUTION SYSTEM (PDS) FOR SIPRNET COMMUNICATIONS SYSTEMS, found at http://mrsi.usace.army.mil/rfp/Shared%20Documents/SECTION_270528-v3.pdf

5.0 GENERAL TECHNICAL REQUIREMENTS

This paragraph contains technical requirements with general applicability to Army facilities. See also Paragraph 3 for facility type-specific operational, functional and technical requirements. Residential or similar grade finishes and materials are not acceptable for inclusion in these buildings, unless otherwise specifically allowed.

5.1. SITE PLANNING AND DESIGN

5.1.1. STANDARDS AND CODES: The site planning and design shall conform to APPLICABLE CRITERIA and to paragraph 6, PROJECT SPECIFIC REQUIREMENTS.

5.1.2. SITE PLANNING OBJECTIVES: Group buildings in configurations that create a sense of community and promote pedestrian use. See paragraph 3 for additional site planning requirements relating to building functions.

5.1.2.1. Provide enclosures and or visual screening devices for Outdoor Utility such as dumpsters, emergency generators, transformers, heating, ventilation, and air conditioning units from streetscape and courtyard views to limit visual impact. Enclosures shall be compatible with the building they serve and accessible by vehicle. The location of dumpsters can have a significant visual impact and should be addressed as part of an overall building design and incorporated in site planning.

5.1.2.2. Where included in the project, dumpster pads shall be concrete (minimum of 8 inches thick on 4 inch base course, unless site conditions dictate more conservative requirements) and directly accessible by way of a paved service drive or parking lot with adequate overhead clearance for collection vehicles. Provide space at dumpster areas for recycling receptacles. Coordinate with Installation on recycling receptacle types, sizes and access requirements and provide space at dumpster areas to accommodate them.

5.1.2.3. Vehicular Circulation. Apply design vehicle templates provided by the American Association of State Highway and Transportation Officials (AASHTO) to the site design. The passenger car class includes passenger cars and light trucks, such as vans and pick-ups. The passenger car template is equivalent to the non-organizational – privately owned vehicle (POV). The truck class template includes single-unit trucks, recreation vehicles, buses, truck tractor-semi-trailer combinations, and trucks or truck tractors with semi-trailers in combination with full trailers. Provide vehicle clearances required to meet traffic safety for emergency vehicles, service vehicles, and moving vans. Provide required traffic control signage Site entrances and site drive aisles shall maximize spacing between drives, incorporate right-angle turns, and limit points of conflict between traffic. Design Services Drives to restrict access to unauthorized vehicles by removable bollards, gates, or other barriers to meet Anti-Terrorism/Force Protection (ATFP) requirements. Orient service drives to building entrances other than the primary pedestrian entry at the front of the building.

5.1.2.4. Provide Emergency Vehicle Access around the facility and shall be in accordance with AT/FP requirements. Maintain a 33-foot clear zone buffer for emergency vehicles, designed to prevent other vehicles from entering the AT/FP standoff to the building.

5.1.2.5. Clear and grub all trees and vegetation necessary for construction; but, save as many trees as possible. Protect trees to be saved during the construction process from equipment.

5.1.2.6. Stormwater Management. Employ design and construction strategies (Best Management Practices) that reduce stormwater runoff, reduce discharges of polluted water offsite and maintain or restore predevelopment hydrology with respect to temperature, rate, volume and duration of flow to the maximum extent practicable. See paragraph 6, PROJECT SPECIFIC requirements for additional information.

5.1.3. EXTERIOR SIGNAGE: Provide exterior signage in accordance with Appendix H, Exterior Signage. Provide exterior NO SMOKING signage that conveys building and grounds smoking policy.

5.1.4. EXISTING UTILITIES: Base utilities maps and capacities for this site are included as part of this RFP. See paragraph 6 for more detailed information.

5.2. SITE ENGINEERING

5.2.1. STANDARDS AND CODES: The site engineering shall conform to APPLICABLE CRITERIA.

5.2.2. SOILS:

5.2.2.1. A report has been prepared to characterize the subsurface conditions at the project site and is **appended to these specifications**. The report provides a general overview of the soil and geologic conditions with detailed descriptions at discrete boring locations. The Contractor's team shall include a licensed geotechnical engineer to interpret the report and develop earthwork and foundation recommendations and design parameters in which to base the contractor's design. If any additional subsurface investigation or laboratory analysis is required to better characterize the site or develop the final design, the Contractor shall perform it under the direction of a licensed geotechnical engineer. There will be no separate payment for the cost of additional tests. If differences between the Contractor's additional subsurface investigation and the government provided soils report or the reasonably expected conditions require material revisions in the design, an equitable adjustment may be made, in accordance with the provisions of the Differing Site Conditions clause. The basis for the adjustment would be the design and construction appropriate for the conditions described in the Government furnished report or the reasonably expected conditions, in comparison with any changes required by material differences in the actual conditions encountered, in accordance with the terms of contract clause Differing Site Conditions.

5.2.2.2. The contractor's licensed geotechnical engineer shall prepare a final geotechnical evaluation report, to be submitted along with the first foundation design submittal, as described in Section 01 33 16, *Design After Award*.

5.2.3. VEHICLE PAVEMENTS: (as applicable to the project)

5.2.3.1. Design procedures and materials shall conform to one of the following: 1) the USACE Pavement Transportation Computer Assisted Structural Engineering (PCASE) program, 2) American Association of State Highway and Transportation Officials (AASHTO) or, 3) the applicable state Department of Transportation standards in which the project is located. See paragraph 5.2.2.2 and Section 01 33 16 for required information for the Contractor's geotechnical evaluation report. The minimum flexible pavement section shall consist of 2 inches of asphalt and 6 inches of base or as required by the pavement design, whichever is greater, unless specifically identified by the Government to be a gravel road. Design roads and parking areas for a life expectancy of 25 years with normal maintenance. Parking area for tactical vehicles (as applicable to the project) shall be Portland Cement Concrete (PCC) rigid pavement design. For concrete pavements, submit joint layout plan for review and concurrence. Design pavements for military tracked vehicles (as applicable to the project) IAW USACE PCASE. Traffic estimates for each roadway area will be as shown on the drawings or listed in Section 01 10 00 Paragraph 6.4.4. Pavement markings and traffic signage shall comply with the Installation requirements and with the Manual on Uniform Traffic Control Devices.

5.2.3.2. Parking Requirements.

(a) All handicap POV parking lots (where applicable in the facility specific requirements) shall meet the ADA and ABA Accessibility Guidelines for accessible parking spaces.

(b) Design POV parking spaces for the type of vehicles anticipated, but shall be a minimum of 9 ft by 18 ft for POVs, except for two wheel vehicles.

5.2.3.3. Sidewalks. Design the network of walks throughout the complex (where applicable) to facilitate pedestrian traffic among facilities, and minimize the need to use vehicles. Incorporate sidewalks to enhance the appearance of the site development, while creating a sense of entry at the primary patron entrances to the buildings. Minimum sidewalk requirements are in Paragraph 3, where applicable and/or paragraph 6 and/or site plans, where applicable..

5.2.4. CATHODIC PROTECTION: Provide cathodic protection systems for all underground metallic systems and metallic fittings/portions of non-metallic, underground systems, both inside and outside the building 5 foot line that are subject to corrosion. Coordinate final solutions with the installation to insure an approach that is consistent with installation cathodic protection programs.

5.2.5. UTILITIES: See paragraph 6.4.6 for specific information on ownership of utilities and utility requirements. Meter all utilities (gas, water, and electric, as applicable) to each facility. For Government owned utilities, install meters that are wireless data transmission capable as well as have a continuous manual reading option. All meters will be capable of at least hourly data logging and transmission and provide consumption data for gas, water, and electricity. Gas and electric meters will also provide demand readings based on consumption over a maximum of any 15 minute period. Configure all meters to transmit at least daily even if no receiver for the data is currently available at the time of project acceptance. For privatized utilities, coordinate with the privatization utility(ies) for the proper meter base and meter installation.

5.2.6. PERMITS: The CONTRACTOR shall be responsible for obtaining all permits (local, state and federal) required for design and construction of all site features and utilities.

5.2.7. IRRIGATION. Landscape irrigation systems, if provided, shall comply with the following:

5.2.7.1. Irrigation Potable Water Use Reduction. Reduce irrigation potable water use by 100 percent using LEED credit WE1.1 baseline (no potable water used for irrigation), except where precluded by other project requirements.

5.2.8. EPA WATERSENSE PRODUCTS AND CONTRACTORS. Except where precluded by other project requirements, use EPA WaterSense labeled products and irrigation contractors that are certified through a WaterSense labeled program where available.

5.3. ARCHITECTURE AND INTERIOR DESIGN:

This element will be evaluated per APPLICABLE CRITERIA under the quality focus.

5.3.1. STANDARDS AND CODES: The architecture and interior design shall conform to APPLICABLE CRITERIA.

5.3.2. GENERAL: Overall architectural goal is to provide a functional, quality, visually appealing facility that is a source of pride for the installation and delivered within the available budget and schedule.

5.3.3. COMPUTATION OF AREAS: See APPENDIX Q for how to compute gross and net areas of the facility(ies).

5.3.4. BUILDING EXTERIOR: Design buildings to enhance or compliment the visual environment of the Installation. Where appropriate, reflect a human scale to the facility. Building entrance should be architecturally defined and easily seen. When practical, exterior materials, roof forms, and detailing shall be compatible with the surrounding development and adjacent buildings on the Installation and follow locally established architectural themes. Use durable materials that are easy to maintain. Exterior colors shall conform to the Installation requirements. See paragraph 6.

5.3.4.1. Building Numbers: Permanently attach exterior signage on two faces of each building indicating the assigned building number or address. Building number signage details and locations shall conform to Appendix H, Exterior Signage.

5.3.5. BUILDING INTERIOR

5.3.5.1. Space Configuration: Arrange spaces in an efficient and functional manner in accordance with area adjacency matrices.

5.3.5.2. Surfaces: Appearance retention is the top priority for building and furniture related finishes. Provide low maintenance, easily cleaned room finishes that are commercially standard for the facility occupancy specified, unless noted otherwise.

5.3.5.3. Color: The color, texture and pattern selections for the finishes of the building shall provide an aesthetically pleasing, comfortable, easily maintainable and functional environment for the occupants. Coordinate the building colors and finishes for a cohesive design. Select colors appropriate for the building type. Use color, texture and pattern to path or way find through the building. Trendy colors that will become dated shall be limited to non-permanent finishes such as carpet and paint. Select finishes with regards to aesthetics, maintenance, durability, life safety and image. Limit the number of similar colors for each material. Use medium range colors for ceramic and porcelain tile grout to help hide soiling. Plastic laminate and solid surface materials shall have patterns that are mottled, flecked or speckled. Coordinate finish colors of fire extinguisher cabinets, receptacle bodies and plates, fire alarms / warning lights, emergency lighting, and other miscellaneous items with the building interior. Match color of equipment items on ceilings (speakers, smoke detectors, grills, etc.) the ceiling color.

5.3.5.4. Circulation: Circulation schemes must support easy way finding within the building.

5.3.5.5. Signage: Provide interior signage for overall way finding and life safety requirements. A comprehensive interior plan shall be from one manufacturer. Include the following sign types: (1) Lobby Directory, (2) Directional Signs; (3) Room Identification Signs; (4) Building Service Signs; (5) Regulatory Signs; (6) Official and Unofficial Signs (7) Visual Communication Boards (8) NO SMOKING signage that conveys building smoking policy. Use of emblems or logos may also be incorporated into the signage plan.

5.3.5.6. Window Treatment: Provide interior window treatments with adjustable control in all exterior window locations for control of day light coming in windows or privacy at night. Maintain uniformity of treatment color and material to the maximum extent possible within a building.

5.3.5.7. Casework: Unless, otherwise specified, all casework for Cabinetry and cases shall be "custom grade", as described in the AWI Quality Standards.

5.3.6. COMPREHENSIVE INTERIOR DESIGN

5.3.6.1. Comprehensive Interior Design includes the integration of a Structural Interior Design (SID) and a Furniture, Fixtures and Equipment (FF&E) design and package. SID requires the design, selection and coordination of interior finish materials that are integral to or attached to the building structure. Completion of a SID involves the selection and specification of applied finishes for the building's interior features including, but not limited to, walls, floors, ceilings, trims, doors, windows, window treatments, built-in furnishings and installed equipment, lighting, and signage. The SID package includes finish schedules, finish samples and any supporting interior elevations, details or plans necessary to communicate the building finish design and build out. The SID also provides basic space planning for the anticipated FF&E requirements in conjunction with the functional layout of the building and design issues such as life safety, privacy, acoustics, lighting, ventilation, and accessibility. See Section 01 33 16 for SID design procedures.

5.3.6.2. The FF&E design and package includes the design, selection, color coordination and of the required furnishing items necessary to meet the functional, operational, sustainability, and aesthetic needs of the facility coordinated with the interior finish materials in the SID. The FF&E package includes the specification, procurement documentation, placement plans, ordering and finish information on all freestanding furnishings and accessories, and a cost estimate. Coordinate the selection of furniture style, function and configuration with the defined requirements. Examples of FF&E items include, but are not limited to workstations, seating, files, tables, beds, wardrobes, draperies and accessories as well as marker boards, tack boards, and presentation screens. Criteria for furniture selection include function and ergonomics, maintenance, durability, sustainability, comfort and cost. See Section 01 33 16 for FFE design procedures.

5.4. STRUCTURAL DESIGN

5.4.1. STANDARDS AND CODES: The structural design shall conform to APPLICABLE CRITERIA.

5.4.2. GENERAL: The structural system must be compatible with the intended functions and components that allows for future flexibility and reconfigurations of the interior space. Do not locate columns, for instance, in rooms requiring visibility, circulation or open space, including, but not limited to entries, hallways, common areas, classrooms, etc. Select an economical structural system based upon facility size, projected load requirements and local availability of materials and labor. Base the structural design on accurate, site specific geotechnical information and anticipated loads for the building types and geographical location. Consider climate conditions, high humidity, industrial atmosphere, saltwater exposure, or other adverse conditions when selecting the type of cement and admixtures used in concrete, the concrete cover on reinforcing steel, the coatings on structural members, expansion joints, the level of corrosion protection, and the structural systems. Analyze, design and detail each building as a complete structural system. Design structural elements to preclude damage to finishes, partitions and other frangible, non-structural elements to prevent impaired operability of moveable components; and to prevent cladding leakage and roof ponding. Limit deflections of structural members to the allowable of the applicable material standard, e.g., ACI, AISC, Brick Industry Association, etc. When modular units or other pre-fabricated construction is used or combined with stick-built construction, fully coordinate and integrate the overall structural design between the two different or interfacing construction types. If the state that the project is located in requires separate, specific licensing for structural engineers (for instance, such as in Florida, California and others), then the structural engineer designer of record must be registered in that state.

5.4.3. LOADS: See paragraph 3 for facility specific (if applicable) and paragraph 6 for site and project specific structural loading criteria. Unless otherwise specified in paragraph 6, use Exposure Category C for wind. If not specified, use Category C unless the Designer of Record can satisfactorily justify another Exposure Category in its design analysis based on the facility Master Plan. Submit such exceptions for approval as early as possible and prior to the Interim Design Submittal in Section "Design After Award". Design the ancillary building items, e.g. doors, window jambs and connections, overhead architectural features, systems and equipment bracing, ducting, piping, etc. for gravity, seismic, lateral loads and for the requirements of UFC 4-010-01, DOD Minimum Antiterrorism Standards for Buildings. Ensure and document that the design of glazed items includes, but is not limited to, the following items under the design loads prescribed in UFC 4-010-01:

- (a) Supporting members of glazed elements, e.g. window jamb, sill, header
- (b) Connections of glazed element to supporting members, e.g. window to header
- (c) Connections of supporting members to each other, e.g. header to jamb
- (d) Connections of supporting members to structural system, e.g. jamb to foundation.

5.4.4. TERMITE TREATMENT: (Except Alaska) Provide termite prevention treatment in accordance with Installation and local building code requirements, using licensed chemicals and licensed applicator firm.

5.5. THERMAL PERFORMANCE

5.5.1. STANDARDS AND CODES: Building construction and thermal insulation for mechanical systems shall conform to APPLICABLE CRITERIA.

5.5.2. BUILDING ENVELOPE SEALING PERFORMANCE REQUIREMENT. Design and construct the building envelope for office buildings, office portions of mixed office and open space (e.g., company operations facilities), dining, barracks and instructional/training facilities with a continuous air barrier to control air leakage into, or out of, the conditioned space. Clearly identify all air barrier components of each envelope assembly on construction documents and detail the joints, interconnections and penetrations of the air barrier components. Clearly identify the boundary limits of the building air barriers, and of the zone or zones to be tested for building air tightness on the drawings. The use of painted interior walls is not an acceptable air barrier method.

5.5.2.1. Trace a continuous plane of air-tightness throughout the building envelope and make flexible and seal all moving joints.

5.5.2.2. The air barrier material(s) must have an air permeance not to exceed 0.004 cfm / sf at 0.3" wg (0.02 L/s.m² @ 75 Pa) when tested in accordance with ASTM E 2178

5.5.2.3. Join and seal the air barrier material of each assembly in a flexible manner to the air barrier material of adjacent assemblies, allowing for the relative movement of these assemblies and components.

5.5.2.4. Support the air barrier so as to withstand the maximum positive and negative air pressure to be placed on the building without displacement, or damage, and transfer the load to the structure.

5.5.2.5. Seal all penetrations of the air barrier. If any unavoidable penetrations of the air barrier by electrical boxes, plumbing fixture boxes, and other assemblies are not airtight, make them airtight by sealing the assembly and the interface between the assembly and the air barrier or by extending the air barrier over the assembly.

5.5.2.6. The air barrier must be durable to last the anticipated service life of the assembly.

5.5.2.7. Do not install lighting fixtures with ventilation holes through the air barrier

5.5.2.8. Provide a motorized damper in the closed position and connected to the fire alarm system to open on call and fail in the open position for any fixed open louvers at elevator shafts. Coordinate the motorized elevator hoistway vent damper(s) with the Fire Protection System design in paragraph 5.10. Ensure that the damper(s) is accessible to facilitate regular inspection and maintenance.

5.5.2.9. Damper and control to close all ventilation or make-up air intakes and exhausts, , etc., when leakage can occur during inactive periods. Atrium smoke exhaust and intakes shall only open when activated per IBC and other applicable Fire Code requirements.

5.5.2.10. If garages under buildings are applicable, compartmentalize garages by providing airtight vestibules at building access points.

5.5.2.11. Compartmentalize spaces under negative pressure such as boiler rooms and provide make-up air for combustion.

5.5.2.12. Performance Criteria and Substantiation: Submit the qualifications and experience of the testing entity for approval. Demonstrate performance of the continuous air barrier for the opaque building envelope by the following tests:

- (a) Develop an Air Barrier Quality Control plan to assure that a competent air barrier inspector/specialist inspects the critical components prior to them being concealed. At a minimum, three onsite inspections are required during construction to assure the completeness of the construction and design.
- (b) Test the completed building and demonstrate that the air leakage rate of the building envelope does not exceed 0.25cfm/ft² at a pressure differential of 0.3" w.g.(75 Pa) in accordance with ASTM's E 779 (2003) or E-1827-96 (2002). Accomplish tests using both pressurization and depressurization.. Divide the volume of air leakage in cfm @ 0.3" w.g. (L/s @ 75 Pa) by the area of the pressure boundary of the building, including roof or ceiling, walls and floor to produce the air leakage rate in cfm/ft² @ 0.3" w.g. (L/s.m² @ 75 Pa). Do not test the building until verifying that the continuous air barrier is in place and installed without failures in accordance with installation instructions so that repairs to the continuous air barrier, if needed to comply with the required air leakage rate, can be done in a timely manner.
- (c) Test the completed building using Infrared Thermography testing. Use infrared cameras with a resolution of 0.1deg C or better. Perform testing on the building envelope in accordance with ISO 6781:1983 and ASTM C1060-90(1997). Determine air leakage pathways using ASTM E 1186-03 Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems, and perform corrective work as necessary to achieve the whole building air leakage rate specified in (a) above.
- (d) Notify the Government at least three working days prior to the tests to provide the Government the opportunity to witness the tests. Provide the Government written test results confirming the results of all tests.

5.6. PLUMBING

5.6.1. STANDARDS AND CODES: The plumbing system shall conform to APPLICABLE CRITERIA.

5.6.2. PRECAUTIONS FOR EXPANSIVE SOILS: Where expansive soils are present, include design features for underslab piping systems and underground piping serving chillers, cooling towers, etc, to control forces resulting from soil heave. Some possible solutions include, but are not necessarily limited to, features such as flexible expansion joints, slip joints, horizontal offsets with ball joints, or multiple bell and spigot gasketed fittings. For structurally supported slabs, suspend piping from the structure with adequate space provided below the pipe for the anticipated soil movement.

5.6.3. HOT WATER SYSTEMS: For Hot Water heating and supply, provide a minimum temp of 140 Deg F in the storage tank and a maximum of 110 Deg F at the fixture, unless specific appliances or equipment specifically require higher temperature water supply.

5.6.4. SIZING HOT WATER SYSTEMS: Unless otherwise specified or directed in paragraph 3, design in accordance with ASHRAE Handbook Series (appropriate Chapters), ASHRAE Standard 90.1, and the energy conservation requirements of the contract. Size and place equipment so that it is easily accessible and removable for repair or replacement.

5.6.5. JANITOR CLOSETS: In janitor spaces/room/closets, provide at minimum, a service sink with heavy duty shelf and wall hung mop and broom rack(s).

5.6.6. FLOOR DRAINS: As a minimum, provide floor drains in mechanical rooms and areas, janitor spaces/rooms/closets and any other area that requires drainage from fixtures or equipment, drain downs, condensate, as necessary.

5.6.7. URINALS: Urinals shall be water-use type, conforming to ASHRAE Standard 189.1 (0.5 gpf/1.9 lpf).

5.6.8. BUILDING WATER USE REDUCTION. Reduce building potable water use in each building 30 percent from the Baseline, using the Manufacturing Performance Requirements for .Plumbing Fixtures

from the Energy Policy Act of 1992 (Public Law 102-486), except as modified by LEED. See Appendix S. Public lavatory faucets shall deliver a maximum flow rate of 0.5 gallons per minute, when tested in accordance with ASME A 112.18/CSA B125 and use that flowrate as the Baseline figure for calculating the 30 percent reduction requirement from the Baseline.

5.6.9. Do not use engineered vent or Sovent® type drainage systems.

5.6.10. Where the seasonal design temperature of the cold water entering a building is below the seasonal design dew point of the indoor ambient air, and where condensate drip will cause damage or create a hazard, insulate plumbing piping with a vapor barrier type of insulation to prevent condensation. Do not locate water or drainage piping over electrical wiring or equipment unless adequate protection against water (including condensation) damage is provided. Insulation alone is not adequate protection against condensation. Follow ASHRAE Fundamentals Chapter 23, Insulation for Mechanical Systems, IMC paragraph 1107 and International Energy Conservation Code for pipe insulation requirements.

5.6.11. Cover all drain, waste and vent piping to prevent mortar or other debris from being flushed down and blocking pipes during such construction activities.

5.7. ELECTRICAL AND TELECOMMUNICATIONS SYSTEMS

5.7.1. STANDARDS AND CODES: The electrical systems for all facilities shall conform to APPLICABLE CRITERIA.

5.7.2. MATERIALS AND EQUIPMENT: Materials, equipment and devices shall, as a minimum, meet the requirements of Underwriters Laboratories (UL) where UL standards are established for those items. Wiring for branch circuits shall be copper. Motors larger than one-half horsepower shall be three phase. All electrical systems shall be pre-wired and fully operational unless otherwise indicated. Wall mounted electrical devices (power receptacles, communication outlets and CATV outlets) shall have matching colors, mounting heights and faceplates.

5.7.3. POWER SERVICE: Primary service from the base electrical distribution system to the pad-mounted transformer and secondary service from the transformer to the building service electrical equipment room shall be underground. See paragraph 6 for additional site electrical requirements.

5.7.3.1. Spare Capacity: Provide 10% space for future circuit breakers in all panelboards serving residential areas of buildings and 15% spaces in all other panelboards.

5.7.4. TELECOMMUNICATION SERVICE: Connect the project's facilities to the Installation telecommunications (voice and data) system through the outside plant (OSP) telecommunications underground infrastructure cabling system per the I3A Criteria. Connect to the OSP cabling system from each facility main cross connect located in the telecommunications room.

5.7.5. LIGHTING: Comply with the recommendations of the Illumination Engineering Society of North America (IESNA), the National Energy Policy Act and Energy Star requirements for lighting products..

5.7.5.1. Interior Lighting:

(a) Reflective Surfaces: Coordinate interior architectural space surfaces and colors with the lighting systems to provide the most energy-efficient workable combinations.

(b) High Efficiency Fluorescent Lighting: Utilize NEMA premium electronic ballasts and energy efficient fluorescent lamps with a Correlated Color Temperature (CCT) of 4100K. Linear fluorescent and compact fluorescent fixtures shall have a Color Rendering Index of (CRI) of 87 or higher. Fluorescent lamps shall be the low mercury type qualifying as non-hazardous waste upon disposal. Do not use surface mounted fixtures on acoustical tile ceilings. Provide an un-switched fixture with emergency ballast at each entrance to the building.

- (c) Solid State Lighting: Fixtures shall provide lighting with a minimum Correlated Color Temperature (CCT) of 4100K and shall have a Color Rendering Index of (CRI) of 75 or higher. Verify performance of the light producing solid state components by a test report in compliance with the requirements of IESNA LM 80. Verify performance of the solid state light fixtures by a test report in compliance with the requirements of IESNA LM 79. Provide lab results by a NVLAP certified laboratory. The light producing solid state components and drivers shall have a life expectancy of 50,000 operating hours while maintaining at least 70% of original illumination level. Provide a complete five year warranty for fixtures.
- (d) Metal Halide Lighting (where applicable): Metal Halide lamp fixtures in the range of 150-500 Watts shall be pulse start type and have a minimum efficiency rating of 88%.
- (e) Lighting Controls: ANSI/ASHRAE/IESNA 90.1 has specific lighting controls requirements. See Also Appendix T, Functional Area Lighting Control Strategy.
- (f) Exterior Lighting: See paragraph 6.9 for site specific information, if any, on exterior lighting systems. Minimize light pollution and light trespass by not over lighting and use cut-off type exterior luminaires.

5.7.6. TELECOMMUNICATION SYSTEM: Building telecommunications cabling systems (BCS) and OSP telecommunications cabling system shall conform to APPLICABLE CRITERIA, including but not limited to I3A Technical Criteria. An acceptable BCS encompasses, but is not limited to, copper and fiber optic (FO) entrance cable, termination equipment, copper and fiber backbone cable, copper and fiber horizontal distribution cable, workstation outlets, racks, cable management, patch panels, cable tray, cable ladder, conduits, grounding, and labeling.. Items included under OSP infrastructure encompass, but are not limited to, manhole and duct infrastructure, copper cable, fiber optic cable, cross connects, terminations, cable vaults, and copper and FO entrance cable.

5.7.6.1. Design, install, label and test all telecommunications systems in accordance with the I3A Criteria and ANSI/TIA/EIA 568, 569, and 606 standards. A Building Industry Consulting Services International (BICSI) Registered Communications Distribution Designer (RCDD) with at least 2 yrs related experience shall develop and stamp telecommunications design, and prepare the test plan. See paragraph 5.8.2.5 for design of environmental systems for Telecommunications Rooms.

5.7.6.2. The installers assigned to the installation of the telecommunications system or any of its components shall be regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. Key personnel; i.e., supervisors and lead installers assigned to the installation of this system or any of its components shall be BICSI Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification for each of the key personnel. In lieu of BICSI certification, supervisors and installers shall have a minimum of 5 years experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products.

5.7.6.3. Perform a comprehensive end to end test of all circuits to include all copper and fiber optic cables upon completion of the BCS and prior to acceptance of the facility. Provide adequate advanced notification to the COR to allow COR and Installation personnel attendance The BCS circuits include but are not limited to all copper and fiber optic(FO) entrance cables, termination equipment, copper and fiber backbone cable, copper and fiber horizontal distribution cable, and workstation outlets. Test in accordance with ANSI/EIA/TIA 568 standards. Use test instrumentation that meets or exceeds the standard. Submit the official test report to include test procedures, parameters tested, values, discrepancies and corrective actions in electronic format. Test and accomplish all necessary corrective actions to ensure that the government receives a fully operational, standards based, code compliant telecommunications system.

5.7.7. LIGHTNING PROTECTION SYSTEM: Provide a lightning protection system where recommended by the Lightning Risk Assessment of NFPA 780, Annex L.

5.8. HEATING, VENTILATING, AND AIR CONDITIONING

5.8.1. STANDARDS AND CODES: The HVAC system shall conform to APPLICABLE CRITERIA.

5.8.2. DESIGN CONDITIONS.

5.8.2.1. Outdoor and indoor design conditions shall be in accordance with UFC 3-410-01FA. Outdoor air and exhaust ventilation requirements for indoor air quality shall be in accordance with ASHRAE 62.1. All Buildings with minimum LEED Silver requirement (or better) will earn LEED Credit EQ 7.1, Thermal Comfort-Design., except where precluded by other project requirements. Where the contract specifies indoor design temperature , airflow, humidity conditions, etc., use those parameters.

5.8.2.2. High Humidity Areas: Design HVAC systems in geographical areas meeting the definition for high humidity in UFC 3-410-01FA to comply with the special criteria therein for humid areas.

5.8.2.3. Cooling equipment may be oversized by up to 15 percent to account for recovery from night setback. Heating equipment may be oversized by up to 30 percent to account for recovery from night setback. Design single zone systems and multi-zone systems to maintain an indoor design condition of 50% relative humidity for cooling only. For heating only where the indoor relative humidity is expected to fall below 20% for extended periods, add humidification to increase the indoor relative humidity to 30%. Provide ventilation air from a separate dedicated air handling unit (DOAU) for facilities using multiple single zone fan-coil type HVAC systems. Do not condition outside air through fan coil units. In Air handlers that handle outdoor air and have fans that run continuously during the occupied mode, direct expansion cooling coils may be used only if the controls and compressor technology is provided that allows the compressor to operate down to 10% of full load without utilizing hot gas bypass to minimize the potential of delivering unconditioned outdoor air to the space.

5.8.2.4. Locate all equipment so that service, adjustment and replacement of controls or internal components are readily accessible for easy maintenance.

5.8.2.5. Environmental Requirements for Telecommunications Rooms and Telecommunications Equipment Rooms, (including SIPRNET ROOMS, where applicable for specific facility type). Comply with ANSI/EIA/TIA 569 (including applicable Addenda). Maintain environmental conditions at the Class 1 and 2 Recommended Operating Environment. Before being introduced into the room, filter and pre-condition outside air to remove particles with the minimum MERV filtration quality shown in the ASHRAE HVAC Applications, Chapter 17. Maintain rooms under positive pressure relative to surrounding spaces. Design computer room air conditioning units specifically for telecommunications room applications. Build and test units in accordance with the requirements of ANSI/ASHRAE Standard 127. A complete air handling system shall provide ventilation, air filtration, cooling and dehumidification, humidification (as determined during the design phase), and heating. The system shall be independent of other facility HVAC systems and shall be required year round.

5.8.2.6. Fire dampers: dynamic type with a dynamic rating suitable for the maximum air velocity and pressure differential to which the damper is subjected. Test each fire damper with the air handling and distribution system running.

5.8.3. BUILDING AUTOMATION SYSTEM. Provide a Building Automation System (BAS), consisting of a building control network , a Utility Monitoring and Control System (UMCS) , and integrate the building control network into the UMCS as specified.

The building control network shall be a single complete non-proprietary Direct Digital Control (DDC) system for control of all the heating, ventilating and air conditioning (HVAC) systems and for control of other building systems. The building control network shall be an Open implementation of LONWORKS® technology using ANSI/EIA 709.1B as the only communications protocol and use only LonMark Standard

Network Variable Types (SNVTs), as defined in the LonMark® Resource Files, for communication between DDC Hardware devices to allow multi-vendor interoperability.

The UMCS shall use the IP network to perform supervisory control and monitoring of a ANSI/CEA-709.1B (LonWorks) network using LonWorks Network Services (LNS). The UMCS shall communicate with building control systems using ANSI/CEA-852 only.

5.8.3.1. The building automation system shall be open in that it is designed and installed such that the Government or its agents are able to perform repair, replacement, upgrades, and expansions of the system without further dependence on the original Contractor. This includes, but is not limited to the following:

- (a) Install hardware such that individual control equipment can be replaced by similar control equipment from other equipment manufacturers with no loss of system functionality.
- (b) Necessary documentation (including rights to documentation and data), configuration information, configuration tools, programs, drivers, and other software shall be licensed to and otherwise remain with the Government such that the Government or its agents are able to perform repair, replacement, upgrades, and expansions of the system without subsequent or future dependence on the Contractor.

5.8.3.2. All DDC Hardware shall:

- (a) Be connected to a TP/FT-10 ANSI/EIA 709.3 control network.
- (b) Communicate over the control network via ANSI/EIA 709.1B exclusively.
- (c) Communicate with other DDC hardware using only SNVTs
- (d) Conform to the LonMark® Interoperability Guidelines.
- (e) Be locally powered; link power (over the control network) is not acceptable.
- (f) Be fully configurable via standard or user-defined configuration parameter types (SCPT or UCPT), standard network variable type (SNVT) network configuration inputs (*nci*), or hardware settings on the controller itself to support the application. All settings and parameters used by the application shall be configurable via standard or user-defined configuration parameter types (SCPT or UCPT), standard network variable type (SNVT) network configuration inputs (*nci*), or hardware settings on the controller itself
- (g) Provide input and output SNVTs required to support monitoring and control (including but not limited to scheduling, alarming, trending and overrides) of the application. Required SNVTs include but are not limited to: SNVT outputs for all hardware I/O, SNVT outputs for all setpoints and SNVT inputs for override of setpoints.
- (h) To the greatest extent practical, not rely on the control network to perform the application.
- (i) Provide on board nonvolatile memory for devices accumulating energy consumption.

5.8.3.3. Controllers shall be Application Specific Controllers whenever an ASC suitable for the application exists. When an ASC suitable for the application does not exist use programmable controllers or multiple application specific controllers.

5.8.3.4. Application Specific Controllers shall be LonMark Certified whenever a LonMark Certified ASC suitable for the application exists. For example, VAV controllers must be LonMark certified.

5.8.3.5. Application Specific Controllers (ASCs) shall be configurable via an LNS plug-in whenever t an ASC with an LNS plug-in suitable for the application exists.

5.8.3.6. Each scheduled system shall accept a network variable of type SNVT_occupancy and shall use this network variable to determine the occupancy mode. If the system has not received a value to this network variable for more than 60 minutes it shall default to a configured occupancy schedule.

5.8.3.7. Gateways may be used provided that each gateway communicates with and performs protocol translation for control hardware controlling one and only one package unit.

5.8.3.8. Provide a supervisory "Utility Monitoring and Control System" (UMCS) which meets the following requirements:

- (a) The UMCS shall perform supervisory control and monitoring of a base-wide ANSI/CEA-709.1B (LonWorks) network using LonWorks Network Services (LNS).
- (b) The UMCS shall be DIACAP certified have a Certificate of Worthiness and shall use the installation's basewide IP network to provide connectivity between building control systems. DIACAP, Worthiness and access to the IP network shall be coordinated with the installation's IT organization (NEC) and the DPW.
- (c) The UMCS monitoring and control (M&C) software shall be a LonWorks Network Services (LNS)-compatible client-server software package that performs supervisory monitoring and control functions including but not limited to Scheduling, Alarm Handling, Alarm Generation, Trending, Report Generation and Electrical Peak Demand Limiting. The software shall be expandable in both number of points and number of clients supported in order to support system expansion. The M&C Software may include drivers to other (non-ANSI/CEA-709.1B) protocols.
- (d) The software shall be capable of scheduling SNVTs such that it can change the value of a SNVT according to an internal schedule.
- (e) The software shall be capable of handling alarms by providing an alarm notification via a pop-up to a user display, printing to a printer, sending an email and sending a numeric page.
- (f) The system shall include a web based Graphical User Interface which allows for hierarchical graphical navigation between systems, graphical representations of systems, access to real-time data for systems, ability to override points in a system, and access to all supervisory monitoring and control functions. Each system display shall clearly distinguish between the following point data types and information: Real-time data, User-entered data, Overridden or operator-disabled points, Devices in alarm (unacknowledged), and Out-of-range, bad, or missing data. The software shall allow the user to create, modify, and delete displays and graphic symbols. Data on graphics pages shall be no more than 10 seconds behind real time.
- (g) Provide a network configuration tool. This software shall use LonWorks Network Services (LNS) for all network configuration and management of ANSI/CEA-709.1B devices, be capable of executing LNS plug-ins, and be capable of performing network database reconstruction of an ANSI/CEA-709.1B control network.

5.8.3.9. Perform all necessary actions needed to fully integrate the building control system. These actions include but are not limited to:

- Configure M&C Software functionality including: graphical pages for System Graphic Displays including overrides, alarm handling, scheduling, trends for critical values needing long-term or permanent monitoring via trends, and demand limiting.
- Install IP routers or ANSI/CEA-852 routers as needed to connect the building control network to the UMCS IP network. Routers shall be capable of configuration via DHCP and use of an ANSI/CEA-852 configuration server but shall not rely on these services for configuration. All communication between the UMCS and building networks shall be via the ANSI/CEA-709.1B protocol over the IP network in accordance with ANSI/CEA-852.

5.8.3.10. Provide the following to the Government for review prior to acceptance of the system:

- The latest version of all software and user manuals required to program, configure and operate the system.
- Points Schedule drawing that shows every DDC Hardware device. The Points Schedule shall contain the following information as a minimum:
 - Device address and NodeID.

- Input and Output SNVTs including SNVT Name, Type and Description.
- Hardware I/O, including Type (AI, AO, BI, BO) and Description.
- Alarm information including alarm limits and SNVT information.
- Supervisory control information including SNVTs for trending and overrides.
- Configuration parameters (for devices without LNS plug-ins) Example Points Schedules are available at <https://eko.usace.army.mil/fa/besc/>
- Riser diagram of the network showing all network cabling and hardware. Label hardware with ANSI.CEA-709.1 addresses, IP addresses, and network names.
- Control System Schematic diagram and Sequence of Operation for each HVAC system.
- Operation and Maintenance Instructions including procedures for system start-up, operation and shut-down, a routine maintenance checklist, and a qualified service organization list.
- LONWORKS® Network Services (LNS®) database for the completed system.
- Quality Control (QC) checklist (below) completed by the Contractor's Chief Quality Control (QC) Representative

Table 5-1: QC Checklist

Instructions: Initial each item, sign and date verifying that the requirements have been met.

#	Description	Initials
1	All DDC Hardware is installed on a TP/FT-10 local control bus.	
2	Communication between DDC Hardware is only via EIA 709.1B using SNVTs. Other protocols and network variables other than SNVTs have not been used.	
3	All sequences are performed using DDC Hardware.	
4	LNS Database is up-to-date and accurately represents the final installed system	
5	All software has been licensed to the Government	
6	M&C software monitoring displays have been created for all building systems, including all override and display points indicated on Points Schedule drawings.	
7	Final As-built Drawings accurately represent the final installed system.	
8	O&M Instructions have been completed and submitted.	
9	Connections between the UMCS IP network and ANSI/CEA-709.1B building networks are through ANSI/CEA-852 Routers.	

By signing below I verify that all requirements of the contract, including but not limited to the above, been met.

Signature: _____ Date: _____

Instructions: Initial each item, sign and date verifying that the requirements have been met.

#	Description	Initials
1	All DDC Hardware is installed on a TP/FT-10 local control bus.	
2	Communication between DDC Hardware is only via EIA 709.1B using SNVTs. Other protocols and network variables other than SNVTs have not been used.	
3	All sequences are performed using DDC Hardware.	
4	LNS Database is up-to-date and accurately represents the final installed system	
5	All software has been licensed to the Government	
6	M&C software monitoring displays have been created for all building systems, including all override and display points indicated on Points Schedule drawings.	
7	Final As-built Drawings accurately represent the final installed system.	
8	O&M Instructions have been completed and submitted.	
9	Connections between the UMCS IP network and ANSI/CEA-709.1B building networks are through ANSI/CEA-852 Routers.	
10	LonWorks Network Services (LNS) based M&C software was provided	
11	The M&C software is covered under a DIACAP and has a certificate of Networthiness	

By signing below I verify that all requirements of the contract, including but not limited to the above, been met.

Signature: _____ Date: _____

5.8.3.11. Perform a Performance Verification Test (PVT) under Government supervision prior to system acceptance. During the PVT demonstrate that the system performs as specified, including but not limited to demonstrating that the system is Open and correctly performs the Sequences of Operation.

5.8.3.12. Provide a 1 year unconditional warranty on the installed system and on all service call work. The warranty shall include labor and material necessary to restore the equipment involved in the initial service call to a fully operable condition.

5.8.3.13. Provide training at the project site on the installed building system and UMCS Upon completion of this training each student, using appropriate documentation, should be able to start the

system, operate the system, recover the system after a failure, perform routine maintenance and describe the specific hardware, architecture and operation of the system. Operation of the UMCS includes but is not limited to

- Configuring and managing alarms
- Configuring schedules
- Creation and modification of trends
- Creation of reports
- Performing operator overrides.

5.8.4. TESTING, ADJUSTING AND BALANCING. Test and balance air and hydronic systems, using a firm certified for testing and balancing by the Associated Air Balance Council (AABC), National Environmental Balancing Bureau (NEBB), or the Testing Adjusting, and Balancing Bureau (TABB). The prime contractor shall hire the TAB firm directly, not through a subcontractor. Perform TAB in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1, NEBB TABES, or SMACNA HVACTAB unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard shall be considered mandatory. Use the provisions of the TAB Standard, including checklists, report forms, etc., as nearly as practicable to satisfy the Contract requirements. Use the TAB Standard for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, adhere to the manufacturer's recommendations. All quality assurance provisions of the TAB Standard such as performance guarantees shall be part of this contract. For systems or system components not covered in the TAB Standard, the TAB Specialist shall develop TAB procedures. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements are mandatory.

5.8.5. COMMISSIONING: Commission all HVAC systems and equipment, including controls, and all systems requiring commissioning for LEED Enhanced commissioning, in accordance with ASHRAE Guideline 1.1, ASHRAE Guideline 0 and LEED. Do not use the sampling techniques discussed in ASHRAE Guideline 1.1 and in ASHRAE Guideline 0. Commission 100% of the HVAC controls and equipment. Hire the Commissioning Authority (CxA), certified as a CxA by AABC, NEBB, or TABB, as described in Guideline 1.1 to perform the ASHRAE Commissioning activities. The CxA will be an independent subcontractor and not an employee of the Contractor nor an employee or subcontractor of any other subcontractor on this project, including the design professionals (i.e., the DOR or their firm(s)). The CxA will communicate and report directly to the Government in execution of commissioning activities. The Government will provide the Commissioning Authority for LEED Enhanced Commissioning. Cooperate and communicate with, fully coordinate with and provide the LEED CxA access to all necessary information and attendance in all necessary meetings and activities related to execution of enhanced commissioning. The Contracting Officer's Representative will act as the Owner's representative in performance of duties spelled out under OWNER in Annex F of ASHRAE Guideline 0. All buildings with Minimum LEED Silver (or better) requirement will earn LEED Credit EA3 Enhanced Commissioning.

5.9. ENERGY CONSERVATION

5.9.1. The building including the building envelope, HVAC systems, service water heating, power, and lighting systems shall meet the Mandatory Provisions and the Prescriptive Path requirements of ASHRAE 90.1. Substantiation requirements are defined in Section 01 33 16, Design After Award.

5.9.2. Design all building systems and elements to meet the minimum requirements of ANSI/ASHRAE/IESNA 90.1. Design the buildings, including the building envelope, HVAC systems, service water heating, power, and lighting systems to achieve an energy consumption that is at least 40% below the consumption of a baseline building meeting the minimum requirements of ANSI/ASHRAE/IESNA Standard 90.1. Energy calculation methodologies and substantiation requirements are defined in Section 01 33 16, Design After Award.

5.9.3. Purchase Energy Star products, except use FEMP designated products where FEMP is applicable to the type product. The term "Energy Star product" means a product that is rated for energy efficiency under an Energy Star program. The term "FEMP designated product" means a product that is designated under the Federal Energy Management Program of the Department of Energy as being among the highest 25 percent of equivalent products for energy efficiency. When selecting integral sized electric motors, choose NEMA PREMIUM type motors that conform to NEMA MG 1, minimum Class F insulation system. Motors with efficiencies lower than the NEMA PREMIUM standard may only be used in unique applications that require a high constant torque speed ratio (e.g., inverter duty or vector duty type motors that conform to NEMA MG 1, Part 30 or Part 31).

5.9.4. Solar Hot Water Heating. Provide at least 30% of the domestic hot water requirements through solar heating methodologies, unless the results of a Life Cycle Cost Analysis (LCCA) developed utilizing the Building Life Cycle Cost Program (BLCC) which demonstrates that the solar hot water system is not life cycle cost effective in comparison with other hot water heating systems. The type of system will be established during the contract or task order competition and award phase, including submission of an LCCA for government evaluation to justify non-selection of solar hot water heating. The LCCA uses a study period of 25 years and the Appendix K utility cost information. The LCCA shall include life cycle cost comparisons to a baseline system to provide domestic hot water without solar components, analyzing at least two different methodologies for providing solar hot water to compare against the baseline system.

5.9.5. Process Water Conservation. When potable water is used to improve a building's energy efficiency, employ lifecycle cost effective water conservation measures, except where precluded by other project requirements.

5.9.6. Renewable Energy Features. The Government's goal is to implement on-site renewable energy generation for Government use when lifecycle cost effective. See Paragraph 6, PROJECT SPECIFIC REQUIREMENTS for renewable energy requirements for this project.

5.10. FIRE PROTECTION

5.10.1. STANDARDS AND CODES Provide the fire protection system conforming to APPLICABLE CRITERIA.

5.10.2. Inspect and test all fire suppression equipment and systems, fire pumps, fire alarm and detection systems and mass notification systems in accordance with the applicable NFPA standards. The fire protection engineer of record shall witness final tests. The fire protection engineer of record shall certify that the equipment and systems are fully operational and meet the contract requirements. Two weeks prior to each final test, the contractor shall notify, in writing, the installation fire department and the installation public work representative of the test and invite them to witness the test.

5.10.3. Fire Extinguisher Cabinets: Provide fire extinguisher cabinets and locations for hanging portable fire extinguishers in accordance with NFPA 10 Standard for Portable Fire Extinguishers. The Government will furnish and install portable fire extinguishers, which are personal property, not real property installed equipment.

5.10.4. Fire alarm and detection system: Required fire alarm and detection systems shall be the addressable type. Fire alarm initiating devices, such as smoke detectors, heat detectors and manual pull stations shall be addressable. When the system is in alarm condition, the system shall annunciate the type and location of each alarm initiating device. Sprinkler water flow alarms shall be zoned by building and by floor. Supervisory alarm initiating devices, such as valve supervisory switches, fire pump running alarm, low-air pressure on dry sprinkler system, etc. shall be zoned by type and by room location.

5.10.5. Roof Access: Paragraph 2-9 of UFC 3-600-01 Fire Protection for Facilities will be modified in the next update to that UFC. Pending revision, comply with roof access and stairway requirements in

accordance with the International Building Code. Where roof access is required by the IBC or other criteria, comply with UFC 4-010-01, Anti-Terrorist Force Protection, Standard 14. "Roof Access".

5.10.6. Fire Protection Engineer Qualifications: In accordance with UFC 3-600-01, FIRE PROTECTION ENGINEERING FOR FACILITIES, the fire protection engineer of record shall be a registered professional engineer (P.E.) who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveys (NCEES), or a registered P.E. in a related engineering discipline with a minimum of 5 years experience, dedicated to fire protection engineering that can be verified with documentation.

5.11. SUSTAINABLE DESIGN

5.11.1. STANDARDS AND CODES: Sustainable design shall conform to APPLICABLE CRITERIA. See paragraph 6, PROJECT-SPECIFIC REQUIREMENTS for which version of LEED applies to this project. The LEED-NC Application Guide for Multiple Buildings and On-Campus Building Projects (AGMBC) applies to all projects. Averaging may be used for LEED compliance as permitted by the AGMBC but is restricted to only those buildings included in this project. Each building must individually comply with the requirements of paragraphs ENERGY CONSERVATION and BUILDING WATER USE REDUCTION.

5.11.2. LEED RATING, REGISTRATION, VALIDATION AND CERTIFICATION: See Paragraph PROJECT-SPECIFIC REQUIREMENTS for project minimum LEED rating/achievement level, for facilities that are exempt from the minimum LEED rating, for LEED registration and LEED certification requirements and for other project-specific information and requirements.

5.11.2.1. Innovation and Design Credits. LEED Innovation and Design (ID) credits are acceptable only if they are supported by formal written approval by GBCI (either published in USGBC Innovation and Design Credit Catalog or accompanied by a formal ruling from GBCI). LEED ID credits that require any Owner actions or commitments are acceptable only when Owner commitment is indicated in paragraph PROJECT-SPECIFIC REQUIREMENTS or Appendix LEED Project Credit Guidance

5.11.3. OPTIMIZE ENERGY PERFORMANCE. : Project must earn, as a minimum, the points associated with compliance with paragraph ENERGY CONSERVATION. LEED documentation differs from documentation requirements for paragraph ENERGY CONSERVATION and both must be provided. For LEED-NC v2.2 projects you may substitute ASHRAE 90.1 2007 Appendix G in its entirety for ASHRAE 90.1 2004 in accordance with USGBC Credit Interpretation Ruling dated 4/23/2008.

5.11.4. COMMISSIONING. See paragraph 5.8.5 COMMISSIONING for commissioning requirements. USACE templates for the required Basis of Design document and Commissioning Plan documents are available at <http://en.sas.usace.army.mil> (click on USACE LEED Commissioning Plan Template) and may be used at Contractor's option.

5.11.5. DAYLIGHTING. Except where precluded by other project requirements, do the following in at least 75 percent of all spaces occupied for critical visual tasks: achieve a 2 percent glazing factor (calculated in accordance with LEED credit EQ8.1) OR earn LEED Daylighting credit, provide appropriate glare control and provide either automatic dimming controls or occupant-accessible manual lighting controls.

5.11.6. LOW-EMITTING MATERIALS. Except where precluded by other project requirements, use materials with low pollutant emissions, including but not limited to composite wood products, adhesives, sealants, interior paints and finishes, carpet systems and furnishings,

5.11.7. CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT. Except where precluded by other project requirements, earn LEED credit EQ 3.1 Construction IAQ Management Plan, During Construction and credit EQ 3.2 Construction IAQ Management Plan, Before Occupancy.

5.11.8. RECYCLED CONTENT. In addition to complying with section RECYCLED/RECOVERED MATERIALS, earn LEED credit MR4.1, Recycled Content, 10 percent except where precluded by other project requirements.

5.11.9. BIOBASED AND ENVIRONMENTALLY PREFERABLE PRODUCTS. Except where precluded by other project requirements, use materials with biobased content, materials with rapidly renewable content, FSC certified wood products and products that have a lesser or reduced effect on human health and the environment over their lifecycle to the maximum extent practicable.

5.11.10. FEDERAL BIOBASED PRODUCTS PREFERRED PROCUREMENT PROGRAM (FB4P). The Farm Security and Rural Investment Act (FSRIA) of 2002 required the U.S. Department of Agriculture (USDA) to create procurement preferences for biobased products that are applicable to all federal procurement (to designate products for biobased content). For all designated products that are used in this project, meet USDA biobased content rules for them except use of a designated product with USDA biobased content is not required if the biobased product (a) is not available within a reasonable time, (b) fails to meet performance standard or (c) is available only at an unreasonable price. For biobased content product designations, see <http://www.biopreferred.gov/ProposedAndFinalItemDesignations.aspx>.

5.12. CONSTRUCTION AND DEMOLITION (C&D) WASTE MANAGEMENT: Achievement of 50% diversion, by weight, of all non-hazardous C&D waste debris is required. Reuse of excess soils, recycling of vegetation, alternative daily cover, and wood to energy are not considered diversion in this context, however the Contractor must track and report it. A waste management plan and waste diversion reports are required, as detailed in Section 01 57 20.00 10, ENVIRONMENTAL PROTECTION.

5.13. SECURITY (ANTI-TERRORISM STANDARDS): Unless otherwise specified in Project Specific Requirements, only the minimum protective measures as specified by the current Department of Defense Minimum Antiterrorism Standards for Buildings, UFC 4-010-01, are required for this project. The element of those standards that has the most significant impact on project planning is providing protection against explosives effects. That protection can either be achieved using conventional construction (including specific window requirements) in conjunction with establishing relatively large standoff distances to parking, roadways, and installation perimeters or through building hardening, which will allow lesser standoff distances. Even with the latter, the minimum standoff distances cannot be encroached upon. These setbacks will establish the maximum buildable area. All standards in Appendix B of UFC 4-010-01 must be followed and as many of the recommendations in Appendix C that can reasonably be accommodated should be included. The facility requirements listed in these specifications assume that the minimum standoff distances can be met, permitting conventional construction. Lesser standoff distances (with specific minimums) are not desired, however can be provided, but will require structural hardening for the building. See Project Specific Requirements for project specific siting constraints. The following list highlights the major points but the detailed requirements as presented in Appendix B of UFC 4-010-01 must be followed.

- (a) Standoff distance from roads, parking and installation perimeter; and/or structural blast mitigation
- (b) Blast resistant windows and skylights, including glazing, frames, anchors, and supports
- (c) Progressive collapse resistance for all facilities 3 stories or higher. Unless determined otherwise by the Installation and noted in paragraphs 3 or 6, the building shall be considered to have areas of uncontrolled public access when designing for progressive collapse.
- (d) Mass notification system (shall also conform to UFC 4-021-01, Mass Notification Systems)
- (e) For facilities with mailrooms (see paragraph 3 for applicability) – mailrooms have separate HVAC systems and are sealed from rest of building

6.0 PROJECT SPECIFIC REQUIREMENTS FORT CAMPBELL, KY

6.1. GENERAL

The requirements of this paragraph augment the requirements indicated in Paragraphs 3 through 5.

6.2. APPROVED DEVIATIONS

6.2.1 The following are approved deviations from the requirements stated in Paragraphs 3 through 5 that only apply to this project.

6.2.1.1. DELETED

6.2.2 Building Automation System

Perform all necessary actions needed to fully integrate the building control system to the FMCS. The following requirements supersede paragraphs 5.8.3.7 and 5.8.3.9.

6.2.2.1 Meter all utilities and include the cost in the contract price.

(a) Provide and install water meter(s). Coordinate meter purchase, location, and installation with the Privatized Utility, CH2MHill.

(b) Provide and install gas meter(s). Coordinate meter purchase and installation from Clarksville Gas and Water. CG&W shall install and program the wireless transmitter on each meter (Also include this cost in the contract price.)

(c) Provide and install wireless electric meter(s) compatible with existing Aclara Data Collection Units. Meters shall be the Aclara Star Network MTU wireless electric meters or an approved equal that functions with the existing system. Provide a working meter including programming of the unit for operation with dedicated server.

6.2.2.2 The building automation system (BAS) controls in the facilities under this contract will be integrated to and become part of the Facility Management and Control System (FMCS). Provide Java Application Control Engines (JACE), version R2, within each building or facility. The JACE (version R2) shall connect the BAS in the building or buildings to the FMCS via Fort Campbell's wide area network.

6.2.2.3 Access to the BAS shall be available locally in each building, and remotely from personal computers residing on the Fort Campbell network. Accomplish access through standard Web browsers, via the Internet and the Fort Campbell network.

6.2.2.4 Each JACE shall communicate with the BAS including the LonMark/LonTalk controllers and other open systems and devices provided in the building. The FMCS is based on the Niagara Framework, a Java-based framework developed by Tridium. Niagara provides an open automation infrastructure that integrates diverse systems and devices regardless of manufacturer into a unified platform that can be easily managed in real time over the Internet using a standard Web browser.

6.2.2.5 The JACE shall serve as the interface between the BAS and the FMCS. The JACE may perform BAS data manager functions such as time schedules for equipment, trend logging, and alarm processing and alarm handling functions. However, the JACE shall not perform process control. Process control shall be handled by the Application Specific Controllers and Programmable Controllers included in the BAS.

6.2.2.6 Provide graphics for each piece of controlled HVAC equipment and other equipment. The graphics shall include the building floor plan with links to mechanical rooms and all controlled equipment. As a minimum, the graphics shall show the equipment modes, commonly adjusted setpoints, sensed

variables, output commands, and actuator positions for each piece of controlled equipment. The graphics shall be available locally using a laptop service tool, or remotely as described above. Demonstrate the graphic interface and show that all sensed values are accurate, that dynamic screen links work properly, that set points can be changed remotely, and that any input or output variable can be trend logged and graphed. Additionally, perform a JACE failure test using an out-of-the-box test JACE furnished by Fort Campbell. The test JACE will be void of any programming. Demonstrate that the program and database required to make the test JACE operate can be successfully loaded from a service lap top tool, and that the test JACE then operates and functions correctly as a replacement JACE.

6.2.2.7 Provide non-expiring licenses for all controllers and software and which require licensing to Fort Campbell.

6.2.2.8 The graphics shall be similar to the existing graphics used on the Fort Campbell Facility Management and Control System. Sample FMCS graphic screens are included in the applicable Appendix. The first graphic resides on the server in building 865. Modify this graphic to add the newly connected building or buildings to the graphic.

6.2.2.8 Green light means no building alarms.

6.2.2.10 Red means building alarms exist.

6.2.2.11 Yellow means the building is not communicating.

6.3. SITE PLANNING AND DESIGN

6.3.1. General:

The MH-47 Hangar is within the 160th SOF compound at Ft. Campbell. The 160th SOF compound is a separate secure area with its own security protocols (See Appendix GG Security Requirements). Specific access and work procedures must be adhered to during the construction of the MH-47 Hangar. A plan has been developed to segregate the contractor from the daily operations of the 160th SOF compound and thus reduce the security measures the contractor must follow. Information on how to segregate the construction site is contained in the drawings in Appendix J and Appendix MM.

The MH-47 Hangar site is constrained by an existing hangar and helicopter parking area to the east of the project site. The new hangar shall be separated from the existing hangar by 50 feet. The existing runway constrains the south part of the site while an existing taxiway constrains the southwest part of the site. An existing covered storage area in the middle of the site must remain as well as an existing sanitary sewer pump station and appurtenances. Sinkholes have been previously found on the site and are discussed and/or shown in Appendices A & J.

Due to the limited site area available, the contractor will need to phase construction at the site. A phasing plan is provided in Appendix J but may be modified with approval of the 160th, Security Forces, USACE and DPW.

Refer to the phasing and contractor access plans within Appendix J for further construction limitations.

6.3.1.1 Construction Access Security

See Appendix J Drawings, Appendix AA Technical Specifications and Appendix MM Contractor Project Access Control Requirements for requirements.

6.3.1.2 Construction Limitations

The new aircraft parking apron will abut an existing taxiway. Ft. Campbell Army Airfield (CAAF) personnel will temporarily close this taxiway during construction.

The MH-47 Hangar site is within close proximity to Runway 18/36. Airfield height restrictions (described in *UFC 3-260-01 Airfield and Heliport Planning and Design*) limit the height objects near this runway. No objects are permitted to be within 500 feet of each side of the runway and 1000 feet from ends of the runway. Objects outside the 500 foot offset are permitted based on a 7:1 height slope limit from the 500 foot offset. The RFP designer has laid the site according to these restrictions which is presented in Appendix J.

Construction within 200 feet of any runway is limited to 8pm Friday to 5pm Monday with prior approval from the COR. The contractor will be required to maintain radio contact (provided by Ft. Campbell) with the control tower when working near the runway. The contractor shall place low type barriers (see Appendix J for limits and detail) along the edge of the existing apron during construction. While construction is taking place on the existing adjacent parking apron, the contractor shall relocate the low type barrier between the new work and the next row of apron parking to the east. All low type barriers shall be removed once adjacent construction activity has been completed.

Due to construction taking place near an active runway and aprons, the contractor will need to ensure Foreign Objects & Debris (FOD) does not become a problem. The site shall be kept clean of items that could be windblown across the site. A FOD sweep shall take place at the end of each day and be signed off by the government. Dumpsters shall have lids restrained so they do not open in the wind and no open containers or drums shall be left at the end of the day.

The existing sanitary lift station, electrical switch, and generator located immediately north of the MH-47 Hangar shall not be disturbed during construction and be kept in service during the project. The existing covered storage building to the north of the MH-47 Hangar shall also not be disturbed.

The use of cranes near the airfield will be permitted but must be approved through the COR prior to bringing on site.

The new apron will require edge lighting per UFC 3-535-01, Visual Air Navigation Facilities. Coordinate with existing apron and taxiway edge lighting as required.

6.3.1.3 Fencing

A portion of the flightline perimeter fencing will be replaced as part of this project – see Appendix J for the location. The new fence will be eight (8) feet high with double strands of barbed wire. A 10 ft wide aggregate strip must be placed along the inside and outside of the perimeter fence. Any items within 33 feet of the building (including existing pump station and generator) must be completely fenced in (all sides and top) to meet AT/FP requirements.

6.3.1.4 Stormwater Management (SWM) Systems

(a) Due to limitations of infiltration of soils at pond depths the current stormwater management methodology has been defined as Technical Infeasibility from Section 438.

(b) Add the following to paragraph 6.3.3.1:

(a) Design shall also follow the requirements of *Fort Campbell Policy for Storm Water Erosion and Sediment Control at Construction Projects*, the *City of Clarksville (TN) Storm Water Management Manual*, in addition to the documents outlined in paragraph 6.3.3.1 below. Infiltration is an acceptable method to obtain quantity and quality control at the site. See Appendix A for design data. Rain gardens for POV parking areas and rainwater reuse from the building roof are acceptable methods to manage additional runoff. Underground stormwater

detention systems are acceptable, however, any underground detention under the helicopter parking apron shall be composed of concrete pipe. Infiltration rates for the site are included in the Geotechnical Report in Appendix A. Grading and Drainage design plans for the site, developed to a 90% level, are included in Appendix J. All drainage structures within the concrete apron pavement shall be designed for aircraft loading. Any utilities that need to cross existing paved streets or roads shall be installed by jack and bore.

(c) Contractor shall provide maintenance procedures for raingardens and rainwater harvesting systems to COR.

6.3.1.5 Erosion and Sediment Control

Add the following paragraph(s) to paragraph 6.3.3.2:

(d) The site discharges to an unnamed tributary of Dry Fork Creek and is considered a warmwater aquatic habitat, primary/secondary contact recreation, and domestic water supply.

6.3.1.6 Storage Containers

Sufficient space shall be provided on site for locating user storage containers. The location of the containers shall not reduce required fire department access or other RFP requirements. All pavement where containers are located shall be painted to indicate limits where containers can be located to not reduce required Fire Department access or other RFP requirement dimensions. See Conceptual Floor Plan Drawings and Appendix J Drawings for proposed locations of storage containers. See Appendix FF Storage Container Dimensions for sizes and quantities of containers. Exterior storage containers shall be attached to mooring points placed in the adjacent pavement.

Reference Appendix J for circulation and parking layouts.

6.3.1.7 Site Structures and Amenities

Add the following to paragraph 6.3.2.2

(c) A dumpster enclosure for 6 total dumpsters (4 garbage, 1 wood, and 1 cardboard) shall be provided as indicated in Appendix J.

6.3.2. Site Structures and Amenities

6.3.2.1 Refer to Appendix J, Site Plan for dumpster location.

6.3.2.2 Provide visual screens for dumpster and mechanical equipment in accordance with ATRP requirements. Enclosures shall match the building's architectural theme and finish material.

(a) **Dumpsters Enclosures.** Dumpster Enclosures shall be 3-sided and sized to accommodate two dumpsters, each measuring 6 ½-feet x 6 ½-feet.(reference Paragraph 5.1.2.1. for additional information). Provide a concrete loading apron for the first 15-feet in front of the dumpster pad to accommodate loading of dumpsters and avoid rutting on the pavement. Enclosures shall be at least 18-feet wide with the swinging doors mounted on the front of the enclosure, not the inside of the enclosure. If the doors are mounted on the inside wall they will need to be at least 19-feet wide. Swinging doors, gate posts, and bollards shall not reduce the clear opening width.

(b) **Exterior Mechanical Equipment.** Enclosures for chillers and cooling towers shall not be more than ten feet high.

6.3.3. Site Functional Requirements:

6.3.3.1. Stormwater Management (SWM) Systems.

(a) Design and construct the stormwater drainage system in accordance with Federal Aviation Administration Advisory Circular FAA AC 150-5320-5C, Surface Drainage Design; Federal Highway Administration Publication No. FHWA-NHI-01-021, Hydraulic Engineering Circular No. 22, Second Edition, URBA DRAINAGE DESIGN MANUAL. Base design of drainage structures on a 10-year storm frequency. Design of the storm drainage system shall incorporate the principles of Low Impact Development (LID), as detailed in UFC 3-210-10 DESIGN: LOW IMPACT DEVELOPMENT MANUAL. The design shall maintain or restore to the maximum extent technically feasible, the predevelopment hydrology of the site with regard to temperature, rate, volume, and duration of flow in accordance with Section 438 of the Energy Independence and Security Act of 2007 (EISA 2007). Design the stormwater management facilities in accordance with DoD Policy Memorandum, Office of the Secretary of Defense, DoD Implementation of Storm Water Requirements under Section 438 of the Energy Independence and Security Act (EISA), 19 Jan 10.

(b) For volume control, an on-site storm water retention/detention system shall be required. Design criteria for storage facilities shall follow the "Fort Campbell Policy for Storm Water Erosion and Sediment Control at Construction Sites" developed by Fort Campbell DPW, as posted on the Fort Campbell Environmental web site (<http://www.campbell.army.mil/envdiv/>). Take special note of the Precipitation Frequency Estimates and the required Pre-developed curve number included in the policy.

(c) Development projects over 5000 square feet are required by the 2007 Energy Independence and Security Act, Section 438, to implement strategies to "maintain or restore, to the maximum extent feasible, the predevelopment hydrology of the property with regard to temperature, rate, volume, and or duration of flow." See the USEPA technical guidance at http://www.epa.gov/oaintrnt/documents/epa_swm_guidance.pdf. In addition, Fort Campbell has a water quality treatment standard for the first flush of 1.1 inches of rainfall.

6.3.3.2. Erosion and Sediment Control

(a) Fort Campbell Environmental Division of Public Works oversees the Stormwater Sediment and Erosion Control Management Plan for the Post. The point of contact for Fort Campbell Environmental Divisions is Dan Etson, (270) 798-8794, dan.etsen@us.army.mil.

(b) Fort Campbell is currently implementing compliance with new five year Phass II MS4 general permits issued by Kentucky and Tennessee in 2010. In order to comply with the provisions of the state and EPA NPDES permits, all construction projects, including those located in the Clarksville Base Development, must comply with the provisions of the "Fort Campbell Policy for Storm Water Erosion and Sediment Control at Construction Sites" developed by Fort Campbell DPW, as posted on the Fort Campbell Environmental web site (<http://www.campbell.army.mil/envdiv/>). These provisions include the Contractor's preparation of a project specific Storm Water Pollution Prevention Plan (SWPPP), the Contractor signing onto Fort Campbell's general permit Notice to Intent, and enforcement of the plan components. Projects located in the Clarksville Base Development are covered under an Individual NPDES Permit for Construction Activities. The Contractor will be signing onto Fort Campbell's permit. Aggressive EPSC measures are critical. Fort Campbell samples project storm water outfalls using a third party EPSC inspector. See 6.15.2 for additional information.

(c) Be aware of any Wetlands, Sinkholes, or Class V Injection Well that may be associated with this project. Do not discharge any storm water off the installation on to private land owners. Install and maintain all erosion and sediment control devices in accordance with the Fort Campbell Policy for Storm Water Erosion and Sediment Control at Construction Sites.

6.3.3.3. Vehicular Circulation.

- (a) Emergency Vehicle Access. The ground access surface shall accommodate all Fort Campbell Fire Department Trucks and Emergency Vehicles in accordance with all applicable criteria. Provide drive through circulation that minimizes the need for turning trucks around within the site boundary to the maximum extent possible.
- (b) Provide ladder vehicle access as a minimum to two sides of each facility and a minimum of three sides of all sleeping quarters to accommodate the Fire Department's trucks and emergency vehicles.
- (c) Design for the Fort Campbell Fire Department's heaviest vehicle, 84,000 lbs. The ladder truck turning radius is 46'-0". Fire lanes shall have a minimum 20'-0" clear width. Grass paver type products may be used for emergency vehicle access if soils engineering studies indicate ground can support such structures. Verify requirements with FTC Fire Department and ensure that the base is prepared to completely support the required loads.

A 20' wide paved access drive shall be placed around the MH-47 Hangar and tied into the new helicopter parking apron on the airside of the hangar. The drive shall be designed to accommodate the turning movements of a WB-65 design vehicle and FTC fire department vehicles..

An asphalt parking lot for 253 POVs shall be provided to the north of the MH-47 Hangar. Accessible parking shall be provided according to ADA/ABA requirements. Parking spaces shall be a minimum of 9'x18' with 24' wide lanes for two way traffic. An additional area of concrete motorcycle parking shall have 5 motorcycle stalls that have minimum dimensions of 4.5'x12'.

A concrete rotary wing aircraft parking area for (2) C-17 aircraft shall be provided between the new hangar building and the existing runway. Parking, mooring, and grounding for the parking apron shall follow *TI 800-01 Design Criteria* and *UFC 3-260-01 Airfield and Heliport Planning and Design*.

At the southern end of the existing apron, the pavement markings and mooring (including grounding) locations for the last row of aircraft shall be modified to accommodate MH-47 aircraft instead of the current MH-60 aircraft. The entire row of existing apron could not be surveyed due temporary buildings in place at the time of development of this RFP. The contractor shall verify the survey in this area and provide markings and moorings for MH-47 aircraft for the entire last row.

Reference Appendix J for circulation and parking layouts.

6.4. SITE ENGINEERING

6.4.1. Existing Topographical Conditions

The Government has provided a three dimensional digital topographic and utility survey. Bring any discrepancies which are found in the Government furnished survey to the immediate attention of the Government for clarification. The survey provides control points based on state plane coordinates and identifies horizontal and vertical datums.

The existing site consists of primarily open grassed areas. There is an existing covered storage building in the middle of the site and parking area to the east. An existing sanitary pump station and generator equipment sit in the middle of the site. There is a large paved area used for storage in the center of the site along with an existing aircraft washrack. A concrete apron area is present to the south of the site. Various structures will be removed on the site, including a TACAN building and tower, a waterpoint, and physical training apparatus.

The existing ground slopes gently on the site towards a swale area just west of the edge of the existing concrete apron.

Reference Appendix J for existing site survey drawings.

(a) Additional Geotechnical Borings

Any additional borings shall be sampled with a splitspoon sampler in accordance with ASTM D-1586, with samples visually classified at 1.5 foot intervals in accordance with the Unified Soil Classification System (ASTM D 2487). The depth to water shall be recorded. Standard Penetration Blow counts shall be recorded. A dated drilling log shall be provided for each boring drilled. Soils information obtained from field logs, laboratory tests and geologist's logs shall be presented on the contract drawings in the form of boring plan, final boring logs and explanatory notes.

(b) Soil Compaction

Compact each layer to not less than the percent of maximum density specified in the Table below, determined in accordance with ASTM D-1557.

<u>Type</u>	<u>Compaction</u>
Soil Compaction Foundations	95%
Concrete Work and Pavements (Non-Airfield)	90%
Concrete Work and Pavements (Airfield)	100%
Landscaping	85%
Retaining Wall Backfill	85 – 90%

The requirements shall be verified or modifications recommended by the Contractor's consulting professional geotechnical engineer in the report whenever engineering, soils or climatic factors indicate the necessity. Any modifications to the stated compaction requirements shall require approval from the COR. Subgrade suitability (by proof rolling operations), fill placement and compaction operations shall be observed and tested on a full time basis by a qualified independent testing agency as directed by the Contractor's project geotechnical engineer. Field in-place density shall be determined and check in accordance with the appropriate ASTM methodologies. The rate of in-place density testing shall be specified in the earthwork specifications. Representative Optimum Moisture and Laboratory Maximum Density Tests shall be made for each type of material or source of material. Upon completion of all earthwork, the contractor's geotechnical engineer shall certify in writing that the fill was placed in accordance with the requirements and provide the backup data including but not limited to: Proctor curves (moisture/density relationship), moisture contents, Atterberg limits, field density checks, sieve analysis, etc... Testing locations and elevations for all results shall be documented so that their position can be substantiated and relocated if necessary. The Contractor's QC plan shall detail these testing requirements and outline his plan to report the testing results. During construction, all foundation excavations shall be inspected and approved by the Contractor's project professional geotechnical engineer prior to placing concrete.

Contractor shall obtain samples of topsoil and subsoil for organic content determination in accordance with ASTM D 2974-07a. Take at least two representative samples of the material visually described as topsoil in the borings for organic analysis. Take at least three representative samples, from three different borings locations, of the subsoil to a depth of one foot below the material visually described as topsoil. Representative means "most typical of the site" and the individual samples should be taken such that they represent the full depth increment. In other words, if visual topsoil is 1 foot thick, "subsamples" of equal volume should be taken from 0 inches to 12 inches, mixed up then put in the jar for laboratory organic content analysis. In this case, the sample directly below the topsoil would be comprised of "subsamples" taken 13 inches to 24 inches.

6.4.2. Existing Geotechnical conditions: See Appendix A for a preliminary geotechnical report.

6.4.2.1. Geotechnical Engineer. A qualified independent testing agency shall observe and test subgrade suitability (by proof rolling operations), fill placement and compaction operations on a full time basis as directed by the Contractor's project Geotechnical Engineer.

6.4.3. Fire Flow Tests See Appendix D for historical fire flow test results. Use test results for proposal purposes and estimating the basis of design for fire flow and domestic water supply and for preparing the proposal cost estimate. After award, verify test results. Coordinate with Contracting Officer and CH2MHill to perform flow test on the water system at the anticipated points of connection in order to provide up-to-date flow information during the design phase. Point of contact for CH2M Hill is Chris Semler, (931) 431-2015. If test results indicates that the available flow or pressure has deteriorated from the data provided in Appendix D, bring this to the attention of the Government.

The fire protection system for buildings on this area of Ft. Campbell is separate from the domestic water system. The domestic water system supplies the fire hydrants and domestic building service lines. The fire protection system does not have hydrants and serves only the sprinkler and foam fire suppression systems within the buildings. Flow tests for the fire suppression system are not available however the pump data is provided within Appendix D. The fire protection line will be extended as shown in Appendix J.

6.4.4. Pavement Engineering and Traffic Estimates:

6.4.4.1 Pavement Design. Minimum flexible pavement sections shall consist of 3.5 inches of asphalt (1.5 inches of surface course and 2 inches of base course) and 8 inches of aggregate subbase and/or base. Minimum rigid pavement section shall consist of 6 inches of concrete and 8 inches of aggregate subbase and/or base. The minimum subbase/base can be neglected if the subgrade has a CBR greater than 30.

(a) Do not use Reclaimed Asphalt Pavement (RAP) in the asphalt surface wearing course.

6.4.4.2 Pavement design recommendations have been prepared and are presented with the Geotechnical Investigation report within Appendix A. Access roadway pavements shall be designed for 20 yearly passes of a fire truck, 100 yearly passes of a WB-65, and 5,000 yearly passes of a light truck. Aircraft parking aprons shall be designed for MH-47 and C-17 loadings. All pavements shall be designed IAW *UFC 3-250-01FA Pavement Design for Roads, Streets, Walks, and Open Storage Areas*, *UFC 3-250-03 Standard Practice Manual for Flexible Pavements*, *UFC 3-250-04 Standard Practice for Concrete Pavements*, and *UFC 3-260-02 Pavement Design for Airfields*.

Grading for the site shall allow for an accessible route according to ADA/ABA codes. Grading for the aircraft parking apron, taxiway, and surrounding areas shall follow the requirements set forth within *UFC 3-260-01 Airfield and Heliport Planning and Design*. Grading and Drainage design plans for the site, developed to a 90% level, are included in Appendix J.

6.4.5. Traffic Signage and Pavement Markings

Roadway and vehicular signage and pavement markings shall comply with the *Manual on Uniform Traffic Control Devices*. Signage, directional lighting, and pavement markings for parking apron and taxiways shall comply with *UFC 3-260-05A Marking of Army Airfield Heliport Operational Maintenance Facilities* and *ETL 04-2 (Change 1) Standard Aircraft Pavement Marking Schemes*.

6.4.6. Base Utility Information

6.4.6.1. Utilities

(a) The Installation's DPW supervises infrastructure and utilities and in some cases they are owned and operated by private entities. Obtain and verify actual utility locations by calling Tennessee One-Call

(1-800-351-1111) prior to start of any excavation work. General location of existing utility services such as potable water, sanitary sewer, electric, natural gas, and communications are located:

6.4.6.1.1 General Utilities

Utility connections and routing are shown in Appendix J. In general, natural gas, domestic water, and sanitary will tie into the existing mains within the utility corridor to the north of the MH-47 Hangar and be routed to the building's mechanical room. The domestic water loop and service shall tie into the 8" water loop and the gas service shall tie into the existing 4" gas main at the indicated locations. The domestic water service shall have fire hydrants placed as prescribed in *UFC 3-600-01 Fire Protection Engineering for Facilities*. Hydrants outside the apron shall have bollards around them as necessary to protect from traffic impacts. A fire hydrant PIV valve is required to be placed between the main line and the fire department connection a minimum of 40 feet from the building. A fire hydrant is required within 150 feet of the fire department connection. The sanitary service shall tie into the existing sanitary system upstream of the existing pump station and just to the north of the new MH-47 Hangar. CH2MHill has indicated that the existing pump station has the capacity to handle the flows from the new MH-47 Hangar. Any utilities that need to cross existing paved streets or roads shall be installed by jack and bore. Water distribution, sanitary sewer, electrical, gas, and communication service plans have been developed to a 90% level and are provided in Appendix J.

All utility mains that currently rest under the future concrete apron shall be relocated to the new asphalt pavement strip between adjacent concrete aprons to allow for future servicing without damaging portions of the concrete apron.

Water and sewer permits from the State of Kentucky may take upwards of six (6) weeks for approval.

6.4.6.1.2 Water Distribution and Sanitary Sewage System

The Government has coordinated utility connections, routing, and flows with CH2MHill. CH2MHill has agreed to the routing and connections as shown in Appendix J. The Contractor shall verify their design flows and parameters with CH2MHill early in design to ensure that their design matches the assumptions made by the RFP designer.

CH2MHill will design and construct the any water main re-alignment at the MH-47 Hangar site. The Contractor will reimburse CH2MHill for these expenses. The estimated cost for this service is \$213,000 with an estimated duration of 90-120 days to design, permit and construct from signature of agreement with the DB Contractor to completion. The Contractor will be responsible for the construction of the domestic and fire service lines and the fire hydrant service lines from the domestic water system. The Contractor will also be responsible for the construction of the oil/water separator and the sanitary service from the building to the main.

Any utility appurtenances within the concrete apron shall be designed to withstand aircraft loadings.

6.4.6.1.3 Gas Distribution System

The Government has coordinated the construction of the MH-47 Hangar with Clarksville Gas and Water (CG&W). The Contractor shall verify their final design flows and parameters with CG&W early in the design process to ensure they closely match RFP designer assumptions. A pressure of 40 psi is anticipated in the main at the connection location as shown in Appendix J. The contractor will reimburse CG&W for the cost of bringing gas service to the building. The estimated cost for this service is \$17,200.

The gas service lines to the facility are shown on drawings in Appendix J.

6.4.6.1.4 Refer to the geophysical investigation for additional information on potential sinkholes and the presence of other underground objects.

(b) Install all utility lines underground. Avoid installing utility lines under pavement to the maximum extent possible. Utility lines that must cross under roadways shall be jack and bore or directional drill and sleeve including water, natural gas, electric, communications and cable TV lines.

(c) Do not construct buildings over or within 10 feet of any new or existing utility lines, to include Water and Wastewater, Storm Sewer, Sanitary Sewerage, Gas, and COMM. Coordinate with respective provider to determine final routing of lines, and locations of connections points.

6.4.6.2. Water Distribution and Sanitary Sewerage System:

(a) CH2M Hill is the owner and operator of the Fort Campbell water distribution sanitary sewerage system. Design and construct the new distribution system and new sewer lines, required building service and sewer lines, and any modifications to the existing distribution lines and main sewers in accordance with the latest edition of CH2M Hill's "Fort Campbell Water and Wastewater Design Guide and Construction Standards". Coordinate with CH2M Hill to determine the locations of connections to the existing water distribution system and final routing of the water distribution lines and service lines including the locations of the distribution mains, and the locations of fire hydrants and post indicator valves. In addition coordinate the routing of the new or relocated main sanitary sewer lines, the routing and locations of the new building sewer lines, the locations of connection points to the main sewer system, the locations of existing sewer lines to be removed, the locations of new and existing manholes, the locations of lift stations and the location of force mains. Submit to CH2M Hill a completed "Application for Water and Wastewater Connection" form and the associated application fee. Include adequate time in the proposal for the design of the water system, the acquisition of State permits, and the construction of the water lines. Point of contact for CH2M Hill at Fort Campbell is Chris Semler, (931) 431-2015. Alternate contact for CH2M HILL is Robert Neath (314) 421-0313.

(b) Contact CH2M HILL representative in a timely manner to coordinate water and sewer service to the facilities being constructed or renovated under this contract. No water and wastewater design or construction may begin without the execution of a permit issued by CH2M HILL. All new construction must satisfy the terms of the permitting process before water or wastewater services will be activated. Comply with all policies, procedures, standards, specifications and details required by CH2M HILL governing the design, construction and supply of water and sewer services required under this contract.

(c) After award and during the design phase of the project, coordinate with CH2M Hill and submit preliminary drawings to CH2M Hill for review. The drawings shall show all new distribution lines, fire hydrants, new service lines, and any modifications to existing distribution system. In addition, show all new main and building sewer lines, manholes, pumping stations, force mains, and any modifications to existing sewer lines, tie-in points, and projected sewer flowrate from each building and at each manhole.

(d) Base the design of the water distribution system on the static and residual water pressure conditions as shown in Paragraph 6.4.3 Fire Flow Tests.

(e) Determine the following for each building in the project and provide this information to CH2M Hill:

- the required capacity of domestic water supply
- the domestic water service line size
- the required capacity of the fire water service line
- the fire water service line size and
- the location of the entrances to the building of the domestic water and fire water service lines.

(f) Coordinate the sequence and timing of all water line tie-ins to existing water lines with CH2M Hill. No work associated with the water system shall begin until all required permits and approvals for the water system are obtained. Existing water service lines and mains serving buildings on the site which remain occupied during construction shall remain in service, uninterrupted, until those buildings are abandoned or until the new water distribution line has been accepted by the Government.

(g) Coordinate the sequence and timing of all tie-ins to existing sewer lines with CH2M Hill. Do not begin construction of the sanitary sewer system until all required permits and approvals for the sanitary

sewer system are obtained. Existing sanitary lines serving buildings on the site which remain occupied during construction shall remain in service, uninterrupted, until those buildings are abandoned.

(h) Submit the final design drawings and specifications for review and comment. Include any changes as a result of the comments in the drawings and specifications prior to the start of construction.

(i) Connect the water meter to the building Direct Digital Control in accordance with Paragraph 6.2.2.1.

(j) CH2M Hill will inspect all construction of water distribution piping and sanitary sewer piping. Point of contact for CH2M HILL at Fort Campbell is Chris Semler, (931) 431-2015. Alternate contact for CH2M HILL is Robert Neath (314) 421-0313.

(k) Field Quality Control for Sanitary Sewer Distribution System. The contracting officer and CH2M Hill will conduct field inspections and witness field tests specified. The Contractor shall perform field tests, and provide labor, equipment, and incidentals required for testing including means for water transport when water is needed. CH2M Hill will furnish water needed for field tests.

6.4.6.3. Gas Distribution System:

(a) Clarksville Gas and Water Department (CG&W) is the owner of the Fort Campbell gas distribution system. CG&W is responsible for the adequacy of design and construction of the required building service lines and modifications to any existing distribution lines. Coordinate with CG&W to determine the routing of any new or relocated gas distribution lines, the routing and locations of new and existing service lines, the locations of connection points to the main gas distribution system, the locations of existing gas distribution lines to be removed, and the locations of new valves. Coordinate directly with CG&W to obtain the cost of the design, permits, and construction of the required building service lines to the five foot line up to and including meters and regulators and any necessary modifications to the distribution lines. Include this cost in the appropriate line item in the CLIN schedule. CG&W may require the following information to determine the cost of the gas system changes: the capacity of gas required for each building; the low pressure gas service line size for the building; the location of the entrances to the buildings of the gas service lines, and locations of the gas regulators and meters. Include adequate time in the proposal for the design of the gas system and the acquisition of permits and approvals. Point of contact for CG&W at Fort Campbell is Randall Lewis, (931) 542-9600. Point of contact for CG&W pertaining to gas service line capacity, size, routing, and points of connection to the gas distribution system is Mike Young, (931) 645-7422.

(b) After award, during the design phase of the project, provide information to CG&W about the expected building gas consumption and shall coordinate with CG&W to complete the gas distribution system design.

(c) Design and installation of the gas distribution system must be in accordance with all policies, procedures, standards, specifications and details required by CG&W. Determine the following for each building in the project:

- the required capacity of gas service,
- the low pressure gas service line size, and
- the preferred location of the service entrance including the gas regulators and meters.

(d) C&W will furnish and install meters and regulators on all buildings. The Contractor shall connect the meters to the building Direct Digital Control system in accordance with paragraph 6.2.2.1. The Contractor shall be responsible for all costs incurred for the gas system installation, including meters and regulators.

(e) Do not abandon in place any gas lines.

(f) Include the following in the design plans and specifications:

- the routing of gas distribution and gas service lines outside the buildings
- the location of gas meters and regulators
- existing gas distribution and service lines to be removed

(g) Coordinate the sequence and timing of all gas line construction activities with CG&W. No work associated with the gas system shall begin until all required permits and approvals for the gas system are obtained. Include adequate time in the proposal for the design of the natural gas system and the acquisition of permits and approvals.

(h) Submit the final design drawings and specifications for review and comment, and include any changes as a result of the comments in the drawings and specifications prior to the start of construction.

6.4.6.4. Electrical:

(a) Furnish and install a meter on electric service to each building. Equip the electric meter with a pulse initiator. Connect the pulse initiator on the electric meter to the building Direct Digital Control system. Coordinate all new electrical work with Fort Campbell DPW. The points of contact are Mihir Chaudhuri at (270) 798-9725 or email mihir.chaudhuri@us.army.mil, or Robert Galbraith at (270) 798-2232 or email robert.t.galbraith@us.army.mil.

6.4.6.5. Telecommunications:

(a) Government Telephones and Data Connectivity. Furnish and construct all outside plant manholes, duct, conduit, and the required distribution cables, between underground terminal boxes and the building central communications closet for Government telephones and data connectivity. Install 3"x4" duct from the closet manhole to the facility telecommunications room. Install 4"x4" duct back along roadways where no duct exists. Toneable trace wire will be installed in at least one of the ducts in the ductbank. Install manholes at a maximum of every 500 feet of duct. Install 4-cell fiber mesh in the duct to accommodate fiber optic cable. Duct shall be concrete encased and protected in all areas, under road surfaces, and in storm drainage area that are subject to washout, in accordance with I3A. Install duct prior to road surfacing. Coordinate with Network Enterprise Center (NEC) during the design process. The Points of contact for NEC are Greg Lantz at (270) 798-6238 or email gregory.lantz@us.army.mil.

6.4.6.6. Cable Television:

(a) Provide cable television outlets in areas as required by I3A. Design, furnish, and install all conduit, wiring and outlet boxes within the facilities. Comcast will be responsible for all the interior jacks and faceplates. Coordinate with Comcast during the design process. The Point of contact for Comcast during design and construction is Bill Goodwin at (615) 244-7462 ext. 1115646 (office) or (615) 405-5589 (cell) or email billy_goodwin@cable.comcast.com Field verify the locations of the point of service (tie point) and facility demarcation point with Comcast prior to start of work.

(b) Provide two inch conduit installed from telecommunication room to point of accessible connectivity at nearest pole with existing CATV.

6.4.7. Cut and Fill

6.4.7.1. Grading.

(a) All Fort Campbell projects should generally maintain existing topography and slopes while recognizing standard minimum and maximum gradients. There should be a balance of the quantity of cut and fill which would create a smooth transition of graded areas into the existing natural terrain. The plan should reflect selective site clearing that preserves groups of trees. Grading should manage site runoff to maintain the rate and quantity of flow to pre-development levels, or reduce site runoff where possible. Apply the principles of positive drainage to control the conditions that remove rainfall away from facilities and functions. Lawn sheet flow shall not flow over sidewalks or paved areas. Do not drain new parking areas onto existing streets and do not drain existing streets into new parking areas. Site designs should seek to minimize the disturbance of land, utilize natural drainage paths where possible, and take into account future construction in the area. Site design should also minimize the impact of construction activities on drainage and prevent loss of soils by water and wind erosion. Designs that improve on existing water quality by incorporating sustainable design principles are encouraged, and consistent with

budget constraints and activity requirements. Incorporate sustainable design principles to improve existing water quality.

(b) The finished grades adjacent to the new building will be a minimum of 6 inch below finished floor except where grades are required on walk ways and entrances to buildings that are handicap accessible. Slope finish grades away from the building at 5% for the first 10 feet and then at a minim of 1% to existing or new storm drainage. Use a preferred minimum gradient or 1% in all parking areas. The maximum gradient used parallel from front to rear of a space shall be 5% and from side to side (width of the space) shall be 1-1/2%.

6.4.7.2. Historically, the potential for sinkholes does exist at Fort Campbell. The preliminary site characteristics for this particular site are located in Appendix A. Geotechnical Information.

6.4.8. Borrow Material

(a) Use only the approved borrow pit. Provide a written list of all personnel and equipment that will be located at the site during borrow operations. Immediately report to the site operational authority any evidence of unauthorized personnel or activities at the site, including unauthorized dumping of wastes, littering, and any other activities that present a potential risk to human health or the environment. Immediately report any problems with runoff and erosion controls. Maintain a daily haul record, including truck counts and estimated volume per truck load. Submit the haul record to the COR on a weekly basis.

Fort Campbell has several borrow pit locations available on post. Borrow material shall meet the specifications and the borrow pit shall be maintained per the *Fort Campbell, Kentucky Technical Design Guide*. Topsoil shall be stockpiled on site as needed for final grading and landscape establishment. No earthwork is permitted to leave Ft. Campbell and all cut material not being used on site must be removed to the landfill at Ft. Campbell.

The contractor will be provided a location within five (5) miles of the site to take excess cut material. Soil taken to the borrow pit shall be separated by USCS Classification, including separating topsoil. The contractor shall also dress site and stabilize after 14 days of inactivity.

It is the responsibility of the Contractor to have any offsite fill material confirmed clean by an environmental engineering firm approved by the COR. This confirmation shall include obtaining and testing representative samples from the proposed borrow source. All proposed borrow sources, borrow materials, sampling and analysis plans and reports shall be approved by the COR prior to transportation of offsite fill to the site.

6.4.9. Haul Routes and Staging Areas

(a) Use Gate 7 as the Haul Route to the construction work area. Refer to Appendix J, Borrow/Disposal Area Plan for Haul Route.

Contractor access to the site and haul routes within the base have been developed and are included in Appendix J. The majority of the route exists as a combination of paved and gravel roads. The contractor is required to evaluate the condition with the COR (providing picture and video evidence as necessary) and document the condition of the existing roadways specified for contractor access to the site. Once construction is complete, the route will be reviewed once again, and the contractor will be required to return the route to a similar condition as existed on the first day of the contract.

No physical fences are required along the access road, except as noted in Appendix J. A manned gate will be required as described in Appendix MM. The contractor will not be permitted stopped traffic (for any length of time), take pictures (except as noted above), or allow workers in any unauthorized area.

No access will be granted to the 160th Compound for the contractor from Bell Station Spur Road. No contractor access will be granted through the 160th compound from Perimeter Road except for deliveries of large and oversized items which must be approved with the COR a minimum of 2 working days prior to desired delivery. Access for these large deliveries will be limited to 0900-1000 and 1300-1500 on weekdays. If the contractor finds another feasible option to obtain access to the site while not compromising the security of the 160th Compound, the Contractor may present that option to the COR for consideration.

The contractor will be required to provide security fencing along his site to separate his worksite from the 160th Compound. Fencing will not be permitted near the existing runway or along the existing apron. A low to the ground barrier/delineator must be provided along the existing concrete apron areas during construction. See Appendix J for more information. The contractor will be required to supply their own security guards – who must be able to meet requirements set forth by the 160th including background checks and security clearances – during construction. These security guards must watch all construction activities occurring near the existing concrete apron area and ensure that unauthorized access is not permitted into the 160th compound along this existing apron. The contractor shall provide a staffed security gate to prohibit unauthorized access to site from his access road.

Construction vehicles are only required to be searched upon their first visit to FTC through Gate 7.

Upon completion of construction, the contractor shall lock the construction gate and leave temporary access roads in place for the government. All temporary fencing/barriers around the construction site shall be otherwise removed.

The staging area provided to the contractor for this project is defined in Appendix J.

6.4.10. Clearing and Grubbing:

The existing wooded area on the site has been evaluated for saleable timber and it has been determined that there is none. The Contractor is responsible for clearing and grubbing all areas.

6.4.11. Landscaping:

(a) Provide landscaping in accordance with UFC 4-010-01 and the Standard Appendix I, Acceptable Plants List. Use the services of a qualified Landscape Architect, experienced in site planning and planting design. Provide a complete, integrated landscape-planting plan consisting of trees only for the overall project. The design shall reflect appropriate groupings and street tree plantings to define the open spaces. Choose tree materials on the basis of plant hardiness, climate, soil conditions, low maintenance, and quality. All selected tree and plant materials shall be easily maintained and tolerant of the specific site conditions. Incorporate sustainable design principles into the selection of plants. Plant only during periods when beneficial results can be obtained. Planting for site development within the 5-foot line shall consist of establishing groundcover (turf or other materials) consistent with adjacent landscaped areas. Additional landscaping such as ornamental planting at building entrances may be provided as a project betterment.

(b) Passive Barriers may be installed as a landscape component and consist of any combination of berms, steep banks, ditches, fences, walls, bollards, trees, and other plant materials that is located between the vehicular circulation areas and the building(s). Trees may be used as long as the spacing between branch structures and size at the time of installation would prevent vehicle intrusion. Some species will require a double row with close proximity to achieve this functionality.

(c) Maintenance during Planting Operation.

Maintain installed plants in a healthy growing condition. Begin maintenance operations immediately after each plant is installed and continue until the plant establishment period commences.

(d) Plant Establishment Period.

On completion of the last day of the planting operation, the plant establishment period for maintaining installed plants in a healthy growing condition shall commence and shall be in effect for the remaining contract time period not to exceed 12 months. When the planting operation extends over more than one season or there is a variance to the planting times, the plant establishment periods shall be established for the work completed.

(e) Maintenance during Establishment Period.

The maintenance of plants shall include straightening plants, tightening stakes and guying material, repairing tree wrap, protecting plant areas from erosion, maintaining erosion material, supplementing mulch, accomplishing wound dressing, removing dead or broken tip growth by pruning, maintaining edging of beds, checking for girdling of plants and maintaining plant labels, watering, weeding, removing and replacing unhealthy plants. If used, irrigation systems shall be for plant establishment only. Remove at the end of this period. Ft Campbell will not furnish potable water for irrigation.

(f) Unhealthy Tree.

A tree shall be considered unhealthy or dead when the main leader has died back, or 25 percent of the crown is dead. Determine the cause for an unhealthy plant. Unhealthy or dead plants shall be removed immediately and shall be replaced as soon as seasonal conditions permit in accordance with the following warranty paragraph.

(g) Warranty.

Furnished plants shall be guaranteed for a period of 12 months beginning on the date of inspection by the Contracting Office to commence the plant establishment period, against defects including death and unsatisfactory growth, lack of adequate maintenance, neglect, or by weather conditions unusual for the warranty period.

6.4.12. Turf:

(a) Seed.

State approved seed of the latest season's crop shall be provided in the original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Labels shall be in conformance with applicable State seed laws. Seed mixtures shall be proportioned by weight. Weed seed shall not exceed one percent by weight of the total mixture.

(b) Sod.

State approved sod shall be provided as classified by applicable State laws. Each individual sod section shall be of a size to permit rolling and lifting without breaking. The sod shall be relatively free of thatch, diseases, nematodes, soil-borne insects, weeds or undesirable plants, stones larger than one (1) inches in any dimension, woody plant roots, and other material detrimental to a healthy stand of turf. Sod that has become dry, moldy, or yellow from heating, or has irregular shaped pieces of sod and torn or uneven ends shall be rejected. Sod shall be machine cut to a uniform thickness of 1-1/4 inches within a tolerance of 1/4 inch excluding top growth and thatch. The limitation of time between harvesting and placing sod shall be 36 hours.

(c) Sprig Quality.

The cultivar shall be provided as healthy living stems, stolons, or rhizomes with attached roots, including two (2) or three (3) nodes, and shall be from four (4) to (6) inches long, without adhering soil. Sprigs shall be provided which have been grown under climatic conditions similar to those in the locality of the project. Sprigs shall be obtained from heavy and dense sod, free from weeds or other material detrimental to a healthy stand of turf. Sprigs that have been exposed to heat or excessive drying shall be rejected. The time limitation between harvesting and placing sprigs shall be 24 hours.

(d) Temporary Turf Cover.

When there are contract delays in the turfing operation or a quick cover is required to prevent erosion, the areas designated for turf shall be seeded with a temporary seed. When no other turfing materials have been applied, the quantity of one-half of the required soil amendments shall be applied and the area tilled.

(e) Final Turf.

The turf shall be installed during appropriate planting times and conditions recommended by the trade for the type and variety of turf specified. The turf operations shall be performed only during periods when beneficial results can be obtained. Drainage patterns shall be maintained. The turf shall be installed by using the methods as recommended by the trade for the type and variety of turf specified. Immediately after turfing, the area shall be protected against traffic or other use by erecting barricades and providing signage as required. The turf establishment period for establishing a healthy stand of turf shall begin on the first day of work under the turfing contract and shall end three (3) months after the last day of the turfing operation. An unsatisfactory stand of turf shall be repaired as soon as turfing conditions permit.

6.4.12.1. Satisfactory Stand of Turf:

(a) Seeded Lawn & Field Area.

A satisfactory stand of turf from the seeding operation is defined as a minimum of 150 grass plants per square foot. The total bare spots shall not exceed 2 percent of the total seeded area.

(b) Sodded Area.

A satisfactory stand of turf from the sodding operation is defined as living sod uniform in color and texture. Bare spots shall be no larger than two (2) inches square. Sod shall be placed in all ditch flow lines and slopes, around each building, and a 10 foot strip adjacent to all structures such as curbs, sidewalks, roads, catch basins, etc.

(c) Sprigged Area.

A satisfactory stand of turf from the sprigging operation is defined as a minimum of 20 sprigs per square meter (2 sprigs per square foot). Bare spots shall be no larger than 9 inches square. The total bare spots shall not exceed two (2) percent of the total sprigged area.

6.4.12.2. Maintenance During Establishment Period:

(a) The maintenance of the turfed areas shall include eradicating weeds, eradicating insects and diseases, protecting embankments and ditches from erosion, maintaining erosion control materials and mulch, protecting turf areas from traffic, mowing, watering, post-fertilization, and replacing unsatisfactory turf areas. If used, irrigation systems shall be for plant establishment only. Remove at the end of this period. Ft Campbell will not furnish potable water for irrigation.

6.5. ARCHITECTURE

6.5.1. General: To the maximum extent possible within the contract cost limitation, the buildings shall conform to the look and feel of the architectural style and shall use the same colors as adjacent facilities as expressed herein. The Government will evaluate the extent to which the proposal is compatible with the architectural theme expressed in the RFP during the contract or task order competition. The first priority in order of importance is that the design provides comparable building mass, size, height, and configuration compared to the architectural theme expressed herein. The second priority is that design is providing compatible exterior skin appearance based upon façade, architectural character (period or style), exterior detailing, matching nearby and installation material/color pallets, as described herein.

6.5.2. Design

6.5.2.1. Appendix F is provided "For Information Only", to establish the desired site and architectural themes for the area. Appendix F identifies the desired project look and feel based on **Fort Campbell's** Installation Architectural Theme from existing and proposed adjacent building forms; i.e. building exterior skin, roof lines, delineation of entrances, proportions of fenestration in relation to elevations, shade and shadow effects, materials, textures, exterior color schemes, and organizational layout.

6.5.2.2. The design should address Fort Campbell's identified preferences. Implement these preferences considering the following:

- (a) Achievable within the Construction Contract Cost Limitation (CCL)
- (b) Meets Milestones within Maximum Performance Duration.
- (c) Achieves Full Scope indentified in this Solicitation
- (d) Best Life-Cycle Cost Design
- (e) Meets the Specified Sustainable Design and LEED requirements.
- (f) Complies with Energy Conservation Requirements Specified in this RFP.

6.5.2.3. Priority #1. Visual Compatibility: Facility Massing (Size, Height, Spacing, Architectural Theme, etc.) Exterior Aesthetic Considerations: The buildings massing, exterior functional aesthetics, and character shall create a comprehensive and harmonious blend of design features that are sympathetic to the style and context of the Installation. The Installation's intent for this area is:

(a) Roof Design

The Contractor shall utilize the services of a Registered Roof Consultant (RRC) certified by the Roof Consultant Institute (RCI) who specializes in roofing to approve the roof design. The RRC shall verify in writing that the roof design is in accordance with current edition of the NRCA Roofing and Waterproofing Manual, applicable UFC's, the RFP and standard industry practices and building codes.

The Contractor shall utilize a Registered Roof Observer (RRO) certified by the Roof Consultant Institute (RCI) who specializes in roofing to approve the roof installation. The RRO shall verify in writing that the roof installation is in accordance with the accepted design, manufacturer's instructions, the NRCA Roofing and Waterproofing Manual, applicable UFC's, the RFP and standard industry practices and building codes.

6.5.2.4. Priority #2. Architectural Compatibility: Exterior Design Elements (Materials, Style, Construction Details, etc.) Roofs, Exterior Skin, and Windows & Door Fenestrations should promote a visually appealing compatibility with the desired character while not sacrificing the integrity and technical competency of building systems.

6.5.2.5. See Appendix F for exterior colors that apply to Architectural character at Fort Campbell. The manufacturers and materials referenced are intended to establish color only, and are not intended to limit manufacturers and material selections.

6.5.2.6. Additional architectural requirements:

- (a) Install fall protection anchor points on all roofs with a slope greater than 2:12
- (b) Exterior Skin. If the Offerors proposal consists of brick, split faced or scored CMU, which will be exposed to weathering, provide efflorescence testing and prevention measures. Schedule tests far enough in advance of starting masonry work to permit retesting. Apply water repellent primer and stain to all exterior architectural CMU walls after completion of exterior work and when the masonry is not subject to damage by construction activities.
- (c) Hardware. Provide a removable Small Format Interchangeable Core (SFIC) "I/C - 7 pin Insta-Key" integrated master keying system for all doors. SFIC's shall be compatible with the existing "I/C - 7

pin Insta-Key" system used at Fort Campbell. Combination locks used in secured areas shall be Mass Hamilton X09 type or LKM 7000 by Lockmasters Inc with an S&G 2740-100; Do not use the CDX-09. Electric locks shall be stand alone Best BASIS "G" system with encoders and Kiosk. Coordinate installation with the DPW Locksmith Shop. Point of contact is Bob Ayers, (270) 798-3581 (office).

(d) Telecommunication Room and Electrical Room locks shall be *Insta-Key* cored and compatible with the Mortise lock - Schlage Model CL5594-MGK-SFS-626-ATR or Cylindrical Lock - Schlage Model CL5196-MGK-SFS-626-ELB-ATR.

(e) Mechanical Rooms shall have an exterior building access only for maintenance personnel and accessible to maintenance vehicles. Provide a hasp and DPW approved padlock in addition to standard *Insta-Key* core.

(f) Telecommunications Rooms shall have an interior access point unless otherwise specified or indicated. In the case of exterior access, install equipment cabinet(s) instead of racks in the Telecommunications Rooms. Cabinet(s) shall be dust rated with glass front door and accessible rear panel.

(g) The Contractor shall utilize the services of a Registered Roof Consultant (RRC) certified by the Roof Consultant Institute (RCI) who specializes in roofing to approve the roof design. The RRC shall verify in writing that the roof design is in accordance with current edition of the NRCA Roofing and Waterproofing Manual, applicable UFC's, the RFP and standard industry practices and building codes.

(h) The Contractor shall utilize a Registered Roof Observer (RRO) certified by the Roof Consultant Institute (RCI) who specializes in roofing to approve the roof installation. The RRO shall verify in writing that the roof installation is in accordance with the accepted design, manufacturer's instructions, the NRCA Roofing and Waterproofing Manual, applicable UFC's, the RFP and standard industry practices and building codes.

6.5.3. Programmable Electronic Key Card Access Systems:

Install programmable electronic key card access system at the main building entrance.

Electronic locks shall be stand alone Best BASIS "G" system with encoders and kiosk as required.

6.5.4. INTERIOR DESIGN

6.5.4.1. Interior building signage requirements:

- All Room Identification signage shall be from one manufacturer.
- All signs shall be made of durable materials and located to be easily visible while avoiding incidental damage from facility operations.
- All room numbers shall be permanent. The Contractor shall work with the Base standards.
- Provide exit door tactile signage as required by NFPA 101.
- All signs shall meet ABA requirements.
- Where possible, use international symbols in addition to messages.
- All emergency/fire evacuation plan signs shall be approved by the COR before production and installation.

- COR to determine the room numbering system and plan. The numbers shall be in chronological order and flow logically through the facility. Room numbers on drawings are for construction only.
- Building Service signs for all permanent spaces such as mechanical, electrical, communication and janitorial rooms shall have permanent room numbers and permanent corresponding room name messages.
- Room identification signs shall be by room number only.
- Identify doors to receive a permanent room name and/or a window insert at final design submittal of the interior signage schedule.
- Direction Signs shall be located at the entrances into all connecting corridors.
- Each door throughout the facility, with the exception of store front doors shall receive a room sign with a permanent room number.
- Secondary Directional signs shall list room numbers with corresponding directional arrows.
- Each corridor shall have emergency/fire evacuation plan signs located at key areas to insure life safety.
- All signs shall be made of durable materials and located to be easily visible while avoiding incidental damage from facility operations

6.5.4.2. Interior Design Considerations:

(a) Interior Partitions and Walls.

The use of wall coverings that do not breathe such as vinyl wall coverings is not permitted on the interior face of exterior walls due to the tendency for mold to develop.

(b) Interior Glass and Glazing: Coordinate the arrangement of fenestrations with the proposed furniture layout.

6.5.4.3. Furniture, Fixtures and Equipment Design Development:

(a) During design development, coordinate the location of furniture so that it does not interfere with other building systems (i.e. electrical and communication outlets, thermostats, etc.).

(b) Coordinate with USACE and DPW during design development. Point of contact for DPW, Master Plans is Sharon (Davis) Presley at (270) 956-2926 or email sharron.davis@us.army.mil.

6.6. STRUCTURAL DESIGN

6.6.1. Site Specific Loading Requirements

6.6.1.1 Structural Loading. Design building structures for the following types of minimum site specific loads per most recent versions of ASCE-7 and IBC.

6.6.1.1.1. Roof Live Load – 20 psf

6.6.1.1.2. Snow Load – 15 psf (pg, ground snow load)

6.6.1.1.3. Wind Load – 90 mph, 3-second gust

6.6.1.1.4. Seismic Criteria - As determined from a site specific geotechnical investigation, but not less than the following values:

$$S_s = 0.59g$$

$$S1 = 0.19g$$

And not more than the following values:

$$Ss = 0.74g$$

$$S1 = 0.22g$$

6.6.2 The structural design shall meet all of the seismic requirements of the Applicable Codes and Standards including a continuous load path and interconnection, consideration of plan irregularities and effects due to inherent and accidental torsion, and consideration of building expansion joints. Seismic design also includes the bracing of various systems, piping, hangars, etc.

6.6.3 Note that areas of Fort Campbell contain Karst geology and are subject to potential sinkholes.

6.6.4 The structural system shall be compatible with building use. For example, do not locate columns in rooms requiring visibility or open space, such as entries, common areas, etc.

6.6.5 Extend bearing portions of substructure to levels below the frost line. Frost penetration is 22 inches below grade.

6.6.6 Treat subgrades under all facility foundations to resist subterranean and other wood destroying insects known to exist in the vicinity of the site. Treat in accordance with the environmental criteria referenced in this document.

6.6.7 Radon Mitigation: Ensure that the building prevents/mitigates the accumulation of radon gas. Fort Campbell requires the installation of radon mitigation features be included in all new construction as shown in the applicable Appendix of this document. The design and construction of foundation walls, slabs, and crawl spaces shall include provisions for the reduction of radon entry and facilitate its removal. Radon exhaust vents shall extend through the roof. Test exhaust vents prior to occupancy. If radon is realized in amounts past the acceptable levels, exhaust fans will be required. An equitable adjustment (credit or increase, as appropriate) will be provided pursuant the contract Changes clause. For additional information, contact the TSCA Program Manager of the Fort Campbell Environmental Division at (270) 798-9604.

6.6.8 Water Barrier: A capillary water barrier is required under all interior slabs-on-grade. The capillary water barrier shall, as a minimum, prevent the mitigation of termites, radon, and moisture.

6.6.9 Equipment Pads: Elevate interior floor or slab-on-grade mounted equipment on minimum 4 inch thick concrete pads to prevent accumulation of water and metal corrosion. Elevate exterior on-grade mounted equipment on minimum 6 inch thick concrete pads. Turn down perimeter of exterior pads to a level below the frost line.

6.7. THERMAL PERFORMANCE

There are no additional requirements other than those previously stated/referenced.

6.8. PLUMBING

There are no additional requirements other than those previously stated/referenced.

6.9. SITE ELECTRICAL AND TELECOMMUNICATIONS SYSTEMS

6.9.1. Primary Electrical Distribution.

The point of connection for the primary feed to the site shall be

via a new pad mount transformer to be provided and installed by the Contractor on the southwestern end of the 160th Complex adjacent to the new hangar (located in accordance with UFC 3-600-01). The Contractor will provide a new 15kV feeder circuit from the 59th Street Substation to the new transformer.

- (a) Provide primary ductbank with one spare conduit. Ductbank shall be concrete encased.

- (b) Primary conductors shall be copper. Aluminum is not permitted.
- (c) Provide load-break cutouts and arrestors at point of connections for underground primary services. For overhead distribution tap lines, provide load break cutouts.
- (d) Coordinate connections with Fort Campbell DPW, Electrical Utility Section.

6.9.2. Underground Secondary Distribution System.

The system shall consist of direct buried conduit and copper conductors.

6.9.3. Transformers.

Transformers shall be pad-mounted type, 12.47 kV delta primary and secondary voltage as appropriate for load(s) to be served. Service transformers, for all 15kV and below, 3-phase underground fed installations, shall be of the pad-mounted type. Transformers shall contain FR3 dielectric fluid. The high-voltage compartment shall be dead-front construction. Primary switching and protective devices shall include loadbreak switching, fuse protection, medium-voltage separable load-break connectors, universal bushing wells and inserts or integral one piece bushings and surge arresters. The nameplate rating for the transformer shall not be less than 110 percent of the KVA demand load calculated for the transformer. Provide copper windings, not aluminum. The enclosure shall include a hasp and pad lock.

6.9.4. Street and Area Lighting.

6.9.4.1 Provide lighting for the project site, at existing and new roadway intersections, and at intervals not exceeding 60.9 m (200 ft) between intersections. Provide area lighting at intervals not exceeding 60.9 m (200 ft) along area walkways not otherwise illuminated; and at all steps. Exterior lighting (parking lot, street, building, etc) shall be LED, Induction, LEP (Light Emitting Plasma), or energy saving technology. "Dark Sky" Lighting is a mandatory requirement for the numerous flight paths over the installation to insure the safety of the flight crews and equipment. Parking lot and security lighting will be provided at a maintained level of 0.5 to 1.0 footcandles and shall have a uniformity ratio, maximum to minimum, of 20:1 or less. All building entrances will be illuminated to 10 footcandles. Parking lot and walkway lighting shall be individually fused and mounted on aluminum poles. Install fuses for the pole-mounted fixtures in the pole base. Control shall be by photocell. This control shall be by means of one photocell per pole. Install a programmable timer with manual switch override in the Mechanical Room.

- (a) Coordinate lighting control requirements for all exterior lighting systems with the Customer, subject to the Contracting Officer's approval, to include the sequencing of the programmable timer.
- (b) Light poles installed in the parking lot shall be installed on raised concrete foundations for protection from vehicles. Light poles provided along the roadways shall be breakaway. The pole locations shall be in accordance with the Applicable Criteria.
- (c) Direct burial conduit is required for street light and area light circuits. All exterior lighting (parking lot, street, building, etc.) shall be either 120, 208, or 277 Volt. 480-Volt lighting is not permitted.

6.9.4.2 Select and locate lighting fixtures to maintain the minimum foot-candle requirements for safety and security purposes. Beyond that, aesthetic considerations should take precedence. Light poles should be consistent and provide uniformity throughout the installation. Determine the pole height by their intended function. Size light fixtures proportionally to the intended pole height. Coordinate final fixture selection with the Contracting Officer for approval.

6.9.5. Telecommunications:

6.9.5.1. General. All communications equipment, materials, and work shall be in accordance with I3A requirements and are subject to approval by the NEC office and the Contracting Officer.

6.9.5.2. The NEC will remark cables upon justifiable request by the Contractor. Contractor is not responsible to maintain locates, except to use reasonable care. For NEC contact information, refer to paragraph 6.4.6.5.

6.9.5.3. Entrance conduits in all buildings shall be a minimum of three-way, 4 inch ducts.

6.9.5.4. Do not implement Free Space Optic (FSO) systems unless approved by the NEC Plans and Architecture Branch..

6.9.5.5. Coordinate with the NEC for a list of areas where 48" of cover is required above the top of the duct. Duct bank encasements shall be in accordance with I3A requirements.

6.9.5.6. Rotary trenchers or plowing are not allowed during trenching or excavation, except in undeveloped range and training areas. NEC prefers the method of open trenching, using bucket type equipment, i.e., backhoe and track hoe. The maximum width of the trench is in accordance with the type of equipment used to dig.

6.9.5.7. Splice cable either in manholes or pedestals. Do not make buried splices or use quasite boxes unless NEC approves in writing.

6.9.5.8. Do not use aerial cable.

6.9.5.9. Provide stainless steel splice cases for all copper cable splices, or an equivalent which shall be approved by the lead planner or the Service Management Division Chief. NEC requires submittals for splice cases and splice modules prior to work beginning. Specify splice cases for the particular environment in which they shall be placed and size to accommodate the cable count spliced. Design end plates for the number and size of the cables served by the splice and design to seal around each cable individually. All splice cases shall be re-enterable and shall contain all necessary equipment to be installed properly, adhering to all appropriate electrical codes.

6.9.5.10. Install warning signs in accordance with the following:

- Sign mounted to steel PSP stake; orange in color
- 4' below ground in concrete; rising 5' above ground
- No closer than 2 feet from the center of the ditch
- If there is a change in direction, position a sign immediately at the turn showing the line
- Although I3A states every 250' for those areas that end up being less than 250' provide sign(s) accordingly, even if an additional sign is necessary.

6.9.5.11. Provide a minimum copper cable size 25 pair.

6.10. FACILITY ELECTRICAL AND TELECOMMUNICATIONS SYSTEMS

Coordinate with Fort Campbell NEC during the design process. Submit all requested deviations from the mandatory design criteria in writing for approval at the discretion of the Government.

6.10.1. Provide dual jacks in lieu of single jacks. Dual jacks shall be two CAT 6 RJ45 type with green inserts.

6.10.2. Provide Copper Voice and Data jacks in new facilities or in facilities with no existing building cabling system in accordance with the I3A Criteria Section 2.4.1.1 (TIA/EIA T568A configuration). If the existing building cabling is of type TIA/EIA T568B, then install TIA/EIA T568B.

6.10.3. Voice and Data drops shall conform to the following wire color scheme:

- Green – Voice and NIPRnet data
- Red – SIPRnet (Secret) data
- Orange – JWICS (Top Secret) data
- All faceplates shall be neutral in color. Inserts shall be the same color as the wiring used for that particular jack.

6.10.4. Install Fiber Optic patch panels in cabinets or racks that house the LAN equipment. Do not install fiber optic patch panels on backboards.

6.10.5. Terminate copper distribution on 110 type rack mounted patch panels only. Do not install 110 type patch panels on backboards.

6.10.6. Make all new fiber optic terminations using LC connectors. Terminate any connectors already in place in renovated buildings or additional fiber connections in existing buildings with the identical type of existing fiber optic connectors.

6.10.7 Key telecommunication Room doors separate from other locks in the building IAW DPW standards. Provide two copies of the key to the NEC Logistics Branch. Reference section 6.5.2.6, (b) for additional lock requirements.

6.10.8 Provide lightning protection, based on NFPA 780 (2004) Annex L Lightning Risk Assessment of the facility. Provide grounding, bonding, shielding for all facilities. Provide grounding straps and connect to the building grounding system. Provide grounding points in vehicle and equipment parking areas on 20 foot centers (maximum) and coordinated with the power and data board units. Provide ground strap on walls, and two (2) grounding points on each functional bay floor. Provide a bonding grounding in oil storage room. If lightning protection is required, install with mechanical fasteners on standing seam metal roofs.

6.11. HEATING, VENTILATING, AND AIR CONDITIONING

6.11.1 Integrate the control system to the installation's existing UMCS. The existing UMCS is FMCS at Fort Campbell, and shall be as described in Paragraph 6.2.1. Coordinate with Installation Energy Manager during the design process. Point of contact for Fort Campbell FMCS's is John Register at (270)-484-2741 or email John.W.Register@us.army.mil.

6.11.1. Outdoor design conditions include the following.

Winter Dry-Bulb:	Design Dry Bulb Day, 14°F (99%)	
Summer Dry-Bulb: (MCDB)	Design Dry Bulb Day, 92°F (1%)	Design Wet Bulb Day, 88°F
Summer Wet-Bulb: (1%)	Design Dry Bulb Day, 76°F (MCWB)	Design Wet Bulb Day, 78°F

6.12. ENERGY CONSERVATION

6.12.1. Inclusion of Renewable Energy Features. The following renewable energy features have been determined lifecycle cost effective, are included in the project budget and shall be provided:

See paragraph 6.14.8 for additional information.

6.13. FIRE PROTECTION

6.13.1. The Fire Alarm Control Panel shall be fully compatible with the existing King-Fisher Industrial Radio Alarm Control System (IRACS) presently in use at Fort Campbell. The fire alarm AM transmitter shall be Government furnished, contractor installed. Mass Notification: The required mass notification system shall be in a separate cabinet from the fire alarm system.

6.13.1.1. The fire alarm system shall be an open protocol type in that it is designed and installed such that the Government or its agents are able to perform: repair, replacement, upgrades, and expansions of the system without further dependence on the original contractor or system manufacturer.

6.13.1.2. Fire Lite, Notifier, Mirtone, and EST are approved Fire Alarm and Mass Notification systems authorized for installation in Fort Campbell facilities based on demonstrated ability to meet UFC 4-021-01 and Fort Campbell criteria and in order to reduce training, maintenance, and reserve parts cost. The proposed fire alarm system particular model must meet all requirements as stated above.

6.13.1.3. There shall be no requirement for software locks, special tools and any other proprietary equipment to maintain, add devices to or delete devices from the system, or test the Fire Alarm system. Fire detection and alarm systems shall be able to be programmed from the control panel and the Government's laptop. Provide any software, cables / interface devices required to manipulate the system, coordinated with Government personnel and jointly installed on the DPW laptop computer without any licensing agreements, signed documents or any requirements upon the Government to rely on any contractor or manufacturer for maintenance or manipulation of the system.

6.13.1.4. Provide space within exterior mechanical and within electrical rooms to accommodate the fire alarm and mass notification panels as well as the Government supplied Contractor installed Kingfisher transmitter. Provide exterior access to the Mechanical Room and where possible to the Electrical Room to allow Fire Dept access. Install remote fire alarm annunciators only when required.

6.13.1.5. Fire alarm system shall be addressable type, Class A, looped.

6.13.1.6. Install a weather proof exterior fire alarm strobe on the outside of the building on the street side to signal responding Fire Dept.

6.13.1.7. Provide a bronze, Series 3200 Knox-Box located within 10 feet of front entrance to the building at a mounting height of five feet.

6.13.2. Mass Notification/PA System:

6.13.2.1. The Mass Notification System shall be capable of connecting to a future facility wide system using dry contacts and 600 Ohm audio inputs

6.13.2.2. Provide LOC (local operating console) without locking door next to staff duty or receptionist station (where applicable to the facility type). Provide additional LOC's as required by applicable criteria.

6.13.2.3. The Mass Notification system shall be pre-programmed MNS (male voice). Audible announcement messages shall be as follows: and include the NFPA 72 (2010) Para 24.4.2.17 "this is a test" requirement:

(a) WEATHER (100 KHZ Steady tone, 5 Seconds); THE NATIONAL WEATHER SERVICE HAS ISSUED A SEVERE WEATHER ALERT FOR THIS AREA. TUNE TO LOCAL RADIO AND TELEVISION STATIONS FOR FURTHER GUIDANCE.

(b) SUSPICIOUS ACTIVITY (Fast whoop, 5 Seconds); MAY I HAVE YOUR ATTENTION PLEASE! A POSSIBLE BREACH IN SECURITY HAS BEEN REPORTED. PLEASE REMAIN CALM. YOU ARE INSTRUCTED TO TAKE APPROPRIATE SECURITY MEASURES AND REPORT SUSPICIOUS PERSONNEL, VEHICLES, PACKAGES OR ACTIVITIES TO SECURITY PERSONNEL.

- (c) FIRE (horn sound, 5 seconds) ATTENTION, ATTENTION. A FIRE EMERGENCY HAS BEEN REPORTED. PLEASE LEAVE THE BUILDING USING THE NEAREST EXIT.
- (d) TORNADO WARNING (horn sound, 5 seconds) ATTENTION, ATTENTION. A TORNADO WARNING HAS BEEN ISSUED FOR THIS AREA. A TORNADO WARNING HAS BEEN ISSUED FOR THIS AREA.
- (e) CHEMICAL RELEASE WARNING (horn sound, 5 seconds) ATTENTION, ATTENTION. A CHEMICAL RELEASE HAS BEEN ISSUED. STAY INSIDE BUILDINGS AND CLOSE WINDOWS AND DOORS UNLESS ADVISED BY AUTHORITIES TO EVACUATE AREA. CHEMICAL RELEASE. STAY INSIDE BUILDINGS AND CLOSE WINDOWS AND DOORS UNLESS ADVISED BY AUTHORITIES TO EVACUATE AREA.
- (f) ALL CLEAR (horn sound, 5 seconds) ATTENTION, ATTENTION. THE EMERGENCY IS OVER. I REPEAT THE EMERGENCY IS OVER. RESUME YOUR NORMAL DUTIES.
- (g) EVACUATION WARNING (horn sound, 5 seconds) ATTENTION, ATTENTION. THIS IS AN EMERGENCY EVACUATION ORDER. REMAIN CALM, FOLLOW THE INSTRUCTIONS OF THE EMERGENCY OFFICIALS. THIS IS AN EMERGENCY EVACUATION ORDER. OBEY THE EMERGENCY OFFICIALS. REMAIN CALM.
- (h) BOMB THREAT WARNING (horn sound, 5 seconds) ATTENTION, ATTENTION, A BOMB THREAT ALERT HAS BEEN ISSUED FOR THIS BUILDING. ALL PERSONNEL ARE TO EVACUATE IMMEDIATELY USING THE NEAREST EXIT. FURTHER INSTRUCTIONS WILL BE ISSUED OUTSIDE THE BUILDING BY EMERGENCY RESPONSE TEAMS.
- (i) TERRORIST THREAT WARNING. (horn sound, 5 seconds) MAY I HAVE YOUR ATTENTION, PLEASE. A TERRORIST THREAT HAS BEEN RECEIVED. EFFECTIVE IMMEDIATELY, WE ARE OPERATING "SECURE AND LOCKDOWN PROCEDURES." ALL PERSONNEL SHOULD REMAIN CALM AND STAY WHERE YOU ARE. PLEASE AWAIT FURTHER INSTRUCTIONS."
- (j) FPCON C (wail, 5 seconds) ATTENTION, ATTENTION. FORT CAMPBELL IS IN FORCE PROTECTION CONDITION CHARLIE. ALL PERSONNEL IMMEDIATELY IMPLEMENT FPCON CHARLIE ACTIONS.
- (k) FPCON D (Wail, 5 seconds) ATTENTION, ATTENTION. FORT CAMPBELL IS IN FORCE PROTECTION CONDITION DELTA. ALL PERSONNEL IMMEDIATELY IMPLEMENT FPCON DELTA ACTIONS.

6.13.3. Portable Fire Extinguishers.

6.13.3.1. Provide and install flush or semi-mounted Fire Extinguisher Cabinets and Brackets in accordance with UFC 3-600-01 and NFPA 101 to accommodate Government Furnished/Government Installed Fire Extinguishers. Do not use glass or lockable doors in fire extinguisher cabinets.

6.13.3.2. Government will provide ten-pound portable dry chemical (Class ABC) Fire Extinguishers manufactured by Amerex.

6.14. SUSTAINABLE DESIGN

6.14.1. LEED Rating Tool Version. This project shall be executed using LEED-NC Version 3.

6.14.2. The minimum requirement for this project is to achieve LEED Silver level. Each non-exempt facility (building plus sitework) must achieve this level. In addition to any facilities indicated as exempt in paragraph 3, the following facilities are exempt from the minimum LEED achievement requirement: None..

6.14.3. Credit Validation: LEED registration, compiling of documentation at LEED OnLine and use of the LEED Letter Templates is required. Registration and payment of registration fees will be by the

Government. Administration/team management of the online project will be by the Government. Validation of credits will be accomplished by the Government. LEED certification of the project by the Contractor is not required. The Government may choose to seek LEED certification of the project, in which case the Government will pay certification fees and coordinate with the GBCI and the Contractor will furnish audit data as requested at no additional cost.

6.14.4. Commissioning: See Appendix M for Owner's Project Requirements document(s).

6.14.5. LEED Credits Coordination. The following information is provided relative to Sustainable Sites and other credits.

SS Credit 1 Site Selection:

Project site IS NOT considered prime farmland.

Project site is five feet or more above 100-year flood elevation.

Project site contains no habitat for threatened or endangered species.

No portion of project site lies within 100 feet of any water, wetlands or areas of special concern.

Project site WAS NOT previously used as public parkland.

SS Credit 2 Development Density & Community Connectivity.

Project site DOES NOT meets the criteria for this credit.

SS Credit 3 Brownfield Redevelopment.

Project site DOES NOT meets the criteria for this credit.

SS Credit 4.1 Public Transportation Access.

Project site DOES NOT meets the criteria for this credit.

EA Credit 6 Green Power.

35% of the project's electricity WILL NOT will be provided through an Installation renewable energy contract. Do not purchase Renewable Energy Credits (REC's) to earn this credit.

MR Credit 2 Construction Waste Management.

The Installation has an on-post recycling facility.

Regional Priority Credits (Version 3 only)

The project zip code is 42223.

6.14.6. LEED Credit Preferences, Guidance and Resources. See Appendix L LEED Project Credit Guidance for supplemental information relating to individual credits.

6.14.7. Not Used

6.14.8. Additional Information

(a) LEED Validation

Due to security requirements, this project shall **not** be registered with GBCI, nor shall GBCI certification be pursued. All documentation shall be completed in accordance with the requirements of the applicable LEED version and validated by the Government. The Contractor shall be responsible for providing all information to the Government for review to a secure internet repository to be validated by the Government. Documentation shall be as indicated in Appendix PP LEED Submittal Requirements for Unregistered Projects, not the requirements shown in Section 01 33 16, Attachment E.

(b) Commissioning

Modify paragraph 5.8.5 to read as follows:

5.8.5. COMMISSIONING: All HVAC systems and equipment including controls, lighting including controls, domestic hot water, and renewable energy systems shall be commissioned in accordance with LEED EA credit 3 Enhanced Commissioning and EA prerequisite 1 Fundamental Commissioning of Building Energy Systems. The Commissioning Authority (CxA) will be provided by the Government. The CxA will develop the commissioning plan, review design documents, develop installation and functional performance test checklists, review submittals, perform inspections, lead functional performance testing, review the systems manual, and prepare a commissioning report. The Contractor shall coordinate with the CxA and provide additional testing and reports indicated in other RFP sections as part of the Commissioning process.

The Contractor shall be responsible for the following:

- The Contractor shall provide a single point of contact for coordination of all commissioning activities. The point of contact shall coordinate all of the Contractor and sub-contractor involvement in the commissioning activities.
- The Contractor and the DOR shall meet with the CxA and USACE prior to the 65% design submittal to discuss commissioning requirements and processes, roles and responsibilities, schedules, lines of communication, and logistics related to the commissioning process. The Owner's Project Requirements document shall be reviewed during this meeting.
- Review the commissioning plan, 1 plan review per design submittal, and provide comments within 2 weeks of receipt.
- Develop the project commissioning specifications. Incorporate the requirements of the commissioning plan into the project commissioning specifications and attach a copy of the plan to the specifications.
- Attach inspection checklists, functional performance test checklists, Owner's Project Requirements document, Basis of Design document, and Training Tracking Template to the project commissioning specifications.
- Evaluate CxA design review comments for each design submittal concurrent with evaluation of USACE review comments.
- The Contractor shall meet with the CxA and USACE prior to beginning construction to discuss commissioning requirements and processes, roles and

responsibilities, lines of communication, inspection and test procedures, incorporation of commissioning activities into the construction schedule, and logistics.

- Respond to deficiencies, problems, or other issues when identified by the CxA.
- Provide all testing/calibration equipment required to perform inspections and testing of equipment and systems undergoing commissioning.
- All sub-contractors associated with systems to be inspected shall complete inspection and document the inspection by completing the inspection checklists provided by the CxA.
- The Contractor's Quality Control Representative shall accompany the CxA during CxA inspections. 100% of equipment in commissioned systems shall be inspected.
- All sub-contractors associated with systems to be tested participate and facilitate functional performance testing in accordance with the commissioning plan. The CxA will lead the tests. Testing will be documented using the functional performance test checklists. 100% of HVAC, lighting control, domestic hot water, and renewable energy systems will be tested to include all capacities, sequences of operation, safeties, interlocks, and sensor calibration. Systems that fail initial testing shall be corrected and re-tested until they pass. Re-testing shall not occur until all deficiencies are corrected.
- The Contractor's Quality Control Representative shall accompany the CxA during functional performance testing.
- Functional performance testing that can not be completed due to weather conditions shall be performed when weather conditions permit. Schedule these tests in coordination with USACE and the CxA.
- Develop a systems manual compliant with LEED EA credit 3 Enhanced Commissioning requirements. System manual shall include at a minimum: single line diagrams, as-built sequences of operation, control drawings, original setpoints, recommended schedule of maintenance if not covered by O&M manuals, and recommended schedule for sensor and actuator calibration. The Contractor shall correct deficiencies found in the system manual by the CxA or USACE.
- Track completion of training by completing the training tracking template. Provide updated template to USACE and the CxA after each training session.
- The Contractor's Quality Control Representative shall accompany the CxA during the post-occupancy building operation review required by LEED EA credit 3 Enhanced Commissioning. The Contractor shall make necessary corrections, modifications and complete all work required by the Corrective Action Plan (required by LEED EA credit 3) developed including ensuring that manufacturer warranty actions are completed.
- The Contractor shall update the Systems Manual based on corrective actions taken after the post-occupancy building operation review work is completed.

(c) Additional Requirements

The project design shall comply with Executive Order 13423 and Engineering and Construction Bulletin (ECB) 2011-1 requirements. ECB 2011-1 is included in Appendix BB for Reference.

In accordance with ECB 2010-14 and ECB 2011-1, all references to energy consumption reduction shall be considered against ASHRAE 90.1-2007. Compliance with the minimum requirements of ASHRAE 90.1-2010 is required.

The following LEED credits are required to be achieved:

- EA 1 Optimize Energy: earn at least 15 points under this credit
- EA 3 Enhanced Commissioning
- EA 5 Measurement and Verification
- MR 2 Construction Waste Management
- MR 4 Recycled Content
- IEQ 3.1 Construction IAQ Management Plans
- IEQ 3.2 Construction IAQ Management Plans
- IEQ 7.1 Thermal Comfort Design

In addition, at least of 40% of the minimum points required for Silver level certification shall be earned in any combination of the following credits as applicable to the project scope and allowed by other RFP requirements (see Appendix O):

- SS 7.1 Heat Island Effect, Non-Roof
- SS 7.2 Heat Island Effect, Roof
- SS 8 Light Pollution Reduction
- WE 1.1 Water Efficient Landscaping - Reduce Potable Water Use by 50%
- WE 1.2 Water Efficient Landscaping - No Potable Use or No Irrigation
- WE 2 Innovative Wastewater Technologies
- WE 3 Water Use Reduction
- EA 1 Optimize Energy Performance
- EA 2 On-Site Renewable Energy
- EA 3 Enhanced Commissioning
- EA 5 Measurement & Verification
- EA 6 Green Power
- IEQ 1 Outside Air Delivery Monitoring
- IEQ 8.1 Daylight & Views - Daylight 75% of Spaces
- ID 1.1-1.5 Innovative Design, if achieved for energy and/or water savings

- RP 1.1-1.4 Regional Priorities, if achieved for energy and/or water savings

(d) Additional ECB 2011-1 Requirements

In accordance with ECB 2011-1, the following Energy and Sustainability Enhancements have been identified by the Government and shall be included in the project:

- Add the following to Paragraph 5.11.5: In addition, achieve a 2 percent glazing factor (calculated in accordance with LEED credit EQ8.1) in all Aircraft Maintenance Bays (see Attachment A) and provide automatic dimming controls. All daylighting shall meet "dark sky" lighting requirements.
- Change the first sentence of Paragraph 5.5.2.12, (b) to read as follows: Test the completed building and demonstrate that the air leakage rate of the building envelope does not exceed the following values at a pressure differential of 0.3" w.g. (75 Pa) in accordance with ASTM's E 779 (2003) or E-1827-96 (2002):
 - Administrative Core and Support Spaces: 0.15 cfm/ft²
 - Aircraft Maintenance Bay and Aircraft Maintenance Areas (Shops): 0.25 cfm/ft²
- All HVAC equipment efficiency ratings shall meet or exceed ASHRAE 189.1 requirements.

6.15. ENVIRONMENTAL

6.15.1. Solid Waste Disposal/Diversion Practices:

6.15.1.1. Solid Waste Disposal/Diversion Practices shall be in accordance with Appendix E, Environmental information. All construction activities at Fort Campbell shall require at least a 50% diversion of construction materials such as excess lumber, roofing, drywall, carpet, piping, cardboard, etc to be diverted from the landfill. Reference Appendix J, for Borrow/Disposal Area Plan.

6.15.1.2. Government policy shall apply to sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy, the Contractor shall: (1) Practice efficient waste management when sizing, cutting, and installing products and materials, (2) use all reasonable means to divert construction, and demolition waste from landfills and incinerators and to facilitate their recycling or reuse. Recycling Construction and Demolition Debris guidance and documentation requirements can be found on the Fort Campbell Environmental Web Site: (<http://www.campbell.army.mil/campbell/directorates/DPW/envdiv/Pages/RecyclingConstructionDemo.aspx>).

6.15.1.3. Submit a Waste Management Plan (WMP) within 15 days after Notice to Proceed (NTP) and prior to initiating any site preparation work. Include the following:

- (a) Name of individuals on the Contractor's staff responsible for waste prevention and management.
- (b) Actions that will be taken to reduce solid waste generation.
- (c) Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas and equipment to be used for processing, sorting, and temporary storage of wastes.
- (d) Characterization, including estimated types and quantities, of the waste to be generated.
- (e) Name of landfill and/or incinerator to be used and the estimated costs for use, assuming that there would be no salvage or recycling on the project.

- (f) Identification of local and regional reuse programs, including non-profit organizations such as schools, local housing agencies, and organizations and accept used materials such as materials exchange networks and Habitat for Humanity.
- (g) List of specific waste materials that will be salvaged for resale, salvaged and reused, or recycled. Recycling facilities that will be used shall be identified.
- (h) Identification of materials that cannot be recycled / reused with an explanation or justification.
- (i) Anticipated net cost savings determined by subtracting Contractor program management costs and the cost of disposal from the revenue generated by sale of the materials and the incineration and/or landfill cost avoidance.

6.15.2. Sediment and Erosion Control:

Design and construct the project in accordance with the Fort Campbell Policy for Stormwater Erosion and Sediment Control at Construction Sites. This policy can be found on the Fort Campbell Environmental Web Site: (<http://www.campbell.army.mil/envdiv/en1.htm>)

6.15.3. Ban on use of asbestos containing materials, lead based paint and PCB's.

6.15.3.1 Do not use asbestos containing materials (ACMs), lead based paint (LBP), or PCBs.

6.15.3.2 Provide the required No Asbestos – Containing Material (ACM) Certification in accordance with the following.

(a) Design Phase. Before final payment of the project design fee, the designer of record (DOR) shall submit to the government, on their firm's letterhead, a signed, stamped and dated copy of the following statement:

"I hereby certify that no asbestos-containing material (ACM) was specified as a building material in any construction document for this project. Furthermore, I certify that no product containing mineral fibers was specified as a building material in any construction document for this project unless I either

- 'Have on file and have submitted to the Government, the manufacturer's certification that the material does not contain asbestos,' or

- 'Have supplied to the Government documentation to show that the material has been microscopically examined by an AIHA- or NVLAP-certified laboratory and the lab has determine that it does not contain asbestos.' "

(b) Construction Phase. Before final payment to the Contractor, the Contractor's project engineer/manager will sign and submit to the Government, on the Contractor's letterhead, a dated copy of the following statement:

"I hereby certify that to the best of my knowledge no asbestos-containing material (ACM) was used as a building material during this project. I understand that the building Owner presumes that all materials marked 'May contain mineral fibers' are asbestos unless I either:

- 'Have on file and have submitted to the Government the manufacturer's certification that the material does not contain asbestos,' or

- 'Have supplied to the Government documentation to show that the material has been microscopically examined by an AIHA- or NVLAP-certified laboratory and the lab has determine that it that it does not contain asbestos.' "

6.15.4. Air pollution restrictions applicable to this project do not allow materials to be burned on Government premises.

6.15.5. The Installation Forrester must complete a survey before any trees with diameters greater than 6 inches are removed. This is in addition to Section 3.1 Land Resources under Section 01 57 20.00 10.

6.15.6. Maintain all excavations, stockpiles, access roads, waste areas, and all other work areas free from excess dust to such a reasonable degree as to avoid causing hazard or nuisance.

6.15.7. Underground Storage Tanks (USTs):

Do not install UST's without approval from the DPW Environmental Division. If permitted, USTs shall be double walled steel fiberglass coated with interstitial monitoring and automatic tank gauging. The monitoring system shall be compatible with the systems already in use and capable of being remotely monitored by the Environmental Division. Do not install used oil USTs.

6.15.8. Aboveground Fuel Storage Tanks (ASTs).

6.15.8.1. ASTs shall conform to all Federal, State, Local regulations and guidelines and these design requirements.

6.15.8.2. ASTs shall be double-walled type tanks. Provide means to establish the integrity of the secondary containment.

6.15.8.3. ASTs shall rest on foundations, made of concrete, masonry, piling, or steel. Design tank foundations to minimize the possibility of uneven settling of the tank and to minimize corrosion in any part of the tank resting on the foundation.

6.15.8.4. The Directorate of Public Works , Environmental Division, Petroleum Storage Tank Manager is the Installation Local Authority Having Jurisdiction (AHJ) who must approve any design proposal and construction before any installation of an AST.

6.15.8.5. Location of Aboveground Fuel Storage Tanks (ASTs). The local AHJ must approve all proposed installations sites of ASTsin writing prior to installation.

(a) No AST shall be installed closer than 5-feet from any type of an electrical disconnect device.

(b) Locate ASTs between the size of 60 U.S. gallons and 2,000 U.S. gallons no closer than 10-feet from any building, lean-to, or property line.

(c) ASTs shall have at the minimum of 5 ft of unobstructed clearance on all sides to facilitate refueling, maintenance and serviceability.

(d) No AST shall be installed without having at least a 15-foot aerial clearance from overhead or underground electrical lines, which includes but limited to weather heads, transformers, and fuses.

(e) The minimum distance between any two ASTs shall be 3-feet.

(f) The minimum distance between an AST with Gasoline or Diesel fuel and a LP tank shall be 20-feet.

(g) Locate Used Oil tanks close to the source of generation, i.e., just outside the building.

6.15.9. Aboveground Fuel Lines.

6.15.9.1. Below ground fuel lines are not permitted for use with an AST.

6.15.9.2. Aboveground supply and return lines. Suspend fuel lines a minimum of 6 inches off the ground and support every 3-feet with some type of approved support. Protect fuel lines against corrosion with protective features that prohibit any collision from motor vehicles. All fuel lines shall be of black carbon-type steel. All AST supply fuel lines shall be ½-inch inside diameter and all return fuel lines shall be ¾-inch inside diameter, unless otherwise directed by Local Authority having Jurisdiction. All supply fuel lines shall have a shut off valve located as close as possible to the AST. There shall be no traps or check valves in the return fuel line to the AST. All pipe joints shall be of the threaded type, no welding of pipes or of the joints shall be permitted. Joints shall be made liquid tight and shall be threaded, except that listed flexible connectors are permitted where installed with prior written approval of the Local AHJ. All threaded joints shall be made up tight with a suitable thread sealant or lubricant. Joints in piping systems handling Class I liquids shall be welded when located in concealed spaces within buildings.

6.15.10. Normal Venting for Aboveground Tanks.

6.15.10.1. Venting requirements shall be in accordance with current Unified Facilities Guide Specifications, Section 13202, Fuel Storage Systems requirements. Stage I vapor recovery is the process of recovering vapors when a storage tank is filled. Stage I vapor recovery is mandatory on all Army Facilities.

6.15.10.2. Prevent the development of vacuum or pressure sufficient to exceed the design pressure due to filling or emptying and the atmospheric temperature changes.

6.15.10.3. If any tank has more than one fill or withdrawal connection and simultaneous filling or withdrawal can be made, base the vent size on the maximum anticipated simultaneous flow.

6.15.10.4. Arrange the outlet of all vents and vent drains on tanks equipped with venting to permit pressures exceeding 2.5 psig to discharge in such a way as to prevent localized overheating of, or flame impingement on, and part of the tank, in the event vapors from such vents are ignited.

6.15.10.5. Where vent pipe outlets for tanks storing Class I liquids are adjacent to building or public ways, locate them so that the vapors are released at a safe point outside of buildings and not less than 12 ft. above the adjacent ground level. In order to aid their dispersion vapors shall be discharged upward or horizontally away from closely adjacent walls. Locate vent outlets so eaves will not trap the flammable vapors or other obstructions and at least 5 ft from building openings.

6.15.10.6. Emergency Venting for Fire Exposure for Aboveground Tanks.

(a) Every aboveground tank shall have some form of construction or device that will relieve excessive internal pressure caused by exposure fires. This requirement shall also apply to each compartment of a compartmented tank, the interstitial space of a secondary containment type tank, and the enclosed space of tanks of closed top dike construction.

(b) Arrange the outlet of all vents and vent drains on tanks, equipped with emergency venting to permit pressures exceeding 2.5 psig to discharge in such a way as to prevent localized overheating of or flame impingement on any part of the tank, in the event vapors from such vents are ignited.

6.15.11. Miscellaneous AST Requirements.

6.15.11.1. All ASTs permanently installed shall have a device(s) for fuel leak detection, fuel level, and all other monitoring requirements.x

6.15.11.2. Mark ASTs in accordance with NFPA. 704.

6.15.11.3. Mark ASTs in accordance with NFPA. 704.

- 6.15.11.4. All ASTs shall have some type of spill containment that will hold 110% of the AST capacity.
- 6.15.11.5. All ASTs that have filling and emptying connections for any Class I or Class II, flammable liquids shall be closed and liquid tight when not in use and shall be properly identified.
- 6.15.11.6. All ASTs fill caps shall have an AHJ approved means of locking when not being refueled.
- 6.15.11.7. All ASTs shall have some device of fire-fighting equipment in the immediate area. (Contact Fort Campbell Fire Prevention Section for further details).
- 6.15.11.8. Provide means for determining the level of liquid in the tank. This means shall be accessible to the delivery operator
- 6.15.11.9. Take precautions to prevent the ignition of flammable vapors. Sources of ignition include, but are not limited to:
- OpenFlames
 - Lightning
 - Hot surfaces
 - Radiant heat
 - Smoking
 - Cutting and welding
 - Spontaneous ignition
 - Frictional heat or sparks
 - Static electricity
 - Electrical sparks-
 - Stray currents-
 - Ovens, furnaces, and heating equipment
- 6.15.11.10. Install bollards around all ASTs to prevent vehicular collision with the tank.
- 6.15.11.11. Construction of secondary containment structures for mobile fuel tankers or storage tanks shall be concrete construction and have sufficient capacity to hold 110% of the largest tank / mobile fuel tanker that it will hold. The secondary containment stormwater discharge valve or valves must be capable of completely draining a containment in 2 hours or less. Four-inch valves are recommended. Locate the outlet drain(s) valves and piping at the lowest elevation of the containment. The bottom of the outlet drain pipe shall be flush with bottom of the containment. Berm control expansion/contraction joints shall be filled with a fuel-resistant sealant. If the concrete berm is placed upon existing concrete, then seal the joint between the new and old concrete with a fuel-resistant sealant. Seal storm water drain piping with fuel resistant sealant. Provide an adequate amount of reinforced concrete above and below the drain pipe(s) to prevent crack formation in the concrete at this location.
- 6.15.12. Contractor Site Specific Spill Plan (CSSSP). Prepare and submit CSSSP through the COR to Fort Campbell Environmental Division. Develop the CSSSP as outlined in the Fort Campbell Environmental Handbook. A link to the fill-in-the-blank version of the CSSSP is located on the Fort Campbell Web site at:
<http://www.campbell.army.mil/campbell/directorates/DPW/envdiv/Pages/Spills.aspx>.
- 6.15.13. Green Procurement. Purchase, supply, and use environmentally referable products and services to the maximum extent practicable. Consider Green products as the "first choice" for procurement. Additional information can be obtained in the applicable Appendix.
- 6.15.14. Sustainable Installation Management System (SIMS). Fort Campbell has implemented an environmental management system entitled SIMS to proactively deal with the environmental impacts of its processes, activities, and services. Fort Campbell's approved Significant Environmental Aspects are located on the DPW Environmental Division web page (<http://www.campbell.army.mil/campbell/directorates/DPW/envdiv/Pages/default.aspx>) under "Sustainable Installation Management System (SIMS/EMS)" on the left menu.

6.15.14.1. Fort Campbell uses the ISO 14001:2004 as the standard for its SIMS. All personnel performing work for or on behalf of Fort Campbell should be aware of and understand Fort Campbell Environmental Policy. Fort Campbell offers SIMS General Awareness Training in the form of an 8 minute video. This video can be found on the Fort Campbell Environmental web site (<http://www.campbell.army.mil/campbell/directorates/DPW/envdiv/Pages/default.aspx>) under "Sustainable Installation Management System (SIMS/EMS)" on the left menu. Ensure that all subcontractors receive SIMS General Awareness Training.

6.15.14.2. Ensure that all goods and services used by the contractor or any of its subcontractors do not deviate from the installation Environmental Policy, objectives and targets of the EMS. Perform work in a manner that conforms to all appropriate Environmental Management Programs and Operational Controls identified by Installation's SIMS, including pollution prevention, waste reduction, energy use, and natural resource protection. Provide monitoring and measurement information as necessary for the organization to address environmental performance relative to the environmental and energy management goals. In the event of non-compliance with Fort Campbell's legal or other requirements or non-conformance with the installation SIMS, take immediate corrective action, perform a root-cause analysis of the non-compliance/non-conformance and develop preventive action to keep the non-compliance/non-conformance from recurring. In the event of any noncompliance with any federal, state, or local environmental law, regulation or requirement, immediately respond by taking all appropriate corrective action and notify the Contracting Officer's Representative (COR) and the DPW Environmental Division. Ensure that employees and subcontract employees are aware of their roles and responsibilities with regard to the SIMS and how these requirements affect the work performed under this contract. Additionally, when ordering supplies for use on Installation, all contractor personnel must favor energy-efficient, recycled or reclaimed material whenever practicable.

6.15.14.3. The responsibility of all contractor personnel include, but are not limited to:

- (a) Recycling all eligible material, including glass, paper (including magazines), plastic, aluminum, and cardboard to the maximum extent practicable;
- (b) Reducing the amount of hazardous material and/or solvent used by purchasing fewer hazardous materials and by increasing the use of products with recycled content;
- (c) Reducing the amount of solid waste from construction and demolition debris, and scrap metal sent to municipal and rubble landfills by reducing, reusing, and recycling; and
- (d) Conserving energy and water usage by turning off lights and equipment when not in use and using only the necessary amount of water needed to complete the required tasks. Continuous conservation of our natural resources is a must.

6.15.15. Direct any questions regarding SIMS to the Installation SIMS Action Officer (Karen Kopp-Voshel, phone 270-798-9597, e-mail karen.kopp@us.army.mil) or Contracting Officer's Representative. For more information regarding environmental compliance requirements contact DPW-Environmental at (270) 798-9645.

6.15.16. Inadvertent Disturbance and Discovery of Cultural Resources. If a previously unidentified historic property or archaeological site is disturbed or if any archaeological remains, including human skeletons, are discovered during construction, immediately halt all activity within in a one hundred (100) foot radius of the disturbance and/or discovery, notify the Fort Campbell Cultural Resources Program 270-412-8174, and implement interim measures to protect the site and/or discovery from looting and vandalism.

6.15.16.1. The Fort Campbell Cultural Resources Program will evaluate the disturbance and/or discovery and provide interim recommendations to the contractor within two working days of notification if the contractor can proceed with the planned activities. In accordance with the current Programmatic

Agreement of Operations the Cultural Resources Program will then consult with the appropriate Tribal Nations and State offices to meet the Installation's legal obligations.

No wetlands have been identified on the site.

No native or endangered species are anticipated to be impacted by this project.

Two ASTs and one UST are located on the project site. Refer to the drawings in Appendix J for more information.

6.16. PERMITS

6.16.1. Permits.

Obtain all permits (local, state and federal) required for design and construction of all site features and utilities. Provide information, as described below, to obtain all necessary permits.

6.16.2. Air Permits.

Provide air permit information to Fort Campbell Environmental Division. Two types of permits are required: (1) A construction permit; and (2) An operating permit. Obtain a construction permit based on the design prior to construction. Obtain an operating permit when the equipment is installed. Provide information for both types of permits to Fort Campbell using the Checklist for Non-Process Source and the Vent Stack Checklist. Each checklist is available from the Fort Campbell Environmental Division and shall be completed for each piece of fuel-burning equipment. The lead time for these permits is approximately 30 days, thus submit all information as soon as possible. Point of contact for these items is Patty Lockard, Fort Campbell Environmental Division, and (270) 798-9603.

6.16.2.1. Fort Campbell (Christian (KY) and Montgomery (TN) Counties) was designated an ozone "maintenance" area in 2005. The installations maintenance plan requirements are designed to maintain the average ozone concentration levels at or below the maximum allowed to sustain compliance with the National Ambient Air Quality Standards. The redesignation as an "attainment maintenance area" will be in effect for 12 years. Section 176(c)(1) of the Clean Air Act (CAA) mandates the General Conformity Rule (GCR) analysis be completed by Fort Campbell to establish that any construction activity will not impede the continuation of the attainment status and ensure the action does not impede Kentucky or Tennessee air pollution control efforts in ozone "attainment maintenance areas". The rule requires that an analysis and other procedures (if required as a result of the analysis) be completed prior to the commencement of any of the project activities.

6.16.2.2. Review is required for all proposed construction activity which will result in the emission of surface ozone precursors (volatile organic compounds and nitrogen oxides) to ensure the action does not impede Tennessee air pollution control efforts to gain attainment of the NAAQS for ozone. Non attainment designations for particulate matter (PM) are based on 3-year averages of either each years' annual average concentration (annual average) or on a 24 hour average basis (rolling 24 hour avg.).

(a) PM2.5. Exceedance of either standard can result in an area being classified as non-attainment for PM2.5. If that should occur, PM2.5 will be considered and added to the GCR process as stated above.

6.16.2.3. Data is required to enable the Air Quality Program of the Fort Campbell Environmental Division to calculate the estimated emissions of ozone precursors resulting from construction equipment (mobile and stationary) burning fossil fuels and other Contractor vehicles (Contractor or private owned) operated on Fort Campbell as a result of the construction contract. To obtain this data representatives of the Fort Campbell Air Quality Program will need to contact either a Contractor representative and/or the Resident Office project manager, as designated by the Fort Campbell Resident Office. See 6.16.2.6 for examples of construction equipment and activities, which need to be identified as to their usage.

6.16.2.4. The primary source of the ozone precursors at Fort Campbell during construction activities is the burning of fossil fuels by mobile non-road construction equipment and other vehicles, including privately owned vehicles operated by construction Contractor personnel and Government supervising personnel (this applies only to that portion of usage directly applicable to the construction activity, which includes the commute to the construction site). In addition, stationary and/or portable units such as fossil fuel fired boilers, space heaters, and electric generators must be considered. Additional sources of concern that may be part of major construction activities include, but are not limited to, coating operations (spray booths), solvent cleaning operations, volatile organic fluids (fuels, etc.) dispensing and storage operations, and site remediation activities.

6.16.2.5. In addition to the data concerning ozone precursor emissions during the construction phase, data are also required to estimate what the emissions will be after the completion of the construction project. This includes evaluations to determine emission increases of ozone precursors resulting from any new permanent stationary sources; any potential increase in vehicle miles traveled by fossil fueled tactical, other federal Government owned, and private owned vehicles; and any increase in demands on current utility services (boiler plants, water plants, etc.). This data will be compiled from review of construction plans, drawings, and by interviews of points of contact other than the Contractor or the Fort Campbell Resident Office.

(a) Fuel Burning Equipment (Natural Gas and/or Fuel Oil): For boilers > 10 MBTU or for any boiler that uses fuel oil, contact the Air Quality Program with specifications for boilers. For hot water heaters > 120 gallons, contact the Air Quality Program with specifications for hot water heaters. The Air Quality Program will submit the Boiler NESHAP Notification to EPA.

(b) Concrete/ Asphalt: Describe whether operations of concrete batch plant/asphalt plant (including any use of a pug mill) will be on or off post. If on post, provide capacity and other design data to determine if air permits would be required and to determine other CAA related compliance issues. Approximately 120 day lead time to obtain state operating permit.

(c) Debris Burning: Air pollution restrictions applicable to this project do not allow materials to be burned on the Government premises.

(d) Debris Disposal: If construction debris is to be sent to a grinder for recycling, describe if the grinding equipment will be on or off post and if on-post, provide grinder capacity (tons/hour) and design in order to determine if air permitting and other CAA related compliance issues apply. Approximately 120 day lead time to obtain state operating permit.

(e) Dust: Maintain all excavations, stockpiles, access roads, waste areas, and all other work areas free from excess dust to such a reasonable degree as to avoid causing a hazard or nuisance.

(f) Ozone Depleting Chemicals: Refrigerants shall have an ozone depleting potential (ODP) of 0.05 or less.

(g) Construction Equipment Listing. The list is not purported to be a complete list. It is based on some of the operations conducted during past major construction activities at Fort Campbell.

- | | |
|-----------------------|---|
| - Bulldozers | - Fossil fuel fired powered air compressors used for activities other than powering paint applicators |
| - Graders | - Fossil fuel powered electric generators, |
| - Excavators | - Lay Down Machines used in paving activities |
| - Backhoes | - Rollers |
| - Dump Trucks | - Compactors |
| - Fuel/Service Trucks | - Water Trucks |

- Tractors
- Pug Mills (on site Fort Campbell)
- Concrete Batch Plant fossil fuel usage (on site Fort Campbell)
- Scrapers
- Ready-Mix Trucks
- Screed, Concrete, (if fossil fuel powered)
- Portable paint sprayers and any associated fossil fuel powered air compressors
- Pavement Stripping Machines
- Traffic road striping (vehicle and product applied)
- Loaders
- Compactors
- Curb and Gutter Pavers

6.16.2.6. The analysis must be completed prior to commencement of any of the construction project activities.

6.16.3. Water Permits.

Any change to the water distribution system requires an Approval from the State Government. The Contractor and the utility owner, CH2MHill, shall have shared responsibility in the coordination of the application for permit for work involving the water distribution system. Provide information as necessary during the design of the project to CH2M Hill for preparation of the permit application. Point of Contact for CH2M Hill at Fort Campbell is Chris Semler, (931) 431-2015. Alternate contact for CH2M HILL is Robert Neath (314) 421-0313.

6.16.4. Sanitary Sewer Permits.

Any change to the sanitary sewer system requires State approval. The Contractor and the utility owner, CH2MHill, shall have shared responsibility in the coordination of the application for permit for work involving the sanitary sewer system. Provide information as necessary during the design of the project to CH2M Hill for preparation of the permit application. Point of Contact for CH2M Hill at Fort Campbell is Chris Semler, (931) 431-2015. Alternate contact for CH2M HILL is Robert Neath (314) 421-0313.

6.16.5. Erosion and Sediment Control Permits.

Coordinate with the Fort Campbell Environmental Division to obtain the latest guidance on the Erosion and Sediment Control Permits. The point of contact is Mr. Dan Etson at phone number (270) 798-9784. No ground disturbing activities shall be made without first securing coverage under Fort Campbell's National Pollution Discharge Elimination System (NPDES) Permit and secondly ensuring all storm water controls are in place. DPW-Environmental maintains a blanket storm water discharge coverage under the applicable state permit for all projects constructed during a calendar year. DPW- Environmental will issue the permit in each state to the Contractor once the Storm Water Manager has reviewed and approved all required environmental submittals. Submit all required submittal documents thirty (30) days prior to start of the project.

6.16.6. Fort Campbell Permits.

No electric equipment shall be installed within or on any Fort Campbell building, structure, or premises, nor shall any alteration or addition be made in any such existing equipment without first securing an Electrical Permit from the Fort Campbell Electrical Inspector in accordance with CAM Regulation 420-4 (Quality Assurance "Electrical" Inspection Standards). An Electrical Contractor Registration Form shall be completed. This form will be attached to the back of the copy of the CAM Regulation. The Contractor's license shall be validated against the Fort Campbell Review Board list of State Electrical Licenses valid on Fort Campbell KY before a permit can be obtained. Copies of CAM Regulation 420-4 and permits shall

be obtained at DPW, Utilities Maintenance Building 868, Bastogne & 16th Street, Fort Campbell, Kentucky.

6.17. DEMOLITION

Existing pavement areas and a washrack will be demolished as part of this project. The existing TACAN tower and equipment in the building along with all physical training apparatus will be relocated by other prior to construction commencing. The Contractor will be required to demolish the existing building and concrete pads that will remain. Existing roads (gravel and asphalt), light poles, airfield fencing, and utilities will also be demolished by this Contractor. One existing 500 gallon above ground storage tank (AST) at the TACAN location will be removed by Ft Campbell personnel. Contractor to coordinate with the COR 10 working days prior to desired removal date. An existing 200 gallon underground storage tank (UST) for used oil next to the existing hangar will be removed by Ft. Campbell prior to the start of this project. A 500 gall AST near the sanitary lift station will remain on the project site.

Several utilities will be demolished as part of this project. All utilities shall be removed from under the footprint of the new hangar building and new apron pavements. Utilities required to remain on site shall be rerouted through the asphalt expansion joints provided between adjacent apron pavements.

Refer to Appendix J for indication of items to be demolished at the site.

Contractor to conduct an asbestos survey of the existing buildings to be demolished prior to demolition. The COR Shall be notified immediately if asbestos containing material is identified during the survey to receive further direction. All work that includes disturbing painted surfaces must be performed in accordance with OSHA Lead in Construction Standard and the Fort Campbell Technical Design Guide.

6.18. ADDITIONAL FACILITIES

A new TACAN site shall be prepared by the Contractor. One potential relocation area and one relocation option have been proposed as part of the project. See Appendix J for the locations. Ft. Campbell is currently performing a study to determine one relocation area for the TACAN from the two possible sites. The TACAN relocation site shown shall be in the Base Bid for the project while the TACAN Relocation Option shall be part of a Bid Option which adds the new location and deletes the first TACAN location from the project. The Contractor shall provide for a concrete antenna pad, generator pad, and transmitter building pad. The transmitter building, generator, bollards, security fence, gates, and turn-around, electric and communications services, and any drainage structures required shall also be provided by the contractor. The entire fenced area around the antenna and transmitter building shall be graded and finished with aggregate surfacing.

6.19 SUPPLEMENTAL REQUIREMENTS TO THE RFP

6.19.1 Section 01 45 04.00 10, 3.4 QUALITY CONTROL ORGANIZATION, paragraphs 3.4.1. through 3.4.4. shall be replaced in their entirety with the following:

3.4.1. Personal Requirements

(a) The requirements for the CQC organization are CQC System Manager, a Design Quality Manager, and sufficient number of additional qualified personnel to ensure safety and contract compliance. A Site Safety Health Officer (SSHO) shall be required for this contract. The CQC System Manager and the Site Safety and Health Officer shall be an employee of the Prime Contractor and as members of the CQC staff. (See Section 01 35 29.00 06 SAFETY AND OCCUPATIONAL HEALTH REQUIREMENTS for the SSHO qualifications and duties.)

(b) The CQC organization shall also include personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly. The contractor's CQC staff shall maintain a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure contract compliance. The CQC staff shall be subject to acceptance by the Contracting Officer. Provide adequate office space, filing systems, and other resources as necessary to maintain an effective and fully functional CQC organization. Promptly furnish complete records of all letters, material submittals, shop drawings submittals, schedules and all other project documentation to the CQC organization. The CQC organization shall be responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Contracting Officer.

3.4.2 CQC System Manager

(a) The Contractor shall identify as CQC System Manager an individual within the onsite work organization who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be either a construction person with a minimum of 10 years in related Work or shall possess a degree in engineering or construction management with 5 years of relevant experience.

(b) The CQC System Manager shall be on the site at all times during construction and shall be employed by the Prime Contractor. An alternate for the CQC System Manager shall be identified in the CQC Plan to serve in the event of the CQC System Manager's absence. The requirements for the alternate shall be the same as for the designated CQC System Manager.

(c) The CQC System Manager shall be assigned no other duties.

3.4.3. CQC Personnel

3.4.3.1. In addition to CQC personnel specified elsewhere in the contract, the Contractor shall provide as part of the CQC organization specialized personnel to assist the CQC System Manager for the following areas identified per Experience Matrix Table. These individuals shall be directly employed by the prime contractor and may not be Employed by a supplier or sub-contractor on this project. These individuals identified per the Experience Matrix Table, shall be responsible to the CQC System Manager; be physically present at the construction site during work on their areas of responsibility; have the necessary education and/or experience in accordance with the experience Matrix listed herein. The individuals in the Experience Matrix Table shall have no other duties except as noted in the Experience Matrix Table.

3.4.4. Experience matrix Table

The word "graduate" below indicates an individual possessing a four-year degree accredited in the respective field listed.

3.4.4.1. Area Qualifications

3.4.4.1.1. SSHO – See Section 01 35 29.00 06 SAFETY AND OCCUPATIONAL HEALTH REQUIREMENTS. Shall be an employee of the Prime Contractor and directly responsible to Corporate Safety.

3.4.4.1.2. Civil – Graduate Civil Engineer with two (2) years experience in the type of work being performed on this Project or technician with five (5) years related experience.

Shall be an employee of the Prime Contractor and may perform duties as Environmental QC if qualified for both.

3.4.4.1.3. Geotechnical – Graduate Geotechnical Engineer with three (3) years of relevant experience. A Civil Engineer may meet this requirement, thus having dual duties.

3.4.4.1.4. Mechanical – Graduate Mechanical Engineer with two (2) years experience or person with five (5) years related experience. Shall be an employee of the Prime Contractor.

3.4.4.1.5. Electrical – Graduate Electrical Engineer with two (2) years related experience or person with five (5) years related experience. Shall be an employee of the Prime Contractor.

3.4.4.1.6. Structural – Graduate Structural Engineer with two (2) years experience or person with five (5) years related experience . Shall be an employee of the Prime Contractor and may perform duties as Architectural QC if qualified for both.

3.4.4.1.7. Architectural – Graduate Architect with two (2) years experience or person with five (5) years related experience. Shall be an employee of the Prime and may perform duties as Structural QC if qualified for both.

3.4.4.1.8. Environmental – Graduate Environmental Engineer with three (3) years experience. Shall be an employee of the Prime and may perform duties as Civil QC if qualified for both.

3.4.4.1.9. LEED AP BD+C – LEED Accredited Professional by GBCI (Green Building Certification Institute). Shall be an employee of the Prime Contractor and may perform other duties.

3.4.4.1.10. Submittals – Submittals Clerk with one (1) year experience.

End of Section 01 10 00

**SECTION 01 32 01.00 10
PROJECT SCHEDULE**

1.0 GENERAL

1.1. REFERENCES

1.2. QUALIFICATION

2.0 PRODUCTS (NOT APPLICABLE)

3.0 EXECUTION

3.1. GENERAL REQUIREMENTS

3.2. BASIS FOR PAYMENT AND COST LOADING

3.3. PROJECT SCHEDULE DETAILED REQUIREMENTS

3.4. PROJECT SCHEDULE SUBMISSIONS

3.5. SUBMISSION REQUIREMENTS

3.6. PERIODIC SCHEDULE UPDATE MEETINGS

3.7. REQUESTS FOR TIME EXTENSIONS

3.8. DIRECTED CHANGES

3.9. WEEKLY PROGRESS MEETINGS

3.10. OWNERSHIP OF FLOAT

3.11. TRANSFER OF SCHEDULE DATA INTO RMS/QCS

1.0 GENERAL

1.1. REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE) ER 1-1-11 (1995) Progress, Schedules, and Network Analysis Systems (Available through the Publications page of the US Army Corps of Engineers TECHINFO Website at <http://www.hnd.usace.army.mil/techinfo/>. See link for Engineer Regulation ER 1-1-11).

1.2. QUALIFICATIONS

Designate an authorized representative who shall be responsible for the preparation of the schedule and all required updating (statusing) and preparation of reports. The authorized representative shall be experienced in scheduling projects similar in nature to this project and shall be experienced in the use of the scheduling software that meets the requirements of this specification.

2.0 PRODUCTS (Not Applicable)

3.0 EXECUTION

3.1. GENERAL REQUIREMENTS

3.1.1. Submit a project schedule as specified herein for approval showing the sequence in which the Contractor proposes to perform the work and dates on which the Contractor contemplates starting and completing all schedule activities. The scheduling of the entire project, including the design and construction sequences is required. Contractor management personnel shall actively participate in its development. Designers, subcontractors and suppliers working on the project shall also contribute in developing an accurate project schedule. The schedule must be a forward planning as well as a project monitoring tool. The approved project schedule shall be used to measure the progress of the work and to aid in evaluating requests for excusable time extensions. The schedule shall be cost loaded and activity coded as specified herein. The schedule will provide the basis for all progress payments. If the Contractor fails to submit any schedule within the time prescribed, the Contracting Officer may withhold approval of progress payments until the Contractor submits the required schedule

3.1.2. Status the schedule on at least a monthly basis, as specified herein. If in the opinion of the Contracting Officer, the Contractor falls behind the approved schedule, the Contractor shall take steps necessary to improve its progress including those that may be required by the Contracting Officer, without additional cost to the Government. In this circumstance, the Contracting Officer may require the Contractor to increase the number of shifts, overtime operations, days of work, and/or the amount of construction plant, and to submit for approval any supplementary schedule or schedules as the Contracting Officer deems necessary to demonstrate how the approved rate of progress will be regained. See paragraph 3.7.4.

3.1.3. Failure of the Contractor to comply with the requirements of the Contracting Officer shall be grounds for a determination by the Contracting Officer that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the time specified in the contract. Upon making this determination, the Contracting Officer may terminate the Contractor's right to proceed with the work, or any separable part of it, in accordance with the default terms of the contract.

3.2. BASIS FOR PAYMENT AND COST LOADING

The schedule shall be the basis for determining contract earnings during each update period and therefore the amount of each progress payment. Lack of an approved schedule update or qualified

scheduling personnel will result in an inability of the Contracting Officer to evaluate contract earned value for the purposes of payment. Failure of the Contractor to provide all information, as specified herein will result in the disapproval of the preliminary, initial and subsequent schedule updates. In the event schedule revisions are directed by the Contracting Officer and those revisions have not been included in subsequent revisions or updates, the Contracting Officer may hold retainage up to the maximum allowed by contract, each payment period, until such revisions to the project schedule have been made. Activity cost loading shall be reasonable as determined by the Contracting Officer. The aggregate value of all activities coded to a contract CLIN as specified herein shall equal the value of the CLIN on the Schedule.

3.3. PROJECT SCHEDULE DETAILED REQUIREMENTS

The computer software system utilized to produce and update the project schedule shall be capable of meeting all requirements of this specification. Failure of the Contractor to meet the requirements of this specification will result in the disapproval of the schedule. Scheduling software that meets the activity coding structure defined in the Standard Data Exchange Format (SDEF) in ER-1-1-11(1995) referenced herein are Primavera Project Planner (P3) by Primavera, and Open Plan by Deltek.

3.3.1. Use of the Critical Path Method

Use the Critical Path Method (CPM) of network calculation to generate the project schedule. Prepare the project schedule using the Precedence Diagram Method (PDM).

3.3.2. Level of Detail Required

Develop the project schedule to an appropriate level of detail. Failure to develop the project schedule to an appropriate level of detail, as determined by the Contracting Officer, will result in its disapproval. The Contracting Officer will consider, but is not limited to, the following characteristics and requirements to determine appropriate level of detail:

3.3.2.1. Activity Durations

Reasonable activity durations are those that allow the progress of ongoing activities to be accurately determined between update periods. Less than 2 percent of all non-procurement activities shall have Original Durations (OD) greater than 20 work days or 30 calendar days. Procurement activities are defined herein.

3.3.2.2. Design and Permit Activities

Include design and permit activities, including necessary conferences and follow-up actions and design package submission activities. Include the design schedule in the project schedule, showing the sequence of events involved in carrying out the project design tasks within the specific contract period. This shall be at a detailed level of scheduling sufficient to identify all major design tasks, including those that control the flow of work. Include review and correction periods associated with each item.

3.3.2.3. Procurement Activities

Include activities associated with the submittal, approval, procurement, fabrication and delivery of long lead materials, equipment, fabricated assemblies and supplies. Long lead procurement activities are those with an anticipated procurement sequence of over 90 calendar days. A typical procurement sequence includes the string of activities: submit, approve/review, procure, fabricate, and deliver.

3.3.2.4. Mandatory Tasks

Include and properly schedule the following tasks (See also the Sample Preliminary Submittal Register Input Form):

- (a) Submission, review and acceptance of design packages, including BIM
- (b) Submission of mechanical/electrical/information systems layout drawings
- (c) Submission and approval of O & M manuals
- (d) Submission and approval of as-built drawings
- (e) Submission and approval of 1354 data and installed equipment lists
- (f) Submission and approval of testing and air balance (TAB)
- (g) Submission of TAB specialist design review report
- (h) Submission and approval of fire protection specialist
- (i) Submission and approval of testing and balancing of HVAC plus commissioning plans and data. Develop the schedule logic associated with testing and commissioning of mechanical systems to a level of detail consistent with the contract commissioning requirements.
- (j) Air and water balancing
- (k) HVAC commissioning
- (l) Controls testing plan submission
- (m) Controls testing
- (n) Performance Verification testing
- (o) Other systems testing, if required
- (p) Contractor's pre-final inspection
- (q) Correction of punch list from Contractor's pre-final inspection
- (r) Government's pre-final inspection
- (s) Correction of punch list from Government's pre-final inspection
- (t) Final Inspection

3.3.2.5. Government Activities. Show Government and other agency activities that could impact progress. These activities include but are not limited to: approvals, design reviews, review conferences, release for construction of design package(s), environmental permit approvals by State regulators, inspections, utility tie-ins, Government Furnished Property/Equipment (GFP) and Notice to Proceed for phasing requirements, if any.

3.3.2.6. Activity Responsibility Coding (RESP)

Assign Responsibility Code for all activities to the Prime Contractor, Subcontractor or Government agency responsible for performing the activity. Activities coded with a Government Responsibility code include, but are not limited to: Government approvals, Government design reviews, environmental permit approvals by State regulators, Government Furnished Equipment (GFE) and Notice to Proceed (NTP) for phasing requirements. Code all activities not coded with a Government Responsibility Code to the Prime Contractor or Subcontractor responsible to perform the work. Activities shall not have more than one Responsibility Code. Examples of acceptable activity code values are: DOR (for the designer of record); ELEC (for the electrical subcontractor); MECH (for the mechanical subcontractor); and GOVT (for USACE). Unacceptable code values are abbreviations of the names of subcontractors.

3.3.2.7. Activity Work Area Coding (AREA)

Assign Work Area code to activities based upon the work area in which the activity occurs. Define work areas based on resource constraints or space constraints that would preclude a resource, such as a particular trade or craft work crew from working in more than one work area at a time due to restraints on

resources or space. Examples of Work Area Coding include different areas within a floor of a building, different floors within a building, and different buildings within a complex of buildings. Activities shall not have more than one Work Area Code. Not all activities are required to be Work Area coded. A lack of Work Area coding will indicate the activity is not resource or space constrained.

3.3.2.8. Contract Changes/Requests for Equitable Adjustment (REA) Coding (MODF)

Assign Activity code to any activity or sequence of activities added to the schedule as a result of a Contract Modification, when approved by Contracting Officer, with a Contract Changes/REA Code. Key all Code values to the Government's modification numbering system. Any activity or sequence of activities added to the schedule as a result of alleged constructive changes made by the Government may be added to a copy of the current schedule, subject to the approval of the Contracting Officer. Assign Activity codes for these activities with a Contract Changes/REA Code. Key the code values to the Contractor's numbering system. Approval to add these activities does not necessarily mean the Government accepts responsibility and therefore liability for such activities and any associated impacts to the schedule, but rather the Government recognizes such activities are appropriately added to the schedule for the purposes of maintaining a realistic and meaningful schedule. Such activities shall not be Responsibility Coded to the Government unless approved. An activity shall not have more than one Contract Changes/REA Code

3.3.2.9. Contract Line Item (CLIN) Coding (BIDI)

Code all activities to the CLIN on the Contract Line Item Schedule to which the activity belongs. An activity shall not contain more than one CLIN Item Code. CLIN Item code all activities, even when an activity is not cost loaded.

3.3.2.10. Phase of Work Coding (PHAS)

Assign Phase of Work Code to all activities, based upon the phase of work in which the activity occurs. Code activities to either a Design Phase or a Construction Phase. Code fast track design and construction phases proposed by the Contractor to allow filtering and organizing the schedule by fast track design and construction packages. If the contract specifies construction phasing with separately defined performance periods, identify a Construction Phase Code to allow filtering and organizing the schedule accordingly. Each activity shall have only one Phase of Work code.

3.3.2.11. Category of Work Coding (CATW)

Assign Category of Work code to all Activities based upon the category of work which the activity belongs. Category of Work Code must include, but is not limited to: Design, Design Submittal, design reviews, review conferences, Construction Submittal, Approvals (if any), Acceptance, Procurement, Fabrication, Delivery, Weather Sensitive Installation, Non-Weather Sensitive Installation, Start Up, Test, and Turnover. Assign a Category of Work code to each activity. Each activity shall have only one Category of Work Code.

3.3.2.12. Definable Features of Work Coding (FOW1, FOW2, FOW3)

Assign a Definable Feature of Work Code to appropriate activities based on the definable feature of work to which the activity belongs. Definable Feature of Work is defined in Specification Section 01 45 04.00 10, Contractor Quality Control. An activity shall not have more than one Definable Feature of Work Code. Not all activities are required to be Definable Feature of Work Coded.

3.3.3. Scheduled Project Completion and Activity Calendars

The schedule interval shall extend from NTP date to the required contract completion date. The contract completion activity (End Project) shall finish based on the required contract duration in the accepted

contract proposal, as adjusted for any approved contract time extensions. The first scheduled work period shall be the day after NTP is acknowledged by the Contractor. Schedule activities on a calendar to which the activity logically belongs. Activities may be assigned to a 7 day calendar when the contract assigns calendar day durations for the activity such as a Government Acceptance activity. If the Contractor intends to perform physical work less than seven days per week, schedule the associated activities on a calendar with non-work periods identified including weekends and holidays. Assign the Category of Work Code - Weather Sensitive Installation to those activities that are weather sensitive. Original durations must account for anticipated normal adverse weather. The Government will interpret all work periods not identified as non-work periods on each calendar as meaning the Contractor intends to perform work during those periods.

3.3.3.1. Project Start Date

The schedule shall start no earlier than the date on which the NTP was acknowledged. Include as the first activity in the project schedule an activity called "Start Project" or "NTP". The "Start Project" activity shall have an "ES" constraint date equal to the date that the NTP was acknowledged, with a zero day duration.

3.3.3.2. Schedule Constraints and Open Ended Logic

Constrain completion of the last activity in the schedule by the contract completion date. Schedule calculations shall result in negative float when the calculated early finish date of the last activity is later than the contract completion date. Include as the last activity in the project schedule an activity called "End Project". The "End Project" activity shall have an "LF" constraint date equal to the contract completion date for the project, and with a zero day duration or by using the "project must finish by" date in the scheduling software. The schedule shall have no constrained dates other than those specified in the contract. The use of artificial float constraints such as "zero fee float" or "zero total float" are typically prohibited. There shall only be 2 open ended activities: Start Project (or NTP) with no predecessor logic and End Project with no successor logic.

3.3.3.3. Early Project Completion

In the event the Preliminary or Initial project schedule calculates an early completion date of the last activity prior to the contract completion date, the Contractor shall identify those activities that it intends to accelerate and/or those activities that are scheduled in parallel to support the Contractor's "early" completion. The Contractor shall include all project and site overhead expenses through the required contract duration period in the contract cost. The Contractor will not be entitled to a time extension or price adjustment for extended overhead related costs due to any delays which may affect early contract completion prior to the required contract completion date. The last activity shall have a late finish constraint equal to the contract completion date and the schedule will calculate positive float. The Government will not approve an early completion schedule with zero float on the longest path. The Government is under no obligation to accelerate activities for which it is responsible to support a proposed early contract completion.

3.3.4. Interim Completion Dates

Constrain contractually specified interim completion dates to show negative float when the calculated early finish date of the last activity in that phase is later than the specified interim completion date.

3.3.4.1. Start Phase

Include as the first activity for a project phase an activity called "Start Phase X" where "X" refers to the phase of work. The "Start Phase X" activity shall have an "ES" constraint date equal to the date on which the NTP was acknowledged, and a zero day duration.

3.3.4.2. End Phase

Include as the last activity for a project phase an activity called "End Phase X" where "X" refers to the phase of work. The "End Phase X" activity shall have an "LF" constraint date equal to the specified completion date for that phase and a zero day duration.

3.3.4.3. Phase "X" Hammock

Include a hammock type activity for each project phase called "Phase X" where "X" refers to the phase of work. The "Phase X" hammock activity shall be logically tied to the earliest and latest activities in the phase.

3.3.5. Default Progress Data Disallowed

Do not automatically update Actual Start and Finish dates with default mechanisms that may be included in the scheduling software. Activity Actual Start (AS) and Actual Finish (AF) dates assigned during the updating process shall match those dates provided from Contractor Quality Control Reports. Failure of the Contractor to document the AS and AF dates on the Daily Quality Control report for every in-progress or completed activity, and failure to ensure that the data contained on the Daily Quality Control reports is the sole basis for schedule updating shall result in the disapproval of the Contractor's updated schedule and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes. Updating of the percent complete and the remaining duration of any activity shall be independent functions. Disable program features which calculate one of these parameters from the other.

3.3.6. Out-of-Sequence Progress

Activities that have progressed before all preceding logic has been satisfied (Out-of-Sequence Progress) will be allowed only on a case-by-case basis subject to approval by the Contracting Officer. Propose logic corrections to eliminate all out of sequence progress or justify not changing the sequencing for approval prior to submitting an updated project schedule..

3.3.7. Negative Lags and Start to Finish Relationships

Lag durations contained in the project schedule shall not have a negative value. Do not use Start to Finish relationships (SF).

3.3.8. Calculation Mode

Schedule calculations shall retain the logic between predecessors and successors even when the successor activity starts and the predecessor activity has not finished. Software features that in effect sever the tie between predecessor and successor activities when the successor has started and the predecessor logic is not satisfied ("progress override") will not be allowed.

3.3.9. Milestones

Include milestone activities for each significant project event including but not limited to: milestone activities for each fast track design package released for construction; design complete; foundation/substructure construction complete; superstructure construction complete; building dry-in or enclosure complete to allow the initiation of finish activities; permanent power complete; and building systems commissioning complete.

3.3.10. Use of Primavera "P6"

If P6 is being used, the following settings are mandatory in the Preliminary Project Schedule, Initial Project Schedule and all schedule submissions to the Government:

- 3.3.10.1. Activity Codes shall be Project Level not Global or EPS level.
- 3.3.10.2. Calendars shall be Project Level not Global or Resource level.
- 3.3.10.3. Set Activity Duration Types to "Fixed Duration & Units".
- 3.3.10.4. Set Percent Complete Types to "Physical".
- 3.3.10.5. Use Default Time Period Admin Preferences "8.0 hr/day, 40 hr/week, 172 hr/month, 2000 hr/year". Set Calendar Work Hours/Day to 8.0 Hour days. This is not to mandate the Contractor's work week. Alternate workweeks may be set up in "Calendar Settings".
- 3.3.10.6. Set Schedule Option for defining Critical Activities "Longest Path".
- 3.3.10.7. Set Schedule Option for defining progressed activities "Retained Logic".
- 3.3.10.8. Set up Cost loading a single lump sum Resource. The Price/Unit shall be \$1/hr, Default Units/Time shall be "8h/d", and select settings "Auto Compute Actuals" and "Calculate costs from units".
- 3.3.10.9. Activity ID's shall not exceed 10 characters.
- 3.3.10.10. Activity Names shall have the most defining and detailed description within the first 30 characters.

3.4. PROJECT SCHEDULE SUBMISSIONS

Provide the submissions as described below. The data CD, reports, and network diagrams required for each submission are contained in paragraph SUBMISSION REQUIREMENTS.

3.4.1. Preliminary Project Schedule Submission

Submit the Preliminary Project Schedule, defining the Contractor's planned operations for the first 90 calendar days for approval within 15 calendar days after the NTP is acknowledged. The approved Preliminary Project Schedule will be used for payment purposes not to exceed 90 calendar days after NTP. Completely cost load the Preliminary Project Schedule to balance the contract award CLINS shown on the Price Schedule. Detail it for the first 90 calendar days. It may be summary in nature for the remaining performance period. It must be early start and late finish constrained and logically tied as previously specified. The Preliminary Project Schedule forms the basis for the Initial Project Schedule specified herein and must include all of the required Plan and Program preparations, submissions and approvals identified in the contract (for example, Quality Control Plan, Safety Plan, and Environmental Protection Plan) as well as design activities, the planned submissions of all early design packages, permitting activities, design review conference activities and other non-construction activities intended to occur within the first 90 calendar days. Schedule any construction activities planned for the first 90 calendar days after NTP. Constrain planned construction activities by Government acceptance of the associated design package(s) and all other specified Program and Plan approvals. Activity code any activities that are summary in nature after the first 90 calendar days with Responsibility Code (RESP) and Feature of Work code (FOW1, FOW2, FOW3)

3.4.2. Initial Project Schedule Submission

Submit the Initial Project Schedule for approval within 42 calendar days after NTP. The schedule shall demonstrate a reasonable and realistic sequence of activities which represent all work through the entire contract performance period. The Initial Schedule shall be at a reasonable level of detail as determined by the Contracting Officer. Include detailed design and permitting activities, including but not limited to identification of individual design packages, design submission, reviews and conferences; permit

submissions and any required Government actions; and long lead procurement activities required prior to design completion. The Initial Project Schedule shall include the entire construction sequence and all fast track construction activities, with as much detail as is known at the time but, as a minimum, shall include all construction start and completion milestone activities, and detailed construction activities through the dry-in milestone, including all activity coding and cost loading. Include the remaining construction, including cost loading, but it may be scheduled summary in nature. As the design proceeds and design packages are developed, fully detail the remaining construction activities concurrent with the monthly schedule updating process. Constrain construction activities by Government acceptance of associated designs. When the design is complete, incorporate into the then approved schedule update all remaining detailed construction activities that are planned to occur after the dry-in milestone.

3.4.3. Design Package Schedule Submission:

With each design package submitted to the Government, submit a frag-net schedule extracted from the then current Preliminary, Initial or Updated schedule which covers the activities associated with that Design Package including construction, procurement and permitting activities.

3.4.4. Periodic Schedule Updates

Based on the result of the meeting specified in PERIODIC SCHEDULE UPDATE MEETINGS, submit periodic schedule updates. These submissions shall enable the Contracting Officer to assess Contractor's progress. If the Contractor fails or refuses to furnish the information and project schedule data, which in the judgment of the Contracting Officer or authorized representative is necessary for verifying the Contractor's progress, the Contractor shall be deemed not to have provided an estimate upon which progress payment may be made. Update the schedule to include detailed lower WBS activities procurement and construction activities as the design progresses, but not later than the submission of the final, un-reviewed design submission for each separate design package. The Contracting Officer may require submission of detailed schedule activities for any distinct construction that is started prior to submission of a final design submission, if such activity is authorized.

3.4.5. Standard Activity Coding Dictionary

Use the activity coding structure defined in the Standard Data Exchange Format (SDEF) in ER 1-1-11, Appendix A. This exact structure is mandatory, even if some fields are not used. A template SDEF compatible schedule backup file (sdef.prx) is available on the QCS website: <http://rms.usace.army.mil> .

The SDEF format is as follows:

Field	Activity Code	Length	Description
1	WRKP	3	Workers per Day
2	RESP	4	Responsible Party (e.g. GC, subcontractor, USACE)
3	AREA	4	Area of Work
4	MODF	6	Modification or REA number
5	BIDI	6	Bid Item (CLIN)
6	PHAS	2	Phase of Work

7	CATW	1	Category of Work
8	FOW1	10	Feature of Work (used up to 10 characters in length)
9	FOW2	10	Feature of Work (used up to 20 characters in length)
10	FOW3	10	Feature of Work (used up to 30 characters in length)

3.5. SUBMISSION REQUIREMENTS

Submit the following items for the Preliminary Schedule, Initial Schedule, and every Periodic Schedule Update throughout the life of the project:

3.5.1. Data CD's

Provide two sets of data CD's containing the project schedule in the backup format. Each CD shall also contain all previous update backup files. File medium shall be CD. Label each CD, indicating the type of schedule (Preliminary, Initial, Update), full contract number, Data Date and file names. Each schedule shall have a unique file name as determined by the Contractor.

3.5.2. Narrative Report

Provide a Narrative Report with the Preliminary, Initial, and each Periodic Update of the project schedule, as the basis of the progress payment request. The Narrative Report shall include: a description of activities along the 2 most critical paths where the total float is less than or equal to 20 work days, a description of current and anticipated problem areas or delaying factors and their impact, and an explanation of corrective actions taken or required to be taken. The narrative report is expected to communicate to the Government, the Contractor's thorough analysis of the schedule output and its plans to compensate for any problems, either current or potential, which are revealed through its analysis. Identify and explain why any activities that, based their calculated late dates, should have either started or finished during the update period but did not.

3.5.3. Approved Changes Verification

Include only those project schedule changes in the schedule submission that have been previously approved by the Contracting Officer. The Narrative Report shall specifically reference, on an activity by activity basis, all changes made since the previous period and relate each change to documented, approved schedule changes.

3.5.4. Schedule Reports

The format, filtering, organizing and sorting for each schedule report shall be as directed by the Contracting Officer. Typically reports shall contain: Activity Numbers, Activity Description, Original Duration, Remaining Duration, Early Start Date, Early Finish Date, Late Start Date, Late Finish Date Total Float, Actual Start Date, Actual Finish Date, and Percent Complete. The following lists typical reports that will be requested. One or all of these reports may be requested for each schedule submission.

3.5.4.1. Activity Report

A list of all activities sorted according to activity number.

3.5.4.2. Logic Report

A list of detailed predecessor and successor activities for every activity in ascending order sorted by activity number.

3.5.4.3. Total Float Report

A list of all incomplete activities sorted in ascending order of total float. List activities which have the same amount of total float in ascending order of Early Start Dates. Do not show completed activities on this report.

3.5.4.4. Earnings Report by CLIN

A compilation of the Contractor's Total Earnings on the project from the NTP to the data date. This report shall reflect the earnings of specific activities based on the agreements made in the schedule update meeting defined herein. Provided that the Contractor has provided a complete schedule update, this report shall serve as the basis of determining progress payments. Group activities by CLIN Item number and sort by activity number. This report shall: sum all activities coded to a particular CLIN and provide a CLIN Item percent earned value; and complete and sum CLIN items to provide a total project percent complete. The printed report shall contain, for each activity: the Activity Number, Activity Description, Original Budgeted Amount, Quantity to Date, Percent Complete (based on cost), and Earnings to Date.

3.5.5. Network Diagram

The network diagram is required for the Preliminary, Initial and Periodic Updates. Depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished. The Contracting Officer will use, but is not limited to, the following conditions to review compliance with this paragraph:

3.5.5.1. Continuous Flow

Show a continuous flow from left to right with no arrows from right to left. Show the activity number, description, duration, and estimated earned value on the diagram.

3.5.5.2. Project Milestone Dates

Show dates on the diagram for start of project, any contract required interim completion dates, and contract completion dates.

3.5.5.3. Critical Path

Clearly show the critical path.

3.5.5.4. Banding

Organize activities as directed to assist in the understanding of the activity sequence. Typically, this flow will group activities by category of work, work area and/or responsibility.

3.5.5.5. S-Curves

Earnings curves showing projected early and late earnings and earnings to date.

3.6. PERIODIC SCHEDULE UPDATE MEETINGS

Conduct periodic schedule update meetings for the purposes of reviewing the Contractor's proposed out of sequence corrections, determining causes for delay, correcting logic, maintaining schedule accuracy and determining earned value. Meetings shall occur at least monthly within five days of the proposed

schedule data date and after the Contractor has updated the schedule with Government concurrence respecting actual start dates, actual finish dates, remaining durations and percent complete for each activity it intend to status. Match the acutal start and finish dates with the dates exported, as described in paragraph 3.3.5. Provide a computer with the scheduling software loaded and a projector during the meeting which allows all meeting participants to view the proposed schedule update during the meeting. The meeting and resultant approvable schedule update shall be a condition precedent to a formal submission of the update as described in SUBMISSION REQUIREMENTS and to the submission of an invoice for payment. The meeting will be a working interactive exchange which will allow the Government and the Contractor the opportunity review the updated schedule on a real time and interactive basis. The Contractor's authorized scheduling representative will organize, sort, filter and schedule the update as requested by the Government. The meeting will last no longer than 8 hours. A rough draft of the proposed activity logic corrections and narrative report shall be provided to the Government 48 hours in advance of the meeting. The Contractor's Project Manager and Authorized Scheduler shall attend the meeting with the Authorized Representative of the Contracting Officer.

3.6.1. Update Submission Following Progress Meeting

Submit a complete update of the project schedule containing all approved progress, revisions, and adjustments, pursuant to paragraph SUBMISSION REQUIREMENTS not later than 4 working days after the periodic schedule update meeting, reflecting only those changes made during the previous update meeting.

3.6.2. Status of Activities

Update statusing information, including Actual Start Dates (AS), Actual Finish Dates (AF), Remaining Durations (RD) and Percent Complete shall be subject to the approval of the Government prior to the meeting. As a minimum, address the following items on an activity by activity basis during each progress meeting:

3.6.2.1. Actual Start and Finish Dates

Accurately status the AS and/or AF dates for each activity currently in-progress or completed since the last update. The Government may allow an AF date to be assigned with the percent complete less than 100% to account for the value of work remaining but not restraining successor activities. Only assign AS dates when actual progress occurs on an activity.

3.6.2.2. Remaining Duration

Update the estimated RD for all incomplete activities independent of Percent Complete. Remaining durations may exceed the activity OD or may exceed the activity's prior update RD if the Government considers the current OD or RD to be understated based on current progress, insufficient work crews actually manning the job, unrealistic OD or deficiencies that must be corrected that restrain successor activities.

3.6.2.3. Percent Complete

Update the percent complete for each activity started based on the realistic assessment of earned value. Activities which are complete but for remaining minor punch list work and which do not restrain the initiation of successor activities may be statused 100 percent complete. To allow for proper schedule management, cost load the correction of punch list from Government pre-final inspection activity(ies) not less than 1% of the total contract value, which activity(ies) may be declared 100 percent complete upon completion and correction of all punch list work identified during Government pre-final inspection(s).

3.6.2.4. Logic Changes

Specifically identify and discuss all logic changes pertaining to NTP on change orders, change orders to be incorporated into the schedule, contractor proposed changes in work sequence, corrections to schedule logic for out-of-sequence progress, and other changes that have been made pursuant to contract provisions. The Government will only approve logic revisions for the purpose of keeping the schedule valid in terms of its usefulness in calculating a realistic completion date, correcting erroneous logic ties, and accurately sequencing the work.

3.6.2.5. Other Changes

Other changes required due to delays in completion of any activity or group of activities include: 1) delays beyond the Contractor's control, such as strikes and unusual weather. 2) delays encountered due to submittals, Government Activities, deliveries or work stoppages which make re-planning the work necessary. 3) Changes required to correct a schedule that does not represent the actual or planned prosecution and progress of the work.

3.7. REQUESTS FOR TIME EXTENSIONS

In the event the Contractor believes it is entitled to an extension of the contract performance period, completion date, or any interim milestone date, furnish the following for a determination by the Contracting Officer: justification, project schedule data, and supporting evidence as the Contracting Officer may deem necessary. Submission of proof of excusable delay, based on revised activity logic, duration, and costs (updated to the specific date that the delay occurred) is a condition precedent to any approvals by the Government. In response to each Request For Proposal issued by the Government, the Contractor shall submit a schedule impact analysis demonstrating whether or not the change contemplated by the Government impacts the critical path.

3.7.1. Justification of Delay

The project schedule shall clearly display that the Contractor has used, in full, all the float time available for the work involved with its request. The Contracting Officer's determination as to the number of allowable days of contract extension shall be based upon the project schedule updates in effect for the time period in question, and other factual information. The Contractor will not be entitled to a time extension or price adjustment for extended overhead related costs due to any delays which may affect early contract completion prior to the required contract completion date.

Actual delays that are found to be caused by the Contractor's own actions, which result in a calculated schedule delay, will not be a cause for an extension to the performance period, completion date, or any interim milestone date.

3.7.2. Submission Requirements

Submit a justification for each request for a change in the contract completion date of less than 2 weeks based upon the most recent schedule update at the time of the NTP or constructive direction issued for the change. Such a request shall be in accordance with the requirements of other appropriate Contract Clauses and shall include, as a minimum:

3.7.2.1. A list of affected activities, with their associated project schedule activity number.

3.7.2.2. A brief explanation of the causes of the change

3.7.2.3. An analysis of the overall impact of the changes proposed.

3.7.2.4. A sub-network of the affected area

Identify activities impacted in each justification for change by a unique activity code contained in the required data file.

3.7.3. Additional Submission Requirements

The Contracting Officer may request an interim update with revised activities for any requested time extension of over 2 weeks. Provide this disk within 4 days of the Contracting Officer's request.

3.7.4. If Progress Falls Behind the Approved Project Schedule

3.7.4.1. Should progress fall behind the approved schedule (more than 20 work days of negative float) due to Contractor generated problems, promptly provide a supplemental recovery or completion schedule that illustrates its efforts to regain time to assure a completion by the required contract completion date.

3.7.4.2. The supplemental recovery or completion schedule will not replace the original, approved schedule as the official contract schedule. Continue to update the original, approved schedule on at least a monthly basis. In addition, the Contractor and the Contracting Officer will monitor the supplemental recovery or completion schedule on at least a bi-weekly basis to determine its effect on regaining the rate of progress to assure project completion by the contractually required completion date.

3.7.4.3. Do not artificially improve progress by simply revising the schedule logic, modifying or adding constraints, or shortening future work activity durations. Resource and manpower load the supplemental recovery schedule or completion schedule with crew size and productivity for each remaining activity, indicating overtime, weekend work, and/or double shifts needed to regain the schedule, in accordance with FAR 52.236.15, without additional cost to the Government. Indicate assumptions made and the basis for any logic, constraint, or duration changes used in the creation of the supplemental recovery or completion schedule in a narrative submitted for the Contracting Officer's approval. Any additional resources or manpower must be evident at the work site. Do not modify the official contract schedule to include these assumptions.

3.7.4.4. Failure to perform work and maintain progress in accordance with the supplemental recovery or completion schedule may result in an interim and final unsatisfactory performance rating and/or may result in corrective action by the Contracting Officer in accordance with FAR 52.236-15.

3.8. DIRECTED CHANGES

If the NTP is issued for changes prior to settlement of price and/or time, submit proposed schedule revisions to the Contracting Officer within 2 weeks of the NTP being issued. The Contracting Officer will approve proposed revisions to the schedule prior to inclusion of those changes within the project schedule. If the Contractor fails to submit the proposed revisions, the Contracting Officer may furnish the Contractor with suggested revisions to the project schedule. The Contractor shall include these revisions in the project schedule until revisions are submitted and final changes and impacts have been negotiated. If the Contractor has any objections to the revisions furnished by the Contracting Officer, advise the Contracting Officer within 2 weeks of receipt of the revisions. Regardless of the objections, the Contractor shall continue to update the schedule with the Contracting Officer's revisions until a mutual agreement in the revisions is reached. If the Contractor fails to submit alternative revisions within 2 weeks of receipt of the Contracting Officer's proposed revisions, the Contractor will be deemed to have concurred with the Contracting Officer's proposed revisions. The proposed revisions will then be the basis for an equitable adjustment for performance of the work.

3.9. WEEKLY PROGRESS MEETINGS

3.9.1. The Government and the Contractor shall meet weekly (or as otherwise mutually agreed to) between the meetings described in paragraph PERIODIC SCHEDULE UPDATE MEETINGS for the purpose of jointly reviewing the actual progress of the project as compared to the as planned progress

and to review planned activities for the upcoming two weeks. The then current and approved schedule update shall be used for the purposes of this meeting and for the production and review of reports. The Contractor's Project Manager and the Authorized Representative of the Contracting Officer shall attend. The weekly progress meeting will address the status of RFI's, RFP's and Submittals.

3.9.2. Provide a bar chart produced by the scheduling software, organized by Total Float and Sorted by Early Start Date, and a two week "look-ahead" schedule by filtering all schedule activities to show only current ongoing activities and activities schedule to start during the upcoming two weeks, organized by Work Area Code (AREA) and sorted by Early Start Date.

3.9.3. The Government and the Contractor shall jointly review the reports. If it appears that activities on the longest path(s) which are currently driving the calculated completion date (driving activities), are not progressing satisfactorily and therefore could jeopardize timely project completion, corrective action must be taken immediately. Corrective action includes but is not limited to: increasing the number of work crews; increasing the number of work shifts; increasing the number of hours worked per shift; and determining if Government responsibility coded activities require Government corrective action.

3.10. OWNERSHIP OF FLOAT

Float available in the schedule, at any time, shall not be considered for the exclusive use of either the Government or the Contractor.

3.11. TRANSFER OF SCHEDULE DATA INTO RMS/QCS

Download and upload the schedule data into the Resident Management System (RMS) prior to RMS databases being transferred to the Government and is considered to be additional supporting data in a form and detail required by the Contracting Officer pursuant to FAR 52.232-5 - Payments under Fixed-Price Construction Contracts. The receipt of a proper payment request pursuant to FAR 52.232-27 - Prompt Payment for Construction Contracts is contingent upon the Government receiving both acceptable and approvable hard copies and electronic export from QCS of the application for progress payment.

End of Section 01 32 01.00 10

**SECTION 01 33 00
SUBMITTAL PROCEDURES**

1.0 GENERAL

- 1.1. DEFINITIONS
- 1.2. NOT USED
- 1.3. SUBMITTAL CLASSIFICATION
- 1.4. APPROVED OR CONCURRED WITH SUBMITTALS
- 1.5. DISAPPROVED SUBMITTALS
- 1.6. WITHHOLDING OF PAYMENT
- 1.7. GENERAL
- 1.8. SUBMITTAL REGISTER
- 1.9. SCHEDULING
- 1.10. TRANSMITTAL FORM (ENG FORM 4025)
- 1.11. SUBMITTAL PROCEDURES
- 1.12. CONTROL OF SUBMITTALS
- 1.13. GOVERNMENT APPROVED SUBMITTALS
- 1.14. INFORMATION ONLY SUBMITTALS
- 1.15. STAMPS

1.0 GENERAL

1.1. DEFINITIONS

1.1.1. Submittal

Contract Clauses "FAR 52.236-5, Material and Workmanship," paragraph (b) and "FAR 52.236-21, Specifications and Drawings for Construction," paragraphs (d), (e), and (f) apply to all "submittals."

1.1.2. Submittal Descriptions (SD)

Submittals requirements are specified in the technical sections. Submittals are identified by SD numbers and titles as follows.

SD-01 Preconstruction Submittals

- Certificates of insurance.
- Surety bonds.
- List of proposed subcontractors.
- List of proposed products.
- Construction Progress Schedule.
- Submittal register.
- Schedule of prices.
- Accident Prevention Plan.
- Work plan.
- Quality control plan.
- Environmental protection plan.

SD-02 Shop Drawings

- Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.
- Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.
- Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

SD-03 Product Data

- Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials or equipment for some portion of the work.
- Samples of warranty language when the contract requires extended product warranties.

SD-04 Samples

- Physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.
- Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.
- Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies that are to be incorporated into the project and those which will be removed at conclusion of the work.

SD-05 Design Data

- Calculations, mix designs, analyses or other data pertaining to a part of work.
- Design submittals, design substantiation submittals and extensions of design submittals.

SD-06 Test Reports

- Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. (Testing must have been within three years of date of contract award for the project.)
- Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.
- Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.
- Investigation reports.
- Daily checklists.
- Final acceptance test and operational test procedure.

SD-07 Certificates

- Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements. Must be dated after award of project contract and clearly name the project.
- Document required of Contractor, or of a supplier, installer or subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.
- Confined space entry permits.
- Text of posted operating instructions.

SD-08 Manufacturer's Instructions

- Preprinted material describing installation of a product, system or material, including special notices and Material Safety Data sheets concerning impedances, hazards and safety precautions.

SD-09 Manufacturer's Field Reports

- Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- Factory test reports.

SD-10 Operation and Maintenance Data

- Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

SD-11 Closeout Submittals

- Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

1.1.3. Approving Authority

Office authorized to approve submittal.

1.1.4. Work

As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce submittals, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.2. NOT USED

1.3. SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.3.1. Designer of Record Approved (DA)

1.3.1.1. Designer of Record (DOR) approval is required for all extensions of design, critical materials, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction", they are considered to be "shop drawings". Provide the Government the number of copies designated hereinafter of all DOR approved submittals, after the DOR has taken appropriate action. The DOR shall ensure that submittals conform to the Solicitation, the Accepted Proposal and the completed design, however see below for those submittals proposing a deviation to the contract or a substitution of a material, system, or piece of equipment that was identified by manufacturer, brand name or model description in the accepted contract proposal.

1.3.1.2. The DOR shall ensure that the submittals comply with all applicable Buy American Act and Trade Agreement Act clauses in the contract. The DOR may confer with the Contracting Officer's Representative for advice and interpretation of those clauses, as necessary.

1.3.1.3. The Government may, but is not required to, review any or all DOR approved submittals for conformance to the solicitation, accepted proposal and the completed design. Except for submittals designated as deviating from the Solicitation, the Accepted Proposal or completed design, the Contractor may proceed with acquisition and installation upon DOR approval. Government Approved (GA)

1.3.2. Government Approved (GA)

Government approval is required for any item specifically designated as requiring Government approval in the Solicitation, for internal and external color finish selections and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," they are considered to be "shop drawings."

1.3.3. Government Conformance Review of Design (CR)

The Government will review all intermediate and final design submittals for conformance with the technical requirements of the solicitation. Section 01 33 16 **DESIGN AFTER AWARD** covers the design submittal and review process in detail. Review will be only for conformance with the applicable codes, standards and contract requirements. Design data includes the design documents described in Section 01 33 16 **DESIGN AFTER AWARD**. Generally, design submittals should be identified as SD-05 Design Data submittals.

1.3.4. Designer of Record Approved/Government Conformance Review (DA/CR)

1.3.4.1. Deviations to the Accepted Design. Designer of Record approval and the Government's concurrence are required for any proposed deviation from the accepted design which still complies with the contract (the Solicitation and Accepted Proposal) before the Contractor is authorized to proceed with material acquisition or installation. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction", they are considered to be "shop drawings." If necessary to facilitate the project schedule, the Contractor and the DOR may discuss a submittal proposing a deviation with the Contracting Officer's Representative prior to officially submitting it to the Government. However, the Government reserves the right to review the submittal before providing an opinion, if it deems it necessary. In any case, the Government will not formally agree to or provide a preliminary opinion on any deviation without the DOR's approval or recommended approval. The Government reserves the right to non-concur with any deviation from the design, which may impact furniture, furnishings, equipment selections or operations decisions that were made, based on the reviewed and concurred design.

1.3.4.2. Substitutions. Unless prohibited or provided for otherwise elsewhere in the Contract, where the accepted contract proposal named products, systems, materials or equipment by manufacturer, brand name and/or by model number or other specific identification, and the Contractor desires to substitute manufacturer or model after award, submit a requested substitution for Government concurrence. Include substantiation, identifying information and the DOR's approval, as meeting the contract requirements and that it is equal in function, performance, quality and salient features to that in the accepted contract proposal.

1.3.5. Designer of Record Approved/Government Approved (DA/GA)

Any proposed deviation to the solicitation and/or the accepted proposal constitutes a change to the contract. In addition to the above stated requirements for proposed deviations to the accepted design, both Designer of Record and Government Approval and, where applicable, a contract modification are required before the Contractor is authorized to proceed with material acquisition or installation for any proposed deviation to the contract. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction", they are considered to be "shop drawings". The Government reserves the right to accept or reject any such proposed deviation at its discretion.

1.3.6. Information Only

All submittals not requiring Designer of Record or Government approval will be for information only. Provide the Government "For Information Only" copies of all submittals not requiring Government approval or concurrence, after the Designer of Record has taken the appropriate action.

1.4. APPROVED OR CONCURRED WITH SUBMITTALS

Do not construe the Contracting Officer's approval of or concurrence with submittals as a complete check, but only that design, general method of construction, materials, detailing and other information appear to meet the Solicitation and Accepted Proposal. Approval or concurrence will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for design, dimensions, all design extensions, such as the design of adequate connections and details, etc., and the satisfactory construction of all work. The Government won't consider re-submittals for the purpose of substituting previously approved materials or equipment unless accompanied by an explanation of why a substitution is necessary.

1.5. DISAPPROVED SUBMITTALS

Make all corrections required by the Contracting Officer, obtain the Designer of Record's approval when applicable, and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. Resubmit any "information only" submittal found to contain errors or unapproved deviations from the Solicitation or Accepted Proposal as one requiring "approval" action, requiring both Designer of Record and Government approval. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, provide prompt notice in accordance with the Contract Clause "Changes" to the Contracting Officer.

1.6. WITHHOLDING OF PAYMENT

No payment for materials incorporated in the work will be made if all required Designer of Record or required Government approvals have not been obtained. No payment will be made for any materials incorporated into the work for any conformance review submittals or information only submittals found to contain errors or deviations from the Solicitation or Accepted Proposal.

1.7. GENERAL

Make submittals as required by the specifications. The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. Prior to submittal, the Contractor's Quality Control (CQC) System Manager and the Designer of Record, if applicable, shall check, approve, sign, and stamp all items, indicating action taken. Clearly identify proposed deviations from the contract requirements. Include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals. Schedule and make submittals requiring Government approval prior to the acquisition of the material or equipment covered thereby. Pick up and dispose of samples remaining upon completion of the work in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

1.8. SUBMITTAL REGISTER (GA)

Develop a complete list of submittals, including each separate design package submittal. Submit the initial submittal register within 15 days after Notice to Proceed, including, as a minimum, the design packages and other initial submittals required elsewhere in the contract. The Designer of Record shall identify required submittals in the specifications, and use the list to prepare the Submittal Register, utilizing the government-provided software, QCS (see Section 01 45 01.10), to create the ENG Form 4288. Appendix R is a preliminary submittal register input form for use with the Quality Management System and the Resident Office Management System (QCS and RMS). The Government will provide the Contractor the actual Excel Spreadsheet version of this sample input form after award to modify and to use for input into QCS. The Excel Spreadsheet is not totally inputable into QCS, so additional keystroke input will be necessary. The sample input form is not all-inclusive. In addition, additional submittals may be required by other parts of the contract. After award, the parties will meet to discuss contract specific (or task order specific for a task order contract) distribution for the submittals all-inclusive and additional submittals may be required by other parts of the contract. Develop and complete the submittal register as the design is completed. Submit it to the Contracting Officer with the un-reviewed final design package submission or as soon as the design specifications are completed, if before the final design submission. When applicable, if the Contractor elects to fast track design and construction, using multiple design package submissions, update the submittal register to reflect the submittals associated with each design submission, clearly denoting all revisions to the previous submission. The submittal register serves as a scheduling document for submittals and for control of submittal actions throughout the contract period. Coordinate the submit dates and need dates used in the submittal register with dates in the Contractor prepared progress schedule. Submit monthly updates to the submittal register showing the Contractor action codes and actual dates with Government action codes and actual dates or until all submittals have been satisfactorily completed. Revise and submit the submittal register when revising the progress schedule.

1.9. SCHEDULING

Schedule submittals covering component items forming a system or items that are interrelated to be coordinated and submitted concurrently. Schedule certifications to be submitted with the pertinent drawings. Allow adequate time (a minimum of 15 calendar days exclusive of mailing time) and show on the register for those items requiring Government approval or concurrence. No delay damages or time extensions will be allowed for time lost in late submittals by the Contractor.

1.10. TRANSMITTAL FORM (ENG FORM 4025)

Use the transmittal form (ENG Form 4025) for submitting submittals in accordance with the instructions on the reverse side of the form. These forms will be furnished to the Contractor or are included in the QCS software if the Contractor is required to use QCS for this contract. Use a separate transmittal form for each specification section Complete this form by filling out all the heading blank spaces and identify

each item submitted. Exercise special care to ensure proper listing of the specification paragraph and/or sheet number of the contract drawings pertinent to the data submitted for each item.

1.11. SUBMITTAL PROCEDURES

Make submittals as follows:

1.11.1. Procedures

The Government will further discuss detailed submittal procedures with the Contractor at the Post-Award Conference.

1.11.2. Deviations

For submittals which include proposed deviations requested by the Contractor, check the column "variation" of ENG Form 4025. Set forth in writing the reason for any deviations and annotate such deviations on the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

1.12. CONTROL OF SUBMITTALS

Carefully control his procurement operations to ensure that each individual submittal is made on or before the scheduled submittal date shown on the approved "Submittal Register."

1.13. GOVERNMENT APPROVED OR CONCURRED WITH SUBMITTALS

Upon completion of review of submittals requiring Government approval or concurrence, the Government will stamp and date the submittals as approved or concurred.. The Government will retain three (3) copies of the submittal and return one (1) copy(ies) of the submittal.

1.14. INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of the Contracting Officer is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe. The Government will retain three (3) copies of information only submittals.

1.15. STAMPS

Use stamps similar to the following on the submittal data to certify that the submittal meets contract requirements:

CONTRACTOR

(FIRM NAME)

Approved

Approved with corrections as noted on submittal data and/or attached sheet(s)

Signature:

Title:

Date:

For design-build construction, both the Contractor Quality Control System Manager and the Designer of Record shall stamp and sign to certify that the submittal meets contract requirements.

**SECTION 01 33 16
DESIGN AFTER AWARD**

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ATTACHMENT A STRUCTURAL INTERIOR DESIGN (SID) REQUIREMENTS

ATTACHMENT B FURNITURE, FIXTURES AND EQUIPMENT REQUIREMENTS

ATTACHMENT C TRACKING COMMENTS IN DRCHECKS

ATTACHMENT D SAMPLE FIRE PROTECTION AND LIFE SAFETY CODE REVIEW

ATTACHMENT E LEED SUBMITTALS

ATTACHMENT F BUILDING INFORMATION MODELING REQUIREMENTS

ATTACHMENT G DESIGN SUBMITTAL DIRECTORY AND SUBDIRECTORY FILE ARRANGEMENT

1.0 GENERAL INFORMATION

1.1. INTRODUCTION

1.1.1. The information contained in this section applies to the design required after award. After award, the Contractor will develop the accepted proposal into the completed design, as described herein.

1.1.2. The Contractor may elect to fast track the design and construction that is, proceed with construction of parts of the sitework and facilities prior to completion of the overall design. To facilitate fast tracking, the Contractor may elect to divide the design into no more than six (6) design packages per major facility type and no more than three (3) design packages for site and associated work. Designate how it will package the design, consistent with its overall plan for permitting (where applicable) and construction of the project. See Sections 01 33 00 SUBMITTAL PROCEDURES and 01 32 01.00 10 PROJECT SCHEDULE for requirements for identifying and scheduling the design packaging plan in the submittal register and project schedule. See also Sections 01 10 00 STATEMENT OF WORK and 01 57 20.00 10 ENVIRONMENTAL PROTECTION for any specified permit requirements. If early procurement of long-lead item construction materials or installed equipment, prior to completion of the associated design package, is necessary to facilitate the project schedule, also identify those long-lead items and how it will assure design integrity of the associated design package to meet the contract requirements (The Contract consists of the Solicitation requirements and the accepted proposal). Once the Government is satisfied that the long-lead items meet the contract requirements, the Contracting Officer will allow the Contractor to procure the items at its own risk.

1.1.3. The Contractor may proceed with the construction work included in a separate design package after the Government has reviewed the final (100%) design submission for that package, review comments have been addressed and resolved to the Government's satisfaction and the Contracting Officer (or the Administrative Contracting Officer) has agreed that the design package may be released for construction.

1.1.4. INTEGRATED DESIGN. To the maximum extent permitted for this project, use a collaborative, integrated design process for all stages of project delivery with comprehensive performance goals for siting, energy, water, materials and indoor environmental quality and ensures incorporation of these goals. Consider all stages of the building lifecycle, including deconstruction.

1.2. DESIGNER OF RECORD

Identify, for approval, the Designer of Record ("DOR") that will be responsible for each area of design. One DOR may be responsible for more than one area. Listed, Professional Registered, DOR(s) shall account for all areas of design disciplines. The DOR's shall stamp, sign, and date each design drawing and other design deliverables under their responsible discipline at each design submittal stage (see contract clause Registration of Designers). If the deliverables are not ready for release for construction, identify them as "preliminary" or "not for release for construction" or by using some other appropriate designation. The DOR(s) shall also be responsible for maintaining the integrity of the design and for compliance with the contract requirements through construction and documentation of the as-built condition by coordination, review and approval of extensions of design, material, equipment and other construction submittals, review and approval or disapproval of requested deviations to the accepted design or to the contract, coordination with the Government of the above activities, and by performing other typical professional designer responsibilities.

2.0 PRODUCTS (Not Applicable)

3.0 EXECUTION

3.1. PRE-WORK ACTIVITIES & CONFERENCES

3.1.1. Design Quality Control Plan

Submit for Government acceptance, a Design Quality Control Plan in accordance with Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL before design may proceed.

3.1.2. Post Award Conference

3.1.2.1. The government will conduct a post award contract administration conference at the project site, as soon as possible after contract award. This will be coordinated with issuance of the contract notice to proceed (NTP). The Contractor and major sub-contractor representatives shall participate. All designers need not attend this first meeting. Government representatives will include COE project delivery team members, facility users, facility command representatives, and installation representatives. The Government will provide an agenda, meeting goals, meeting place, and meeting time to participants prior to the meeting.

3.1.2.2. The post award conference shall include determination and introduction of contact persons, their authorities, contract administration requirements, discussion of expected project progress processes, and coordination of subsequent meetings for quality control (see Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL), Partnering (see below and SCR: Partnering), and the initial design conference (see below).

3.1.2.3. The government will introduce COE project delivery team members, facility users, facility command representatives, and installation representatives. The DB Contractor shall introduce major subcontractors, and other needed staff. Expectations and duties of each person shall be defined for all participants. A meeting roster shall be developed and distributed by the government with complete contact information including name, office, project role, phone, mailing and physical address, and email address.

3.1.3. Partnering & Project Progress Processes

3.1.3.1. The initial Partnering conference may be scheduled and conducted at any time with or following the post award conference. The Government proposes to form a partnership with the DB Contractor to develop a cohesive building team. This partnership will involve the COE project delivery team members, facility users, facility command representatives, installation representatives, Designers of Record, major subcontractors, contractor quality control staff, and contractor construction management staff. This partnership will strive to develop a cooperative management team drawing on the strengths of each team member in an effort to achieve a quality project within budget and on schedule. This partnership will be bilateral in membership and participation will be totally voluntary. All costs, excluding labor and travel expenses, shall be shared equally between the Government and the Contractor. The Contractor and Government shall be responsible for their own labor and travel costs. Normally, partnering meetings will be held at or in the vicinity of the project installation.

3.1.3.2. As part of the partnering process, the Government and Contractor shall develop, establish, and agree to comprehensive design development processes including conduct of conferences, expectations of design development at conferences, fast-tracking, design acceptance, Structural Interior Design (SID)/ Furniture, Fixtures & Equipment (FF&E) design approval, project closeout, etc. The government will explain contract requirements and the DB Contractor shall review their proposed project schedule and suggest ways to streamline processes.

3.1.4. Initial Design Conference

The initial design conference may be scheduled and conducted at the project installation any time after the post award conference, although it is recommended that the partnering process be initiated with or before the initial design conference. Any design work conducted after award and prior to this conference should be limited to site and is discouraged for other items. All Designers of Record shall participate in

the conference. The purpose of the meeting is to introduce everyone and to make sure any needs the contractor has are assigned and due dates established as well as who will get the information. See also Attachment F, BUILDING INFORMATION MODELING REQUIREMENTS for discussion concerning the BIM Implementation Plan demonstration at this meeting. The DB Contractor shall conduct the initial design conference.

3.1.5. Pre-Construction Conference

Before starting construction activities, the Contractor and Government will jointly conduct a pre-construction administrative conference to discuss any outstanding requirements and to review local installation requirements for start of construction. It is possible there will be multiple Pre-Construction Conferences based on the content of the design packages selected by the Contractor. The Government will provide minutes of this meeting to all participants.

3.2. STAGES OF DESIGN SUBMITTALS AND OVER THE SHOULDER PROGRESS REVIEWS

The stages of design submittals described below define Government expectations with respect to process and content. The Contractor shall determine how to best plan and execute the design and review process for this project, within the parameters listed below. As a minimum, the Government expects to see at least one interim design submittal, at least one final design submittal before construction of a design package may proceed and at least one Design Complete submittal that documents the accepted design. The Contractor may sub-divide the design into separate packages for each stage of design and may proceed with construction of a package after the Government accepts the final design for that package. See discussion on waivers to submission of one or more intermediate design packages where the parties partner during the design process. See also Attachment F, BUILDING INFORMATION MODELING REQUIREMENTS for discussion concerning BIM and the various stages of design submittals and over-the-shoulder progress reviews.

3.2.1. Site/Utilities

To facilitate fast-track design-construction activities the contractor may submit a final (100%) site and utility design as the first design submittal or it may elect to submit interim and final site and utility design submittals as explained below. Following review, resolution, and incorporation of all Government comments, and submittal of a satisfactory set of site/utility design documents, after completing all other pre-construction requirements in this contract and after the pre-construction meeting, the Government will allow the Contractor to proceed with site development activities, including demolition where applicable, within the parameters set forth in the accepted design submittal. For the first site and utility design submission, whether an interim or final, the submittal review, comment, and resolution times from this specification apply, except that the Contractor shall allow the Government a 14 calendar day review period, exclusive of mailing time. No on-site construction activities shall begin prior to written Government clearance to proceed.

3.2.2. Interim Design Submittals

The Contractor may submit either a single interim design for review, representing a complete package with all design disciplines, or split the interim design into smaller, individual design packages as it deems necessary for fast-track construction purposes. As required in Section 01 32 01.00 10 PROJECT SCHEDULE, the Contractor shall schedule its design and construction packaging plan to meet the contract completion period. This submission is the Government's primary opportunity to review the design for conformance to the solicitation and to the accepted contract proposal and to the Building Codes at a point where required revisions may be still made, while minimizing lost design effort to keep the design on track with the contract requirements. The requirements for the interim design review submittals and review conferences are described hereinafter. This is not necessarily a hold point for the design process; the Contractor may designate the interim design submittal(s) as a snapshot and proceed with design development at its own risk. See below for a waiver, where the parties establish an effective

over-the-shoulder progress review procedure through the partnering process that would eliminate the need for or expedite a formal intermediate design review on one or more individual design packages.

3.2.3. Over-the-Shoulder Progress Reviews

To facilitate a streamlined design-build process, the Government and the Contractor may agree to one-on-one reviewer or small group reviews, electronically, on-line (if available within the Contractor's standard design practices) or at the Contractor's design offices or other agreed location, when practicable to the parties. The Government and Contractor will coordinate such reviews to minimize or eliminate disruptions to the design process. Any data required for these reviews shall normally be provided in electronic format, rather than in hard copy. If the Government and Contractor establish and implement an effective, mutually agreeable partnering procedure for regular (e.g., weekly) over-the-shoulder review procedures that allow the Government reviewers the opportunity to keep fully informed of the progress, contents, design intent, design documentation, etc. of the design package, the Government will agree to waive or to expedite the formal intermediate design review period for that package. The Contractor shall still be required to submit the required intermediate design documentation, however the parties may agree to how that material will be provided, in lieu of a formal consolidated submission of the package. It should be noted that Government funding is extremely limited for non-local travel by design reviewers, so the maximum use of virtual teaming methods must be used. Some possible examples include electronic file sharing, interactive software with on-line or telephonic conferencing, televideo conferencing, etc. The Government must still perform its Code and Contract conformance reviews, so the Contractor is encouraged to partner with the reviewers to find ways to facilitate this process and to facilitate meeting or bettering the design-build schedule. The Contractor shall maintain a fully functional configuration management system as described herein to track design revisions, regardless of whether or not there is a need for a formal intermediate design review. The formal intermediate review procedures shall form the contractual basis for the official schedule, in the event that the partnering process determines that the formal intermediate review process to be best suited for efficient project execution. However, the Government pledges to support and promote the partnering process to work with the Contractor to find ways to better the design schedule.

3.2.4. Final Design Submissions

This submittal is required for each design package prior to Government acceptance of that design package for construction. The requirements for the final design submittal review conferences and the Government's acceptance for start of construction are described herein after.

3.2.5. Design Complete Submittals

After the final design submission and review conference for a design package, revise the design package to incorporate the comments generated and resolved in the final review conferences, perform and document a back-check review and submit the final, design complete documents, which shall represent released for construction documents. The requirements for the design complete submittals are described hereinafter.

3.2.6. Holiday Periods for Government Review or Actions

Do not schedule meetings, Government reviews or responses during the last two weeks of December or other designated Government Holidays (including Friday after Thanksgiving). Exclude such dates and periods from any durations specified herein for Government actions.

3.2.7. Late Submittals and Reviews

If the Contractor cannot meet its scheduled submittal date for a design package, it must revise the proposed submittal date and notify the government in writing, at least one (1) week prior to the submittal, in order to accommodate the Government reviewers' other scheduled activities. If a design submittal is

over one (1) day late in accordance with the latest revised design schedule, or if notification of a proposed design schedule change is less than seven (7) days from the anticipated design submission receipt date, the Government review period may be extended up to seven (7) days due to reviewers' schedule conflicts. If the Government is late in meeting its review commitment and the delay increases the Contractor's cost or delays completion of the project, the Suspension of Work and Defaults clauses provide the respective remedy or relief for the delay.

3.3. DESIGN CONFIGURATION MANAGEMENT

3.3.1. Procedures

Develop and maintain effective, acceptable design configuration management (DCM) procedures to control and track all revisions to the design documents after the Interim Design Submission through submission of the As-Built documents. During the design process, this will facilitate and help streamline the design and review schedule. After the final design is accepted, this process provides control of and documents revisions to the accepted design (See Special Contract Requirement: Deviating From the Accepted Design). The system shall include appropriate authorities and concurrences to authorize revisions, including documentation as to why the revision must be made. Include the DCM procedures in the Design Quality Control Plan. The DCM data shall be available to the Government reviewers at all times. The Contractor may use its own internal system with interactive Government concurrences, where necessary or may use the Government's "DrChecks Design Review and Checking System" (see below and Attachment C).

3.3.2. Tracking Design Review Comments

Although the Contractor may use its own internal system for overall design configuration management, the Government and the Contractor shall use the DrChecks Design Review and Checking System to initiate, respond to, resolve and track Government design compliance review comments. This system may be useful for other data which needs to be interactive or otherwise available for shared use and retrieval. See Attachment C for details on how to establish an account and set-up the DrChecks system for use on the project.

3.3.3. Design and Code Checklists

Develop and complete various discipline-specific checklists to be used during the design and quality control of each submittal. Submit these completed checklists with each design submittal, as applicable, as part of the project documentation. See Section 01 45 04.00 10 Contractor Quality Control, Attachment D for a Sample Fire Protection and Life Safety Code review checklist and Attachment E for LEED SUBMITTALS.

3.4. INTERIM DESIGN REVIEWS AND CONFERENCES

3.4.1. General

At least one interim design submittal, review and review conference is required for each design package (except that, per paragraph 3.2.1, the Contractor may skip the interim design submission and proceed directly to final design on the sitework and utilities package). The DB Contractor may include additional interim design conferences or over-the-shoulder reviews, as needed, to assure continued government concurrence with the design work. Include the interim submittal review periods and conferences in the project schedule and indicate what part of the design work is at what percentage of completion. The required interim design conferences shall be held when interim design requirements are reached as described below. See also Paragraph: **Over-the-Shoulder Progress Reviews** for a waiver to the formal interim design review.

3.4.2. Procedures

After receipt of an Interim Design submission, allow the Government fourteen (14) calendar days after receipt of the submission to review and comment on the interim design submittal. For smaller design packages, especially those that involve only one or a few separate design disciplines, the parties may agree on a shorter review period or alternative review methods (e.g., over-the-shoulder or electronic file sharing), through the partnering process. For each interim design review submittal, the COR will furnish, to the Contractor, a single consolidated, validated listing of all comments from the various design sections and from other concerned agencies involved in the review process using the DrChecks Design Review and Checking System. The review will be for conformance with the technical requirements of the solicitation and the Contractor's RFP proposal. If the Contractor disagrees technically with any comment or comments and does not intend to comply with the comment, he/she must clearly outline, with ample justification, the reasons for noncompliance within five (5) days after receipt of these comments in order that the comment can be resolved. Furnish disposition of all comments, in writing, through DrChecks. The Contractor is cautioned that if it believes the action required by any comment exceeds the requirements of this contract, that it should take no action and notify the COR in writing immediately. The Interim Review conference will be held for each design submittal at the installation. Bring the personnel that developed the design submittal to the review conference. The conference will take place the week after the receipt of the comments by the Contractor. For smaller fast-track packages that involve only a few reviewers, the parties may agree to alternative conferencing methods, such as teleconferencing, or televideo, where available, as determined through Partnering.

3.4.3. Conference Documentation

3.4.3.1. In order to facilitate and accelerate the Government code and contract conformance reviews, identify, track resolution of and maintain all comments and action items generated during the design process and make this available to the designers and reviewers prior to the Interim and subsequent design reviews.

3.4.3.2. The DB Contractor shall prepare meeting minutes and enter final resolution of all comments into DrChecks. Copies of comments, annotated with comment action agreed on, will be made available to all parties before the conference adjourns. Unresolved problems will be resolved by immediate follow-on action at the end of conferences. Incorporate valid comments. The Government reserves the right to reject design document submittals if comments are significant. Participants shall determine if any comments are critical enough to require further design development prior to government concurrence. Participants shall also determine how to proceed in order to obtain government concurrence with the design work presented.

3.5. INTERIM DESIGN REQUIREMENTS

Interim design deliverables shall include drawings, specifications, and design analysis for the part of design that the Contractor considers ready for review.

3.5.1. Drawings

Include comments from any previous design conferences incorporated into the documents to provide an interim design for the "part" submitted.

3.5.2. Design Analyses

3.5.2.1. The designers of record shall prepare and present design analyses with calculations necessary to substantiate and support all design documents submitted. Address design substantiation required by the applicable codes and references and pay particular attention to the following listed items:

3.5.2.2. For parts including sitework, include site specific civil calculations.

3.5.2.3. For parts including structural work, include structural calculations.

- (a) Identify all loads to be used for design.
- (b) Describe the method of providing lateral stability for the structural system to meet seismic and wind load requirements. Include sufficient calculations to verify the adequacy of the method.
- (c) Provide calculations for all principal roof, floor, and foundation members and bracing and secondary members.
- (d) Provide complete seismic analyses for all building structural, mechanical, electrical, architectural, and building features as dictated by the seismic zone for which the facility is being constructed.
- (e) Computer generated calculations must identify the program name, source, and version. Provide input data, including loads, loading diagrams, node diagrams, and adequate documentation to illustrate the design. The schematic models used for input must show, as a minimum, nodes/joints, element/members, materials/properties, and all loadings, induced settlements/deflections, etc., and a list of load combinations. Include an output listing for maximum/minimum stresses/forces and deflections for each element and the reactions for each loading case and combination.
- (f) See also the Security (Anti-Terrorism) requirements below for members subject to Anti-Terrorist Force Protection (ATFP) and Progressive Collapse requirements.
- (g) Fully coordinate and integrate the overall structural design between two different or interfacing construction types, such as modular and stick-built or multistory, stacked modular construction. Provide substantiation of structural, consolidation/settlement analysis, etc., as applicable, through the interfaces.

3.5.2.4. For Security (Anti-Terrorism): Provide a design narrative and calculations where applicable, demonstrating compliance with each of the 22 standards in UFC 4-010-01, which includes Design of Buildings to Resist Progressive Collapse (use the most recent version of UFC 4-023-03, regardless of references to any specific version in UFC 4-010-01). Where sufficient standoff distance is not being provided, show calculations for blast resistance of the structural system and building envelope. Show complete calculations for members subjected to ATFP loads, e.g., support members of glazed items (jambs, headers, sills) connections of windows to support members and connections of support members to the rest of the structure. For 3 story and higher buildings, provide calculations to demonstrate compliance with progressive collapse requirements.

3.5.2.5. For parts including architectural work, include building floor area analysis.

3.5.2.6. For parts including mechanical work, include HVAC analysis and calculations. Include complete design calculations for mechanical systems. Include computations for sizing equipment, compressed air systems, air duct design, and U-factors for ceilings, roofs and exterior walls and floors. Contractor shall employ commercially available energy analysis techniques to determine the energy performance of all passive systems and features. Use of hourly energy load computer simulation is required (see paragraph 3.5.5.2 for list of acceptable software). Based on the results of calculations, provide a complete list of the materials and equipment proposed with the manufacturer's published cataloged product installation specifications and roughing-in data.

3.5.2.7. For parts including life safety, include building code analysis and sprinkler and other suppression systems. Notwithstanding the requirements of the Codes, address the following:

- (a) A registered fire protection engineer (FPE) must perform all fire protection analyses. Provide the fire protection engineer's qualifications. See Section 01 10 00, paragraph 5 for qualifications.
- (b) Provide all references used in the design including Government design documents and industry standards used to generate the fire protection analysis.
- (c) Provide classification of each building in accordance with fire zone, building floor areas and height and number of stories.

(d) Provide discussion and description of required fire protection requirements including extinguishing equipment, detection equipment, alarm equipment and water supply. Alarm and detection equipment shall interface to requirements of Electronic Systems.

(e) Provide hydraulic calculations based on water flow test for each sprinkler system to insure that flow and pressure requirements can be met with current water supply. Include copies of Contractor's water flow testing done to certify the available water source.

3.5.2.8. For parts including plumbing systems:

(a) List all references used in the design.

(b) Provide justification and brief description of the types of plumbing fixtures, piping materials and equipment proposed for use.

(c) Detail calculations for systems such as sizing of domestic hot water heater and piping; natural gas piping; LP gas piping and tanks, fuel oil piping and tanks, etc., as applicable.

(d) When the geotechnical report indicates expansive soils are present, indicate in the first piping design submittal how piping systems will be protected against damage or backfall/backflow due to soil heave (from penetration of slab to the 5 foot building line).

3.5.2.9. For elevator systems:

(a) List all criteria codes, documents and design conditions used.

(b) List any required permits and registrations for construction of items of special mechanical systems and equipment.

3.5.2.10. For parts including electrical work, include lighting calculations to determine maintained foot-candle levels, electrical load analysis and calculations, electrical short circuit and protective device coordination analysis and calculations and arc fault calculations.

3.5.2.11. For parts including telecommunications voice/data (including SIPRNET, where applicable), include analysis for determining the number and placement of outlets

3.5.2.12. For Cathodic Protection Systems, provide the following stamped report by the licensed corrosion engineer or NACE specialist with the first design submission. The designer must be qualified to engage in the practice of corrosion control of buried or submerged metallic surfaces. He/she must be accredited or certified by the National Association of Corrosion Engineers (NACE) as a NACE Accredited Corrosion Specialist or a NACE certified Cathodic Protection Specialist, or must be a registered professional engineer with a minimum of five years experience in corrosion control and cathodic protection, Clearly describe structures, systems or components in soil or water to be protected. Describe methods proposed for protection of each.

3.5.2.13. Air Barrier System: Provide a narrative of the design and installation requirements for the Air Barrier system. As part of the design quality control process an air barrier consultant shall review drawing details to assure that details of critical Air Barrier components are properly detailed and incorporated during the design drawings and process (i.e. window flashing details, penetration in air barrier details, door flashing details, roofing/ceiling barrier interface details and etc.). Furnish the Government written review details and results.

3.5.3. Geotechnical Investigations and Reports:

3.5.3.1. The contractor's licensed geotechnical engineer shall prepare a final geotechnical evaluation report, to be submitted along with the first foundation design submittal. Make this information available as early as possible during the over-the-shoulder progress review process. Summarize the subsurface conditions and provide recommendations for the design of appropriate utilities, foundations, floor slabs, retaining walls, embankments, and pavements. Include compaction requirements for fill and backfill under

buildings, sidewalks, other structures and open areas. Recommend foundation systems to be used, allowable bearing pressures for footings, lateral load resistance capacities for foundation systems, elevations for footings, grade beams, slabs, etc. Provide an assessment of post-construction settlement potential including total and differential. Provide recommendations regarding lateral earth pressures (active, at-rest, passive) to be used in the design of retaining walls. Include the recommended spectral accelerations and Site Class for seismic design along with an evaluation of any seismic hazards and recommendations for mitigation, if required. Include calculations to support the recommendations for bearing capacity, settlement, and pavement sections. Include supporting documentation for all recommended design parameters such as Site Class, shear strength, earth pressure coefficients, friction factors, subgrade modulus, California Bearing Ratio (CBR), etc. Provide earthwork recommendations, expected frost penetration, expected groundwater levels, recommendations for dewatering and groundwater control and the possible presence of any surface or subsurface features that may affect the construction of the project such as sinkholes, boulders, shallow rock, old fill, old structures, soft areas, or unusual soil conditions. Include pH tests, salinity tests, resistivity measurements, etc., required to design corrosion control and grounding systems. Include the raw field data. Arrange a meeting with the Government subsequent to completion and evaluation of the site specific geotechnical exploration to outline any differences encountered that are inconsistent with the Government provided preliminary soils information. Clearly outline differences which require changes in the foundation type, or pavement and earthwork requirements from that possible and contemplated using the Government furnished preliminary soils investigation, which result in a change to the design or construction. Any equitable adjustment is subject to the provisions of the contract's Differing Site Conditions Clause.

3.5.3.2. Vehicle Pavements: The Contractor's geotechnical report shall contain flexible and rigid pavement designs, as applicable for the project, including design CBR and modulus of subgrade reaction and the required compaction effort for subgrades and pavement layers. Provide Information on the types of base course materials available in the area and design strengths.

3.5.3.3. The Contractor and the professional geotechnical engineer consultant shall certify in writing that the design of the project has been developed consistent with the Contractor's final geotechnical report. The certification shall be stamped by the consulting professional geotechnical engineer and shall be submitted with the first design submission. If revisions are made to the initial design submission, a new certification shall be provided with the final design submission.

3.5.4. LEED Documentation:

Assign a LEED Accredited Professional, responsible to track LEED planning, performance and documentation for each LEED credit through construction closeout. Incorporate LEED credits in the plans, specifications and design analyses. Develop LEED supporting documentation as a separable portion of the Design Analysis and provide with each required design submittal. Include the LEED Project checklist for each non-exempt facility (one checklist may be provided for multiple facilities in accordance with the LEED-NC Application Guide for Multiple Buildings and On-Campus Building Projects and the LEED SUBMITTALS (Attachment E, herein) with each submittal. Final design submittal for each portion of the work must include all required design documentation relating to that portion of work (example - all site credit design documents with final site design). Submittal requirements are as indicated in Attachment E, LEED SUBMITTALS. Submit all documentation indicated on Attachment E as due at final design at final design submittal (for fast-track projects with multiple final design submittals, this shall be at the last scheduled final design submittal). All project documentation related to LEED shall conform to USGBC requirements for both content and format, including audit requirements and be separate from other design analyses. Maintain and update the LEED documentation throughout project progress to construction closeout and shall compile product data, receipts, calculations and other data necessary to substantiate and support all credits claimed. The Government may audit any or all individual credits. Audit documentation is not required to be submitted unless requested. These requirements apply to all projects. If the project requires the Contractor to obtain USGBC certification, the Contractor shall also be responsible for obtaining USGBC certification and shall provide written evidence of certification with the construction closeout LEED documentation submittal. Install the USGBC building plaque at the location

indicated by the Government upon receipt. If Contractor obtains USGBC interim design review, submit the USGBC review to the Government within 30 days of receipt for information only.

3.5.4.1. LEED Documentation for Technology Solution Set. If the Solicitation provides a Prescriptive Technology Solution Set, use of the Technology Solution set has no effect on LEED documentation requirements. Provide all required LEED documentation, including energy analysis, in accordance with LEED requirements when using the Technology Solution Set.

3.5.5. Energy Conservation:

3.5.5.1. Refer to Section 01 10 00, Paragraph 5. Interim and Final Design submittals shall demonstrate that each building including the building envelope, HVAC systems, service water heating, power, and lighting systems meet the Mandatory Provisions and the Prescriptive Path requirements of ASHRAE 90.1. Use Compliance Documentation forms available from ASHRAE and included in the ASHRAE 90.1 User's Manual for this purpose. The Architectural Section of the Design Analysis shall include completed forms titled "Building Envelope Compliance Documentation Parts I and II". The Heating Ventilating and Air Conditioning (HVAC) Section of the Design Analysis shall include a completed form titled "HVAC Simplified Approach Option - Part I" if this approach is allowed by the Standard. Otherwise, the HVAC Section of the Design Analysis shall include completed forms titled "HVAC Mandatory Provisions - Part II" and "HVAC Prescriptive Requirements - Part III". The Plumbing Section of the Design Analysis shall include a completed form titled "Service Water Heating Compliance Documentation". The Electrical Section of the Design Analysis shall include an explanatory statement on how the requirements of ASHRAE 90.1 Chapter 8 Power were met. The Electrical Section of the Design Analysis shall also include a completed form titled "Lighting Compliance Documentation".

3.5.5.2. Interim and Final Design submittals which address energy consuming systems, (heating, cooling, service hot water, lighting, power, etc.) must also include calculations in a separate Energy Conservation Section of the Design Analysis which demonstrate and document (a) the baseline energy consumption for the facility or facilities under contract, that would meet the requirements of ANSI/ASHRAE/IESNA Standard 90.1 and (b) the energy consumption of the facility or facilities under contract utilizing the materials and methods required by this construction contract. Use the USGBC Energy and Atmosphere (EA) Credit 1 compliance template / form or an equivalently detailed form for documenting compliance with the energy reduction requirements. This template / form is titled PERFORMANCE RATING METHOD and is available when the project is registered for LEED. The calculation methodology used for this documentation and analysis shall follow the guidelines set forth in Appendix G of ASHRAE 90.1, with two exceptions: a) receptacle and process loads may be omitted from the calculation; and b) the definition of the terms in the formula for Percentage Improvement found in paragraph G1.2 are modified as follows: Baseline Building Performance shall mean the annual energy consumption calculated for a building design intended for use as a baseline for rating above standard design meeting the minimum requirements of the energy standard, and Proposed Building Performance shall mean annual energy consumption calculated for the proposed building design intended for construction. This calculation shall address all energy consuming systems in a single integrated methodology. Include laboratory fume hoods and kitchen ventilation loads in the energy calculation. They are not considered process loads. Individual calculations for heating, cooling, power, lighting, power, etc. systems will not be acceptable. The following building simulation software is acceptable for use in calculating building energy consumption: Hourly Analysis Program (HAP) by Carrier Corp., TRACE 700 by Trane Corp., DOE-2 by US Department of Energy, EnergyPlus by DOD/DOE.

3.5.6. Specifications

Specifications may be any one of the major, well known master guide specification sources. Use only one source. Examples include specifications from MASTERSPEC from the American Institute of Architects, SPECTEXT from Construction Specification Institute or Unified Facility Guide Specifications (UFGS using MASTERFORMAT 2004 numbering system), etc. The UFGS are available through the "Whole Building Design Guide" website, using a websearch engine. Manufacturers' product specifications, utilizing CSI's Manu-Spec, three part format may be used in conjunction with the selected

specifications. The designers of record shall edit and expand the appropriate Specifications to insure that all project design requirements, current code requirements, and regulatory requirements are met. Specifications shall clearly identify, where appropriate, specific products chosen to meet the contract requirements (i.e., manufacturers' brand names and model numbers or similar product information). Note that the UFGS are NOT written for Design-Build and must be edited appropriately. For instance, they assume that the Government will approve most submittals, whereas in Design-Build, the Designer of Record has that action, unless this Solicitation requires Government approval for specific submittals. The Designer of Record should also note that some UFGS sections might either prescribe requirements exceeding the Government's own design standards in applicable references or contain requirements that should be selected where appropriately required by the applicable references. At any rate, where the UFGS are consistent with other major, well known master commercial guide specifications, then generally retain such requirements, as good practices.

3.5.7. Building Rendering

Present and provide a draft color computer, artist, or hand drawn rendering with the conceptual design submittal of the building exterior. Perspective renderings shall include a slightly overhead view of the entire building to encompass elevations and the roof configuration of the building. After Government review and acceptance, provide a final rendering, including the following:

Three (3) 18" x 24" color prints, framed and matted behind glass with project title underneath the print.

One (1) Image file (high resolution) in JPG format on CD for those in the submittal distribution list.

3.5.8. Interim Building Design Contents

The following list represents what the Government considers should be included in the overall completed design for a facility or project. It is not intended to limit the contractor from providing different or additional information as needed to support the design presented, including the require design analyses discussed above. As the Contractor develops individual design packages and submits them for Interim review, include as much of the applicable information for an individual design package as is developed at the Interim design level for review purposes. These pieces shall be developed as the design progresses toward the design complete stage.

3.5.8.1. Lawn and Landscaping Irrigation System

3.5.8.2. Landscape, Planting and Turfing

3.5.8.3. Architectural

- (a) Design Narrative
- (b) Architectural Floor Plans, Typical Wall and Roof Sections, Elevations
- (c) Finish schedule
- (d) All required equipment
- (e) Special graphics requirements
- (f) Door and Window Schedules
- (g) Hardware sets using BHMA designations
- (h) Composite floor plan showing all pre-wired workstations
- (i) Structural Interior Design (SID) package: See ATTACHMENT A for specific requirements
- (j) Furniture, Fixtures & Equipment (FF&E) design package: See ATTACHMENT B for specific requirements

(k) Air Barrier Design: Details of all Air Barrier components, (i.e. window flashing details, penetrations in air barrier details, door flashing details, roofing/ceiling barrier interface details and etc.)

3.5.8.4. Structural Systems. Include:

- (a) Drawings showing principal members for roof and floor framing plans as applicable
- (b) Foundation plan showing main foundation elements where applicable
- (c) Typical sections for roof, floor, and foundation conditions

3.5.8.5. Plumbing Systems

- (a) Show locations and general arrangement of plumbing fixtures and major equipment
- (b) Plan and isometric riser diagrams of all areas including hot water, cold water, waste and vent piping. Include natural gas (and meter as required), (natural gas and meter as required), (LP gas), (fuel oil) and other specialty systems as applicable.
- (c) Include equipment and fixture connection schedules with descriptions, capacities, locations, connection sizes and other information as required

3.5.8.6. HVAC Systems

- (a) Mechanical Floor Plans: The floor plans shall show all principle architectural features of the building which will affect the mechanical design. The floor plans shall also show the following:
 - (1) Room designations.
 - (2) Mechanical legend and applicable notes.
 - (3) Location and size of all ductwork and piping.
 - (4) Location and capacity of all terminal units (i.e., registers, diffusers, grilles, hydronic baseboards).
 - (5) Pre-Fabricated Paint Spray Booth (where applicable to project scope)
 - (6) Paint Preparation Area (where applicable to project scope)
 - (7) Exhaust fans and specialized exhaust systems.
 - (8) Thermostat location.
 - (9) Location of heating/cooling plant (i.e., boiler, chiller, cooling tower, etc).
 - (10) Location of all air handling equipment.
 - (11) Air balancing information.
 - (12) Flue size and location.
 - (13) Piping diagram for forced hot water system (if used).
- (b) Equipment Schedule: Provide complete equipment schedules. Include:
 - (1) Capacity
 - (2) Electrical characteristics
 - (3) Efficiency (if applicable)
 - (4) Manufacturer's name
 - (5) Optional features to be provided
 - (6) Physical size
 - (7) Minimum maintenance clearances

- (a) Details: Provide construction details, sections, elevations, etc., only where required for clarification of methods and materials of design.
- (b) HVAC Controls: Submit complete HVAC controls equipment schedules, sequences of operation, wiring and logic diagrams, Input/Output Tables, equipment schedules, and all associated information. See the Statement of Work for additional specific requirements.

3.5.8.7. Fire Protection and Life Safety.

- (a) Provide plan for each floor of each building that presents a compendium of the total fire protection features being incorporated into the design. Include the following types of information:
 - (1) The location and rating of any fire-resistive construction such as occupancy separations, area separations, exterior walls, shaft enclosures, corridors, stair enclosures, exit passageways, etc.
 - (2) The location and coverage of any fire detection systems
 - (3) The location and coverage of any fire suppression systems (sprinkler risers, standpipes, etc.)
 - (4) The location of any other major fire protection equipment
 - (5) Indicate any hazardous areas and their classification
 - (6) Schedule describing the internal systems with the following information: fire hazard and occupancy classifications, building construction type, GPM/square foot sprinkler density, area of operation and other as required
- (b) Working plans and all other materials submitted shall meet NFPA 13 requirements, with respect to required minimum level of detail.

3.5.8.8. Elevators. Provide:

- (a) Description of the proposed control system
- (b) Description, approximate capacity and location of any special mechanical equipment for elevators.

3.5.8.9. Electrical Systems.

- (a) Electrical Floor Plan(s): Show all principle architectural features of the building which will affect the electrical design. Show the following:
 - (1) Room designations.
 - (2) Electrical legend and applicable notes.
 - (3) Lighting fixtures, properly identified.
 - (4) Switches for control of lighting.
 - (5) Receptacles.
 - (6) Location and designation of panelboards. Clearly indicate type of mounting required (flush or surface) and reflect accordingly in specifications.
 - (7) Service entrance (conduit and main disconnect).
 - (8) Location, designation and rating of motors and/or equipment which requires electrical service. Show method of termination and/or connection to motors and/or equipment. Show necessary junction boxes, disconnects, controllers (approximate only), conduit stubs, and receptacles required to serve the motor and/or equipment.
- (b) Building Riser Diagram(s) (from pad-mounted transformer to unit load center panelboard): Indicate the types and sizes of electrical equipment and wiring. Include grounding and metering requirements.

- (c) Load Center Panelboard Schedule(s): Indicate the following information:
- (1) Panelboard Characteristics (Panel Designation, Voltage, Phase, Wires, Main Breaker Rating and Mounting).
 - (2) Branch Circuit Designations.
 - (3) Load Designations.
 - (4) Circuit Breaker Characteristics. (Number of Poles, Trip Rating, AIC Rating)
 - (5) Branch Circuit Connected Loads (AMPS).
 - (6) Special Features
- (d) Lighting Fixture Schedule(s): Indicate the following information:
- (1) Fixture Designation.
 - (2) General Fixture Description.
 - (3) Number and Type of Lamp(s).
 - (4) Type of Mounting.
 - (5) Special Features.
- (e) Details: Provide construction details, sections, elevations, etc. only where required for clarification of methods and materials of design.

3.5.8.10. Electronic Systems including the following responsibilities:

- (a) Fire Detection and Alarm System. Design shall include layout drawings for all devices and a riser diagram showing the control panel, annunciator panel, all zones, radio transmitter and interfaces to other systems (HVAC, sprinkler, etc.)
- (b) Fire Suppression System Control. Specify all components of the Fire Suppression (FS) System in the FS section of the specifications. Clearly describe how the system will operate and interact with other systems such as the fire alarm system. Include a riser diagram on the drawings showing principal components and interconnections with other systems. Include FS system components on drawing legend. Designate all components shown on floor plans "FS system components" (as opposed to "Fire Alarm components"). Show location of FS control panels, HVAC control devices, sensors, and 120V power panel connections on floor plans. Indicate zoning of areas by numbers (1, 2, 3) and detectors sub-zoned for cross zoning by letter designations (A and B). Differentiate between ceiling mounted and under floor detectors with distinct symbols and indicate sub-zone of each.
- (c) Public Address System
- (d) Special Grounding Systems. Completely reflect all design requirements in the specifications and drawings. Specifications shall require field tests (in the construction phase), witnessed by the Government, to determine the effectiveness of the grounding system. Include drawings showing existing construction, if any.
- (e) Cathodic Protection.
- (f) Intrusion Detection, Card Access System
- (g) Central Control and Monitoring System
- (h) Mass Notification System
- (i) Electrical Power Distribution Systems

3.5.8.11. Separate detailed Telecommunications drawings for Information Systems including the following responsibilities:

- (a) Telecommunications Cabling

- (b) Supporting Infrastructure
- (c) Outside Plant (OSP) Cabling - Campus or Site Plans - Exterior Pathways and Inter-Building Backbones
- (d) Include a layout of the voice/data outlets (including voice only wall & pay phones) on telecommunication floor plan drawing, location of SIPRNET data outlets (where applicable), and a legend and symbol definition to indicate height above finished floor. Show size of conduit and cable type and size on Riser Diagram. Do not show conduit runs between backboard and outlets on the floor plans. Show underground distribution conduit and cable with sizing from point of presence to entrance facility of building.
- (e) Layout of complete building per floor - Serving Zone Boundaries, Backbone Systems, and Horizontal Pathways including Serving Zones Drawings - Drop Locations and Cable ID's
- (f) Communication Equipment Rooms - Plan Views - Tech and AMEP/Elevations - Racks and Walls. Elevations with a detailed look at all telecomm rooms. Indicate technology layout (racks, ladder-racks, etc.), mechanical/electrical layout, rack elevation and backboard elevation. They may also be an enlargement of a congested area of T1 or T2 series drawing.

3.6. FINAL DESIGN REVIEWS AND CONFERENCES

A final design review and review conference will be held upon completion of final design at the project installation, or – where equipment is available - by video teleconference or a combination thereof, for any design package to receive Government acceptance to allow release of the design package for construction. For smaller separate design packages, the parties may agree on alternative reviews and conferences (e.g., conference calls and electronic file sharing, etc.) through the Partnering process. Include the final design conference in the project schedule and shall indicate what part of the design work is at 100% completion. The final design conference will be held after the Government has had seven (7) calendar days after receipt of the submission to review the final design package and supporting data. For smaller packages, especially those involving only one or a few design disciplines the parties may agree on a shorter period.

3.7. FINAL DESIGN REQUIREMENTS

Final design deliverables for a design package shall consist of 100% complete drawings, specifications, submittal register and design analyses for Government review and acceptance. The 100% design submission shall consist of drawings, specifications, updated design analyses and any permits required by the contract for each package submitted. In order to expedite the final design review, prior to the conference, ensure that the design configuration management data and all review comment resolutions are up-to-date. Include the 100% SID and 100% FF&E binders for government approval. The Contractor shall have performed independent technical reviews (ITR's) and back-checks of previous comment resolutions, as required by Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL, including providing documentation thereof. Use DrChecks or other acceptable comment tracking system during the ITR and submit the results with each final design package

3.7.1. Drawings

3.7.1.1. Submit drawings complete with all contract requirements incorporated into the documents to provide a 100% design for each package submitted.

3.7.1.2. Prepare all drawings with the Computer-Aided Design and Drafting (CADD)/Computer-Aided Design (CAD) system, organized and easily referenced electronically, presenting complete construction information.

3.7.1.3. Drawings shall be complete. The Contractor is encouraged to utilize graphics, views, notes, and details which make the drawings easier to review or to construct but is also encouraged to keep such materials to those that are necessary.

3.7.1.4. Provide detail drawings that illustrate conformance with the contract. Include room finish schedules, corresponding color/finish/special items schedules, and exterior finish schedules that agree with the submitted SID binders.

3.7.1.5. The design documents shall be in compliance with the latest version of the A/E/C CAD Standard, available at <https://cadbim.usace.army.mil/CAD>. Use the approved vertical Corps of Engineers title blocks and borders on all drawings with the appropriate firm name included within the title block area.

3.7.1.6. CAD System and Building Information Modeling (BIM) (NOTE: If this is a Single Award or Multiple Award, Indefinite Delivery/Indefinite Quantity Contract, this information will be provided for each task order.)

All CAD files shall be fully compatible with MicroStation V8 or higher. Save all design CAD files as MicroStation V8 or higher files. Select BIM application(s) and software(s) but all submitted BIM Models and associated Facility Data shall be fully compatible with any of the following file formats: Autodesk Revit 9.0 or higher, Bentley BIM v8 with associated USACE Bentley BIM v8 Workspace, or ArchiCAD 11 or higher.

(a) CAD Data Final File Format: During the design development capture geo-referenced coordinates of all changes made to the existing site (facility footprint, utility line installations and alterations, roads, parking areas, etc) as a result of this contract. There is no mandatory methodology for how the geo-referenced coordinates will be captured, however, Engineering and Construction Bulletin No. 2006-15, Subject: Standardizing Computer Aided Design (CAD) and Geographic Information Systems (GIS) Deliverables for all Military Design and Construction Projects identifies the format for final as-built drawings and data sets to be delivered to the government. Close-out requirements at the as-built stage; require final geo-referenced GIS Database of the new facility along with all exterior modifications. The Government will incorporate this data set into the Installation's GIS Masterplan or Enterprise GIS System. See also, Section 01 78 02.00 10 Closeout Submittals.

(b) Electronic Drawing Files: In addition to the native CAD design files, provide separate electronic drawing files (in editable CAD format and Adobe Acrobat PDF version 7.0 or higher) for each project drawing.

(c) Each file (both CAD and PDF) shall represent one complete drawing from the drawing set, including the date, submittal phase, and border. Each drawing file shall be completely independent of any data in any other file, including fonts and shapes not included with the basic CAD software program utilized. Fonts that are not included as part of the default CAD software package installation or recognized as an allowable font by the A/E/C CAD Standard are not acceptable in delivered CAD files. All displayed graphic elements on all levels of the drawing files shall be part of the project drawing image. The drawing files shall not contain any graphic element that is not part of the drawing image.

(d) Deliver BIM Model and associated Facility Data files in their native format. At a minimum, BIM files shall address major architecture design elements, major structural components, mechanical systems and electrical/communication distribution and elements as defined in Attachment F. See Attachment F for additional BIM requirements.

(e) Drawing Index: Provide an index of drawings sheet in CAD as part of the drawing set, and an electronic list in Microsoft Excel of all drawings on the CD. Include the electronic file name, the sheet reference number, the sheet number, and the sheet title, containing the data for each drawing.

(f) Hard Copies: Plot submitted hard copy drawings directly from the "electronic drawing files" and copy for quantities and sizes indicated in the distribution list at the end of this specification section. The Designers of Record shall stamp, sign and date original hard copy sheets as Released For Construction, and provide copies for distribution from this set.

3.7.2. Design Analyses

3.7.2.1. The designers of record shall update, finalize and present design analyses with calculations necessary to substantiate and support all design documents submitted.

3.7.2.2. The responsible DOR shall stamp, sign and date the design analysis. Identify the software used where, applicable (name, version, vendor). Generally, provide design analyses, individually, in an original (file copy) and one copy for the assigned government reviewer.

3.7.2.3. All disciplines review the LEED design analysis in conjunction with their discipline-specific design analysis; include a copy of the separable LEED design analysis in all design analysis submittals.

3.7.2.4. Do not combine multi-disciplined volumes of design-analysis, unless multiple copies are provided to facilitate multiple reviewers (one copy per each separate design analysis included in a volume).

3.7.3. Specifications

Specifications shall be 100% complete and in final form.

3.7.4. Submittal Register

Prepare and update the Submittal Register and submit it with the 100% design specifications (see Specification Section 01 33 00, SUBMITTAL PROCEDURES) with each design package. Include the required submittals for each specification section in a design package in the submittal register.

3.7.5. Preparation of DD Form 1354 (Transfer of Real Property)

This form itemizes the types, quantities and costs of various equipment and systems that comprise the project, for the purpose of transferring the new construction project from the Corps Construction Division to the Installation's inventory of real property. The Government will furnish the DB Contractor's design manager a DD Form 1354 checklist to use to produce a draft Form 1354. Submit the completed checklist and prepared draft Form DD 1354 with the 100% design in the Design Analysis. The Corps will use these documents to complete the final DD 1354 upon completion of construction.

3.7.6. Acceptance and Release for Construction

3.7.6.1. At the conclusion of the Final Design Review (after resolutions to the comments have been agreed upon between DOR and Government reviewers), the Contracting Officer or the ACO will accept the Final Design Submission for the design package in writing and allow construction to start for that design package. The Government may withhold acceptance until all major corrections have been made or if the final design submission requires so many corrections, even though minor, that it isn't considered acceptably complete.

3.7.6.2. Government review and acceptance of design submittals is for contract conformance only and shall not relieve the Contractor from responsibility to fully adhere to the requirements of the contract, including the Contractor's accepted contract proposal, or limit the Contractor's responsibility of design as prescribed under Special Contract Requirement: "Responsibility of the Contractor for Design" or limit the Government's rights under the terms of the contract. The Government reserves the right to rescind inadvertent acceptance of design submittals containing contract deviations not separately and expressly identified in the submittal for Government consideration and approval.

3.8. DESIGN COMPLETE CONSTRUCTION DOCUMENT REQUIREMENTS

After the Final Design Submission and Review Conference and after Government acceptance of the Final Design submission, revise the design documents for the design package to incorporate the comments

generated and resolved in the final review conference, perform and document a back-check review and submit the final, design complete documents. Label the final design complete documents "FOR CONSTRUCTION" or use similar language. In addition to the final drawings and specifications, the following deliverables are required for distribution and field use. The deliverable includes all documentation and supporting design analysis in final form, as well as the final review comments, disposition and the back-check. As part of the quality assurance process, the Government may perform a back-check of the released for construction documentation. Promptly correct any errors or omissions found during the Government back-check. The Government may withhold retainage from progress payments for work or materials associated with a final design package until this submittal has been received and the Government determines that it is complete.

3.9. SUBMITTAL DISTRIBUTION, MEDIA AND QUANTITIES

3.9.1. Submittal Distribution and Quantities

General: The documents which the Contractor shall submit to the Government for each submittal are listed and generally described in preceding paragraphs in this Section. Provide copies of each design submittal and design substantiation as follows (NOTE: If this is a Single Award or Multiple Award, Indefinite Delivery/Indefinite Quantity Contract, this information will be provided for each task order):

Activity and Address	Drawing Size (Full Size) ANSI D Full Sets/ *Partial Sets	Design Analyses & Specs Full Sets/ *Partial Sets	Drawing Size (Half Size) 11" x 17" Full Sets/ *Partial Sets	Non-BIM Data CD-ROM or DVD as Necessary (PDF & .dgn)	Furniture Submittal (Per Attachment B)	Structural Interior Design Submittal	BIM Data DVD (Per Attach F)
Commander, U.S.Army Engineer District Louisville	0/0	6/0	6/0	6	1	1	2
Commander, U.S.Army Engineer District, Center of Standardization Mobile	0/0	1/0	1/0	1	N/A	0	0
Installation	0/0	7/0	9/0	45	2	1	1
U.S.Army Corps of Engineers Construction Area Office	0/0	3/0	3/0	3	1	1	0
Information Systems Engineering Command (ISEC)	0/0	0/0	0/0	1	*Partial Set (Work Station/System Furniture- IT Details)	N/A	1

Activity and Address	Drawing Size (Full Size) ANSI D Full Sets/ *Partial Sets	Design Analyses & Specs Full Sets/ *Partial Sets	Drawing Size (Half Size) 11" x 17" Full Sets/ *Partial Sets	Non-BIM Data CD-ROM or DVD as Necessary (PDF & .dgn)	Furniture Submittal (Per Attachment B)	Structural Interior Design Submittal	BIM Data DVD (Per Attachment F)
Huntsville Engineer & Support Center, Central Furnishings Program	N/A	N/A	N/A	N/A	1 Interim/Refer to attachment B for the final submission Qty	N/A	N/A
Other Offices	0/0	6/0	6/0	6	N/A	1	1

***NOTE: For partial sets of drawings, specifications and design analyses, see paragraph 3.9.3.3, below.**

****NOTE: When specified below in 3.9.2, furnish Installation copies of Drawings as paper copies, in lieu of the option to provide secure web-based submittals.**

3.9.2. Web based Design Submittals

Web based design submittals will be acceptable as an alternative to the paper copies listed in the Table above, provided a single hard-copy PDF based record set is provided to the Contracting Officer for record purposes. Where the contract requires the Contractor to submit documents to permitting authorities, still provide those authorities paper copies (or in an alternate format where required by the authority). Web based design submittal information shall be provided with adequate security and availability to allow unlimited access those specifically authorized to Government reviewers while preventing unauthorized access or modification. File sizes must be of manageable size for reviewers to quickly download or open on their computers. As a minimum, drawings shall be full scale on American National Standards Institute (ANSI) D sheets (34" x 22"). In addition to the optional website, provide the BIM data submission on DVD to each activity and address noted above in paragraph 3.9.1 for each BIM submission required in Attachment F.

3.9.3. Mailing of Design Submittals

3.9.3.1. Mail all design submittals to the Government during design and construction, using an overnight mailing service. The Government will furnish the Contractor addresses where each copy shall be mailed to after award of the contract (or individual task order if this is an indefinite delivery/indefinite quantity, task order contract). Mail the submittals to four (4) different addresses. Assemble drawing sheets, specs, design analyses, etc. into individual sets; do not combine duplicate pages from individual sets so that the government has to assemble a set.

3.9.3.2. Each design submittal shall have a transmittal letter accompanying it indicating the date, design percentage, type of submittal, list of items submitted, transmittal number and point of contact with telephone number.

3.9.3.3. Provide partial sets of drawings, specifications, design analyses, etc., as designated in the Table in paragraph 3.9.1, to those reviewers who only need to review their applicable portions of the design,

such as the various utilities. The details of which office receives what portion of the design documentation will be worked out after award.

3.10. AS-BUILT DOCUMENTS

Provide as-built drawings and specifications in accordance with Section 01 78 02.00 10, CLOSEOUT SUBMITTALS. Update LEED design phase documentation during construction as needed to reflect construction changes and advancing project completion status (example - Commissioning Plan updates during construction phase) and include updated LEED documentation in construction closeout submittal.

ATTACHMENT A STRUCTURAL INTERIOR DESIGN (SID) REQUIREMENTS

1.0 GENERAL INFORMATION

Structural Interior Design includes all building related elements and components generally part of the building itself, such as wall finishes, ceilings finishes, floor coverings, marker/bulletin boards, blinds, signage and built in casework. Develop the SID in conjunction with the furniture footprint.

2.0 STRUCTURAL INTERIOR DESIGN (SID) REQUIREMENTS FOR THE INTERIM AND FINAL DESIGN SUBMITTALS

2.1. FORMAT AND SCHEDULE

Prepare and submit for approval an interior and exterior building finishes scheme for an interim design submittal. The DOR shall meet with and discuss the finish schemes with the appropriate Government officials prior to preparation of the schemes to be presented. Present original sets of the schemes to reviewers at an interim design conference.

At the conclusion of the interim phase, after resolutions to the comments have been agreed upon between DOR and Government reviewers, the Contractor may proceed to final design with the interior finishes scheme presented.

The SID information and samples are to be submitted in 8 ½" x 11" format using three ring binders with pockets on the inside of the cover. When there are numerous pages with thick samples, use more than one binder. Large D-ring binders are preferred to O-ring binders. Use page protectors that are strong enough to keep pages from tearing out. Anchor large or heavy samples with mechanical fasteners, Velcro, or double-faced foam tape rather than rubber cement or glue. Fold out items must have a maximum spread of 25 ½". Provide cover and spine inserts sheets identifying the document as "Structural Interior Design" package. Include the project title and location, project number, Contractor/A/E name and phone number(s), submittal stage and date.

Design submittal requirements include, but are not limited to:

2.1.1. Narrative of the Structural Interior Design Objectives

The SID shall include a narrative that discusses the building related finishes. Include topics that relate to base standards, life safety, sustainable design issues, aesthetics, durability and maintainability, discuss the development and features as they relate to the occupants requirements and the building design.

2.1.2. Interior Color Boards

Identify and key each item on the color boards to the contract documents to provide a clear indication of how and where each item will be used. Arrange finish samples to the maximum extent possible by room type in order to illustrate room color coordination. Label all samples on the color boards with the manufacturer's name, patterns and colors name and number. Key or code samples to match key code system used on contract drawings.

Material and finish samples shall indicate true pattern, color and texture. Provide photographs or colored photocopies of materials or fabrics to show large overall patterns in conjunction with actual samples to show the actual colors. Finish samples must be large enough to show a complete pattern or design where practical.

Color boards shall include but not be limited to original color samples of the following:

All walls finishes and ceiling finishes, including corner guards, acrylic wainscoting and wall guards/chair rail finishes

All tile information, including tile grout color and tile patterns.

- All flooring finishes, including patterns.
- All door, door frame finishes and door hardware finishes
- All signage, wall base, toilet partitions, locker finishes and operable/folding partitions and trim
- All millwork materials and finishes (cabinets, counter tops, etc.)
- All window frame finishes and window treatments (sills, blinds, etc.)

Color board samples shall reflect all actual finish textures, patterns and colors required as specified. Patterned samples shall be of sufficient size to adequately show pattern and its repeat if a repeat occurs.

2.1.3. Exterior Color Boards

Prepare exterior finishes color boards in similar format as the interior finishes color boards, for presentation to the reviewers during an interim design conference. Provide original color samples of all exterior finishes including but not limited to the following:

- All Roof Finishes
- All Brick and Cast Stone Samples
- All Exterior Insulation and Finish Samples
- All Glass Color Samples
- All Exterior Metals Finishes
- All Window & Door Frame Finishes
- All Specialty Item Finishes, including trim

Identify each item on the exterior finishes color boards and key to the building elevations to provide a clear indication of how and where each item will be used.

2.2. STRUCTURAL INTERIOR DESIGN DOCUMENTS

2.2.1. General

Structural interior design related drawings must indicate the placement of extents of SID material, finishes and colors and must be sufficiently detailed to define all interior work. The following is a list of minimum requirements:

2.2.2. Finish Color Schedule

Provide finish color schedule(s) in the contract documents. Provide a finish code, material type, manufacturer, series, and color designations. Key the finish code to the color board samples and drawings.

2.2.3. Interior Finish Plans

Indicate wall and floor patterns and color placement, material transitions and extents of interior finishes.

2.2.4. Furniture Footprint Plans

Provide furniture footprint plans showing the outline of all freestanding and systems furniture for coordination of all other disciplines.

2.2.5. Interior Signage

Include interior signage plans or schedules showing location and quantities of all interior signage. Key each interior sign to a quantitative list indicating size, quantity of each type and signage text.

2.2.6. Interior Elevations, Sections and Details

Indicate material, color and finish placement.

**ATTACHMENT B
FURNITURE, FIXTURES & EQUIPMENT (FF&E) REQUIREMENTS**

1.0 FF&E REQUIREMENTS FOR THE INTERIM AND FINAL DESIGN SUBMITTALS

1.1. FORMAT AND SCHEDULE

Prepare and submit for approval a comprehensive FF&E scheme for an interim design submittal. The Contractor's interior designer, NOT A FURNITURE DEALER, shall develop the design. FF&E is the selection, layout, specification and documentation of furniture and includes but is not limited to workstations, seating, tables, storage and shelving, filing, trash receptacles, clocks, framed artwork, artificial plants, and other accessories. Contract documentation is required to facilitate pricing, procurement and installation. The FF&E package is based on the furniture footprint developed in the Structural Interior Design (SID) portion of the interior design. Develop the FF&E package concurrently with the building design to ensure that there is coordination between the electrical outlets, switches, J-boxes, communication outlets and connections, and lighting as appropriate. In addition, coordinate layout with other building features such as architectural elements, thermostats, location of TV's, GF/GI equipment (for example computers, printers, copiers, shredders, faxes), etc. Locate furniture in front of windows only if the top of the item falls below the window and unless otherwise noted, do not attach furniture including furniture systems to the building. If project has SIPRNET and/or NIPRNET, coordinate furniture layout with SIPRNET and NIPRNET separation requirements. Verify that access required by DOIM for SIPRNET box and conduit is provided. The DOR shall interview appropriate Government personnel to determine FF&E requirements for furniture and furnishings prior to preparation of the scheme to be presented. Determine FFE items and quantities by, but not limited to: (1) the number of personnel to occupy the building, (2) job functions and related furniture/office equipment to support the job function, (3) room functions, (4) rank and grade. Present original sets of the scheme to reviewers at an interim design conference upon completion of the interim architectural submittal or three months prior to the submittal of the final FF&E package (whichever comes first).

Design may proceed to final with the FF&E scheme presented at the conclusion of the interim phase, after resolutions to the comments have been agreed upon between DOR and Government reviewers.

Provide six copies of the electronic versions of all documents upon completion of the final architectural submittal or ten months prior to the contract completion date (whichever comes first), to ensure adequate time for furniture acquisition. Provide unbound, electronic drawings in CAD and BIM. Provide all files needed to view complete drawings. Submit all text documents in Microsoft Word or Excel..

Submit four copies of the final and complete FF&E information and samples in 8 ½" x 11" format using three ring binders with pockets on the inside of the cover upon completion of the final architectural submittal or ten months prior to the contract completion date (whichever comes first). Use more than one binder when there are numerous pages with thick samples. Large D-ring binders are preferred to O-ring binders. Use page protectors that are strong enough to keep pages from tearing out for upholstery and finish boards. Anchor large or heavy samples with mechanical fasteners, Velcro, or double-faced foam tape rather than rubber cement or glue. Fold out items must have a maximum spread of 25 ½". Provide cover and spine inserts sheets identifying the document as "Furniture, Fixtures & Equipment" package and include the project title and location, project number, Contractor/A/E name and phone number(s), submittal stage and date.

Provide electronic copies of all documents upon completion of the final architectural submittal or ten months prior to the contract completion date (whichever comes first), to ensure adequate time for furniture acquisition. Provide six compact disks with all drawings files needed to view the complete drawings unbound and in the latest version AutoCAD. Provide six additional compact disks of all text documents in Microsoft Word or Excel.

Design submittal requirements include, but are not limited to:

1.1.1. Narrative of Interior Design Objectives

Provide a narrative description of the furniture, to include functional, safety and ergonomic considerations, durability, sustainability, aesthetics, and compatibility with the building design.

1.1.2. Furniture Order Form

Prepare one Furnishings Order Form for each item specified in the design. This form identifies all information required to order each individual item. In addition to the project name and location, project number, and submittal phase, the order form must include:

- (a) Furniture item illustration and code
- (b) Furniture item name
- (c) Job name, location, and date
- (d) General Services Administration (GSA) FSC Group, part, and section
- (e) GSA Contract Number, Special Item Number (SIN), and contract expiration date
- (f) Manufacturer, Product name and Product model number or National Stock Number (NSN)
- (g) Finish name and number (code to finish samples)
- (h) Fabric name and number, minimum Wyzenbeek Abrasion Test double rubs (code to fabric samples)
- (i) Dimensions
- (j) Item location by room number and room name
- (k) Quantity per room
- (l) Total quantity
- (m) Special instructions for procurement ordering and/or installation (if applicable)
- (n) Written Product Description: include a non-proprietary paragraph listing the salient features of the item to include but not limited to:
 - (1) required features and characteristics
 - (2) ergonomic requirements
 - (3) functional requirements
 - (4) testing requirements
 - (5) furniture style
 - (6) construction materials
 - (7) minimum warranty

The following is an example for "m" features and characteristics, ergonomic requirements and functional requirements:

Chair Description:

- (1) Mid-Back Ergonomic Task Chair
- (2) Pneumatic Gaslift; Five Star Base
- (3) Mesh Back; Upholstered Seat
- (4) Height and Width Adjustable Task Arms:

- a. Arm Height: 6" - 11" (+-1/2")
- b. Arm Width: 2"– 4" adjustment
- (5) Height Adjustable Lumbar Support
- (6) Adjustable Seat Height 16"-21" (+- 1")
- (7) Sliding Seat Depth Adjustment 15"-18" (+-1")
- (8) Standard Hard Casters (for carpeted areas)
- (9) Overall Measurements:
 - a. Overall width: 25" - 27"
 - b. Overall depth: 25"– 28"
- (10) Must have a minimum of the following adjustments (In addition to the above):
 - a. 360 Degree Swivel
 - b. Knee-Tilt with Tilt Tension
 - c. Back angle
 - d. Forward Tilt
 - e. Forward Tilt and Upright Tilt Lock

For projects with systems furniture, also provide a written description of the following minimum requirements:

- (1) Type furniture systems (panel, stacking panels, spine wall, desk based system, or a combination)
- (2) Minimum noise reduction coefficient (NRC)
- (3) Minimum sound transfer coefficient (STC)
- (4) Minimum flame spread and smoke development
- (5) UL testing for task lighting and electrical system
- (6) Panel widths and heights and their locations (this may be done on the drawings) Worksurface types and sizes (this may be done on the drawings)
- (7) Worksurface edge type
- (8) Varying panel/cover finish materials and locations (locations may be shown on the drawings)
- (9) Storage requirements
- (10) Keyboard requirements
- (11) Lock and keying requirements
- (12) Accessory components (examples: tack boards, marker boards, paper management)
- (13) Electrical and communication raceway requirement; type, capacity and location (base, beltline, below and/or above beltline)
- (14) Locations of communication cables (base, beltline, below and/or above beltline, top channel)
- (15) Types of electrical outlets
- (16) Types of communication jacks; provided and installed by others
- (17) Locations of electrical outlets and communication jacks (this may be done on the drawings)

- (18) Type of cable (examples: Cat. 5, Cat. 6, fiber optic; UTP or STP, etc.) system needs to support; provided and installed by others

1.1.3. Manufacturer & Alternate Manufacturer List

Provide a table consisting of all the major furniture items in the order forms and two alternate manufacturers for each item. ALTERNATE MANUFACTURER ITEMS MUST BE SELECTED FROM GSA SCHEDULE AND MEET ALL THE SALIENT FEATURES OF THE ORIGINALLY SPECIFIED ITEM. Provide manufacturer name, address, telephone number, product series and product name for each item and the two alternate items. Major furniture items include, but are not limited to, casegoods, furniture systems, seating, and tables. Organize matrix by item code and item name.

1.1.4. FF&E Procurement List

Provide a table that lists all FF&E furniture, mission unique equipment and building Contractor Furnished/Contractor Installed (CF/CI) items. Give each item a code and name and designate whether item will be procured as part of the FF&E furniture, mission unique equipment or the building construction contract. Use the item code to key all FF&E documents including location plans, color boards, data sheets, cost estimate, etc. Divide the FF&E package into different sections based on this listing, applies to order forms and cost estimates.

1.1.5. Points of Contact (POCs)

Provide a comprehensive list of POCs needed to implement the FF&E package. This would include but not be limited to appropriate project team members, using activity contacts, interior design representatives, construction contractors and installers involved in the project. In addition to name, address, phone, fax and email, include each contact's job function. Divide the FF&E package into different sections based on this listing, applies to order forms and cost estimates.

1.1.6. Color Boards

Provide color boards for all finishes and fabrics for all FF&E items. Finishes to be included but not limited to paint, laminate, wood finish, fabric, etc.

1.1.7. Itemized Furniture Cost Estimate

Provide an itemized cost estimate of furnishings keyed to the plans and specifications of products included in the package. This cost estimate should be based on GSA price schedules. The cost estimate must include separate line items for general contingency, installation, electrical hook-up for systems furniture or other furniture requiring hardwiring by a licensed electrician, freight charges and any other related costs. Installation and freight quotes from vendors should be used in lieu of a percentage allowance when available. Include a written statement that the pricing is based on GSA schedules. An estimate developed by a furniture dealership may be provided as support information for the estimate, but must be separate from the contractor provided estimate.

1.2. INTERIOR DESIGN DOCUMENTS

1.2.1. Overall Furniture and Area Plans

Provide floor Plans showing locations and quantities of all freestanding, and workstation furniture proposed for each floor of the building. Key each room to a large scale Furniture Placement Plan showing the furniture configuration, of all furniture. Provide enlarged area plans with a key plan identifying the area in which the building is located. Key all the items on the drawings by furniture item code. Do not provide manufacturer specific information such as product names and numbers on drawings, Drawings shall be non-proprietary. This is typical for FFE on all plans, including those

mentioned below. Coordinate the overall furniture and area plans with the Life Safety Code Review to ensure adequate clearances are provided for egress. Provide a narrative of this coordination to accompany the Furniture and Area plans.

1.2.2. Workstation Plans

Show each typical workstation configuration in plan view. In addition, provide either elevations or an isometric view. Drawings shall illustrate panels and all major components for each typical workstation configuration. Identify workstations using the same numbering system as shown on the project drawings. Key components to a legend on each sheet which identifies and describes the components along with dimensions. Provide the plan, elevations and isometric of each typical workstation together on the same drawing sheet.

1.2.3. Panel Plans

Show panel locations and critical dimensions from finished face of walls, columns, panels including clearances and aisle widths. Key panel assemblies to a legend which shall include width, height, configuration of frames, panel fabric and finishes (if there are different selections existing within a project), powered or non-powered panel and wall mount locations.

1.2.4. Desk Plans

Provide typical free standing desk configurations in plan view. In addition, provide either elevation or an isometric view and identify components to clearly represent each desk configuration.

1.2.5. Reflected Ceiling Plans

Provide typical plans showing ceiling finishes and heights, lighting fixtures, heating ventilation and air conditioning supply and return, and sprinkler head placement for coordination of furniture.

1.2.6. Electrical and Telecommunication Plans

Show power provisions including type and locations of feeder components, activated outlets and other electrical components. Show locations and quantities of outlets for workstations. Clearly identify different outlets, i.e. electrical, LAN and telecommunication receptacles indicating each type proposed. Show wiring configuration, (circuiting, switching, internal and external connections) and provide as applicable.

1.2.7. Artwork Placement Plans

Provide an Artwork Placement Plan to show location of artwork, assign an artwork item code to each piece of artwork. As an alternative, artwork can be located on the Furniture Plans. Provide a schedule that identifies each piece by room name and number. Provide installation instructions; include mounting height.

1.2.8. Window Drapery Plans

Provide Interior Window Drapery Plans. Key each drapery treatment to a schedule showing color, pattern, material, drapery size and type, draw direction, location and quantities.

1.2.9. Portable Fire extinguishers:

Provide a list of all required portable fire extinguishers, with descriptions (location, size, type, etc.) and total number per type. See also attachment D, "SAMPLE FIRE PROTECTION AND LIFE SAFETY CODE REVIEW", paragraph 1.14.

1.3. FURNITURE SELECTION

1.3.1. Select furniture from the GSA Schedules. Specify furniture available open market when an item is not available on the GSA Schedules. Provide justification for items not available on the GSA Schedules.

1.3.2. To the greatest extent possible when specifying furniture work within a manufacturer's family of furniture for selections, example: Steelcase, Turnstone, Brayton International, Metro, and Vecta are all Steelcase companies. Each alternate should also be specified from a manufacturer's family of furniture, example: first set of alternates would be specified from Knoll's family of furniture and the second from Herman Miller family of furniture. It may be necessary to make some selections from other than a manufacturer's family of furniture if costs are not reasonable for particular items, some items are not available or appropriate for the facility or the items are not on GSA Schedule. If this occurs, consider specifying product from an open line that is accessible by numerous dealerships. Select office furniture including case goods, tables, storage, seating, etc. that is compatible in style, finish and color. Select furniture that complies with ANSI/BIFMA and from manufacturer's standard product line as shown in the most recent published price list and/or amendment and not custom product.

1.4. CONSTRUCTION

1.4.1. Provide knee space at workstations and tables that is not obstructed by panels/legs that interfere with knee space of seated person and specify modesty panels at walls to be of a height or be hinged to allow access to building wall electrical outlets and communication jacks. Provide desks, storage and tables with leveling devices to compensate for uneven floors.

1.4.2. Unless otherwise noted, specify workstations and storage of steel construction. Provide high pressure laminate worksurface tops constructed to prevent warpage (thermally fused worksurfaces are not acceptable). Provide user friendly features such as radius edges. Do not use sharp edges and exposed connections and ensure the underside of desks, tables and worksurfaces are completely and smoothly finished. Provide abutting worksurfaces that mate closely and are of equal heights when used in side-by-side configurations in order to provide a continuous and level worksurface.

1.4.3. Drawers shall stay securely closed when in the closed position and protect wires from damage during drawer operation. Include a safety catch to prevent accidental removal when fully open

1.4.4. Unless otherwise noted, provide lockable desks and workstations, filing cabinets and storage. Key all locks within a one person office the same; key all one person offices within a building differently. If an office or open office area has more than one workstation, key all the workstations differently, but key all locks within an individual workstation the same. Use tempered glass glazing when glazing is required. Use light-emitting diode (LED)/solid state lighting where task lighting is required in furniture.

1.5. FINISHES AND UPHOLSTERY

1.5.1. Specify neutral colors for casegoods, furniture systems, storage and tables. Specify desk worksurfaces and table tops that are not too light or too dark in color and have a pattern to help hide soiling. Accent colors are allowed in break and lounge areas. Keep placement of furniture systems panel fabric accent colors to a minimum. All finishes shall be cleanable with ordinary household cleaning solutions.

1.5.2. Use manufacturer's standard fabrics; including textile manufacturers fabrics that have been graded into the furniture manufacturers fabric grades and are available through their GSA Schedule. Customers Own Material (COM) can be used in headquarter buildings in command suites with executive furniture. Coordinate specific locations with Corps of Engineers Interior Designer.

1.5.3. Specify seating upholstery that meets Wyzenbeek Abrasion Test, 55,000 minimum rubs. Specify a soil retardant finish for woven fabrics if Crypton or vinyl upholstery is not provided for seating in dining areas. Use manufacturer's standard fabrics. This includes textile manufacturers fabrics that have been graded into the furniture manufactures fabric grades and are available through their GSA Schedule. Specify upholstery and finish colors and patterns that help hide soiling. Specify finishes that can be cleaned with ordinary household cleaning solutions.

1.6. ACCESSORIES

1.6.1. Specify all accessories required for completely finished furniture installation. Provide filing cabinets and storage for office supplies. Provide tack surfaces at workstations with overhead storage. Provide tackable surfaces at workstations with overhead storage.

1.6.2. Not Used.

1.6.3. Workstations are to be equipped with stable keyboard trays that have height adjustability, tilting capability, including negative tilt, have a mouse pad at same height as the keyboard tray that can accommodate both left and right handed users, and retractable under worksurface.

1.7. MISSION UNIQUE EQUIPMENT

Funding for FF&E furniture items and mission unique equipment (MUE) items are from two different sources. Separate the designs and procurement documentation for FFE items and MUE. MUE includes, but is not limited to, items such as commercial appliances, fitness equipment, IT equipment and supporting carts. The User will purchase and install mission unique equipment items, unless otherwise noted. Identify locations of known MUE items such as commercial appliances, etc. for space planning purposes.

1.8. SUSTAINABILITY

1.8.1. For all designs provided regardless of facility type, make every effort to implement all aspects of sustainability to the greatest extent possible for all the selections made in the FF&E package. This includes but is not limited to the selection of products that consider: **Material Chemistry and Safety of Inputs** (What chemicals are used in the construction of the selections?); **Recyclability** (Do the selections contain recycled content?); **Disassembly** (Can the selections be disassembled at the end of their useful life to recycle their materials?).

1.8.2. Make selections to the greatest extent possible of products that possess current McDonough Braungart Design Chemistry ([MBDC](#)) certification or other "third-party" certified Cradle to Cradle program, Forest Stewardship Council (FSC) certification, GREENGAURD certification or similar "third-party" certified products consisting of low-emitting materials.

1.9. FURNITURE SYSTEMS

1.9.1. General.

Where appropriate, design furniture systems in open office areas. Coordinate style and color of furniture systems with other storage, seating, etc. in open office areas. Minimize the number of workstation typicals and the parts and pieces required for the design to assist in future reconfiguration and inventorying.

1.9.2. Connector Systems.

Specify a connector system that allows removal of a single panel or spine wall within a typical workstation configuration without requiring disassembly of the workstation or removal of adjacent panels. Specify

connector system with tight connections and continuous visual seals. When Acoustical panels are used, provide connector system with continuous acoustical seals. Specify concealed clips, screws, and other construction elements, where possible.

1.9.3. Panels and Spine Walls

Specify panels and spine walls with hinged or removable covers that permit easy access to the raceway when required but are securely mounted and cannot be accidentally dislodged under normal conditions. Panels shall be capable of structurally supporting more than 1 fully loaded component per panel per side. Raceways are to be an integral part of the panel and must be able to support lay-in cabling and have a large capacity for electrical and IT. Do not thread cables through the frame.

1.9.4. Electrical And Information/Technology (IT)

Design furniture with electrical systems that meets requirements of UL 1286 when powered panels are required and UL approved task lights that meet requirements of NFPA 70. Dependent on user requirements and Section 01 10 00, paragraph 3 requirements, it is recommended that workstation electrical and IT wiring entry come from the building walls to eliminate the use of power poles and access at the floor. Design electrical and IT systems that are easily accessed in the spine wall and panels without having to move return panels and components. Electrical and IT management will be easily accessible by removable wall covers which can be removed while workstation components are still attached. Specify connector system that has continuation of electrical and IT wiring within workstations and workstation to workstation.

1.9.5. Pedestals

Specify pedestals that are interchangeable from left to right, and right to left, and retain pedestal locking system capability.

1.10. EXECUTIVE FURNITURE

1.10.1. Design for executive furniture in command areas, coordinate specific locations with Corps of Engineers Interior Designer. Use upgraded furniture, upholsteries and finishes in command suites. This includes but is not limited to wood casegoods, seating and tables. Select executive furniture casegoods from a single manufacturer and style line, to include workstations, credenzas, filing, and storage, etc.

1.10.2. Specify furniture with wood veneer finish with mitered solid wood edge of same wood type. Other executive office furniture such as seating, tables, executive conference room furniture, etc. shall be compatible in style, finish and color with executive furniture casegoods.

1.11. SEATING

1.11.1. General

Specify appropriate chair casters and glides for the floor finish where the seating is located. All task seating shall support up to a minimum of 250 lbs.

1.11.2. Desk and Guest Seating

Select ergonomic desk chairs with casters, waterfall front, swivel, tilt, variable back lock, adjustable back height or adjustable lumbar support, pneumatic seat height adjustment, and padded, contoured upholstered seat and back. Desk and guest chair backs may be other than upholstered such as mesh fabric if it is ergonomically designed, forms to back and is comfortable. Depending on scale of desk chair provide seat pan forward and back adjustment to increase or decrease depth of seat pan. All desk chairs

shall have an adjustable seat height range of 4 1/2", range to include 16 1/2-20". Select guest chairs that are compatible in style, finish and color with the desk chairs.

1.11.3. Conference Room Seating

At tables, select ergonomic conference seating with casters, non-upholstered arms, waterfall front, swivel, tilt, pneumatic seat height adjustment, and padded, contoured seat and back, unless otherwise noted. Select arm height and/or design that allows seating to be moved up closely to the table top. Conference chair backs may be other than upholstered such as mesh fabric if it is ergonomically designed, forms to back and is comfortable. Perimeter conference chairs shall be compatible in style, finish and color with conference seating at the tables.

1.11.4. Lounge, Waiting and Reception Area Seating

Select seating with arms and cushioned, upholstered seat and back. In heavy use areas, arms shall be easily cleaned such as non-upholstered arms or upholstered arms with wood arm caps unless otherwise noted.

1.11.5. Break Room Seating

Select stackable seating that is easily cleaned. Seating shall be appropriate for table and counter heights as applicable with non-upholstered arms if arms are required. Chairs shall have metal legs and composite materials for seats.

1.12. FILING AND STORAGE.

Select storage and shelving units that meet customer's functional load requirements for stored items. Specify counterweights for filing cabinets when required by the manufacturer for stability. File drawers shall allow only one drawer to be opened at a time. Provide heavy duty storage and shelving if information is not available.

1.13. TRAINING TABLES.

training tables shall be reconfigurable, moveable and storable; lighter weight folding with dollies or casters as necessary. Plastic laminate self edges are unacceptable. Specify power and data requirements and dollies as required.

1.14. FURNITURE WARRANTIES.

Specify manufacturer's performance guarantees or warranties that include parts, labor and transportation as follows:

Furniture System, unless otherwise noted – 10 year minimum
Furniture System Task Lights – 2 year minimum, excluding bulbs
Furniture System Fabric – 3 year minimum
Wood Desks - 10 year minimum

Metal Desks – 12 year minimum
Seating, unless otherwise noted - 10 year minimum
Seating Mechanisms and Pneumatic Cylinders - 10 years
Seating Fabric - 3 years minimum
Wood Filing and Storage - 10 year minimum

Tables, unless otherwise noted - 10 year minimum
Table Mechanisms – 5 year minimum

Table Ganging Device - 1 year minimum
Items not listed above - 1 year minimum

ATTACHMENT C TRACKING COMMENTS IN DRCHECKS

1.0 General

The Government and DB Contractor shall set up the project in Dr Checks. Throughout the design process, the parties shall enter, track, and back-check comments using the DrChecks system. Government and Contractor reviewers enter design review comments into DrChecks. Designers of Record shall annotate comments timely and specifically to indicate for the review conference exactly what action will be taken or why the action is not required. After the design review conference and prior to the next design submittal for the package, the DOR's will annotate those comments that require DOR action, design revision, etc. to show how and where it has been addressed in the design documents, This shall be part of the required design configuration management plan. Comments considered critical by the conference participants shall be flagged as such.

2.0 DrChecks Review Comments

The Contractor and the Government shall monitor DrChecks to assure all comments are annotated and resolved prior to the next submittal. Print and include the DrChecks comments and responses and included in the design analysis for record in the next design submittal for that package.

2.1. Upon review of comments prior to the design review conference, the DOR(s) shall identify whether they concur, non-concur, mark it "for information only" or mark it "check and resolve". Indicate exactly what action will be taken or why the action is not required.

2.2. Conference participants (reviewers) will expect coordination between Design Analysis calculations and the submitted design. Reviewers will also focus on the design submittal's satisfaction of the contract requirements.

2.3. After the conference, the DOR(s) shall formally respond to each applicable comment in DrChecks a second time prior to the next submittal, clearly indicating what action was taken and what drawing/spec/design analysis changed. Designers of Record are encouraged to directly contact reviewers to discuss and agree to the formal comment responses rather than relying only on DrChecks and review meetings to discuss comments. With the next submittal, reviewers will back-check answers to the comments against the new submittal, in addition to reviewing additional design work.

2.4. Clearly annotate in DrChecks those comments that, in the DB Contractor's opinion, require effort outside the scope of the contract. Do not proceed with work outside the contract until a modification to the contract is properly executed, if one is necessary.

3.0 DrChecks Initial Account Set-Up

To initialize an office's use of DrChecks, choose a contact person within the office to call the DrChecks Help Desk at 800-428-HELP, M-F, 8AM-5PM, Central time. This POC will be given an office password to distribute to others in the office. Individuals can then go to the hyperlink at <http://www.projnet.org> and register as a first time user. Upon registration, each user will be given a personal password to the DrChecks system.

3.1. Once the office and individuals are registered, the COE's project manager or lead reviewer will assign the individuals and/or offices to the specific project for review. At this point, persons assigned can make comments, annotate comments, and close comments, depending on their particular assignment.

4.0 DrChecks Reviewer Role

The Contractor is the technical reviewer and the Government is the compliance reviewer of the DB's design documents. Each reviewer enters their own comments into the Dr Checks system. To enter comments:

- 4.1. Log into DrChecks.
- 4.2. Click on the appropriate project.
- 4.3. Click on the appropriate review conference. An Add comment screen will appear.
- 4.4. Select or fill out the appropriate sections (particularly comment discipline and type of document for sorting) of the comment form and enter the comment in the space provided.
- 4.5. Click the Add Comment button. The comment will be added to the database and a fresh screen will appear for the next comment you have.
- 4.6. Once comments are all entered, exit DrChecks by choosing "My Account" and then Logout.

5.0 DrChecks Comment Evaluation (Step 1 of 2)

The role of the DOR(s) is to evaluate and respond to the comments entered by the Government's and DB Contractor's reviewers. To respond to comments:

- 5.1. Log into DrChecks.
- 5.2. Click on the appropriate project.
- 5.3. Under "Evaluate" click on the number under "Pending".
- 5.4. Locate the comments that require your evaluation. (Note: If you know the comment number you can use the Quick Pick window on your home page in DrChecks; enter the number and click on go.)
- 5.5. Select the appropriate evaluation radio button (concur, non-concur, for information only, or check and resolve) and respond with a brief explanation in the Discussion field. An explanation other than to say "concur" is not necessary for "Concur", but may be useful for the Design Configuration Management purposes.
- 5.6. Click on the Add button. The evaluation will be added to the database and a fresh screen will appear with the next comment.
- 5.7. Once evaluations are all entered, exit DrChecks by choosing "My Account" and then Logout.

6.0 DrChecks Comment Evaluation (Step 2 of 2)

This is where the DOR(s) respond to each applicable comment in DrChecks after the design review conference, prior to the next submittal, clearly indicating what action was taken and what drawing/spec/design analysis changed. Respond to the previous comments, following the same steps as above, adding the narrative in the discussion field.

7.0 DrChecks Back-Check

At the following design conference, (where applicable) or at some other agreed time, Government and Contractor reviewers will back-check comment annotations against newly presented documents to verify that the designers' responses are acceptable and that all revisions have been completed. Reviewers

shall either enter additional back-check comments, if necessary, or close those where actions are complete.

- 7.1. Log into DrChecks.
- 7.2. Click on the appropriate project.
- 7.3. Under "My Backcheck" click on the number under "Pending".
- 7.4. If you agree with the designer's response select "Close Comment" and add a closing response if desired.
- 7.5. If you do not agree with the designer's response or the submittal does not reflect the response given, select "Issue Open", enter additional information.
- 7.6. Click on the Add button. The back-check will be added to the database and a fresh screen will appear with the next comment.
- 7.7. Once back-checks are all entered, exit DrChecks by choosing "My Account" and then Logout. The design is completed and final when there are no pending comments to be evaluated and there are no pending or open comments under back-check.

ATTACHMENT D
SAMPLE FIRE PROTECTION AND LIFE SAFETY CODE REVIEW

Instructions: Use the information outlined in this document to provide the minimum requirement for development of Fire Protection and Life Safety Code submittals for all building projects. Additional and supplemental information may be used to further develop the code review. Insert N/A after criteria, which may be "not applicable".

1.0 SAMPLE FIRE PROTECTION AND LIFE SAFETY CODE REVIEW

- 1.1. Project Name (insert name and location)
- 1.2. Applicable Codes and Standards
 - 1.2.1. Unified Facilities Criteria (UFC): 3-600-01, Design: Fire Protection Engineering For Facilities
 - 1.2.2. International Building Code (IBC) for fire resistance requirements, allowable floor area, building height limitations and building separation distance requirements, except as modified by UFC 3-600-01.
 - 1.2.3. National Fire Protection Association (NFPA) 101 Life Safety Code (latest edition), for building egress and life safety and applicable criteria in UFC 3-600-01.
 - 1.2.4. ADA and ABA Accessibility Guidelines. For Buildings and Facilities See Section 01 10 00, Paragraph 3 for facility specific criteria.
- 1.3. Occupancy Classification
IBC chapters 3 and 4
- 1.4. Construction Type
IBC chapter 6
- 1.5. Area Limitations
IBC chapter 5, table 503
- 1.6. Allowable Floor Areas
IBC section 503, 505
- 1.7. Allowable area increases
IBC section 506, 507
- 1.8. Maximum Height of Buildings
IBC section 504
- 1.9. Fire-resistive substitution
- 1.10. Occupancy Separations
IBC table 302.3.2
- 1.11. Fire Resistive Requirements
 - 1.11.1. Exterior Walls - [] hour rating, IBC table 601, 602

- 1.11.2. Interior Bearing walls - [] hour rating
- 1.11.3. Structural frame - [] hour rating
- 1.11.4. Permanent partitions - [] hour rating
- 1.11.5. Shaft enclosures - [] hour rating
- 1.11.6. Floors & Floor-Ceilings - [] hour rating
- 1.11.7. Roofs and Roof Ceilings - [] hour rating
- 1.12. Automatic Sprinklers and others used to determine the need for automatic Extinguishing Equipment, Extinguishing Systems, Foam Systems, Standpipe
- 1.12.1. UFC 3-600-01, chapters 4 and 6 systems, wet chemical systems, etc. State which systems are required and to what criteria they will be designed.
- 1.12.2. UFC 3-600-01, Appendix B Occupancy Classification. Note the classification for each room. This may be accomplished by classifying the entire building and noting exceptions for rooms that differ (E.g. The entire building is Light Hazard except boiler room and storage rooms which are [], etc.)
- 1.12.3. UFC 3-600-01, Chapter 3 Sprinkler Design Density, Sprinkler Design Area, Water Demand for Hose Streams (supply pressure and source requirements).
- 1.12.4. UFC 3-600-01, Chapter 4 Coverage per sprinkler head. Extended coverage sprinkler heads are not permitted.
- 1.12.5. Available Water Supply. Provide the results of the water flow tests showing the available water supply static pressure and residual pressure at flow. Based on this data and the estimated flow and pressure required for the sprinkler system, determine the need for a fire pump.
- 1.12.6. NFPA 13, Para. 8.16.4.6.1. Provide backflow preventer valves as required by the local municipality, authority, or water purveyor. Provide a test valve located downstream of the backflow preventer for flow testing the backflow preventer at full system demand flow. Route the discharge to an appropriate location outside the building.
- 1.13. Kitchen Cooking Exhaust Equipment
Describe when kitchen cooking exhaust equipment is provided for the project. Type of extinguishing systems for the equipment should be provided. per NFPA 96. Show all interlocks with manual release switches, fuel shutoff valves, electrical shunt trips, exhaust fans, and building alarms.
- 1.14. Portable Fire Extinguishers, fire classification and travel distance. per NFPA 10
- 1.15. Enclosure Protection and Penetration Requirements. - Opening Protectives and Through Penetrations
- 1.15.1. IBC Section 712, 715 and Table 715.3. Mechanical rooms, exit stairways, storage rooms, janitor [] hour rating. IBC Table 302.1.1
- 1.15.2. Fire Blocks, Draft Stops, Through Penetrations and Opening Protectives
- 1.16. Fire Dampers. Describe where fire dampers and smoke dampers are to be used (IBC Section 716 and NFPA 90A). State whether isolation smoke dampers are required at the air handler.

1.17. Detection Alarm and Communication. UFC 3-600-01, (Chapter 5); NFPA 101 para. 3.4 (chapters 12-42); NFPA 72

1.18. Mass Notification. Describe building/facility mass notification system (UFC 4-021-01) type and type of base-wide mass notification/communication system. State whether the visible notification appliances will be combined with the fire alarm system or kept separate. (Note: Navy has taken position to combine visible notification appliances with fire alarm).

1.19. Interior Finishes (classification). NFPA 101.10.2.3 and NFPA 101.7.1.4

1.20. Means of Egress

1.20.1. Separation of Means of Egress, NFPA 101 chapters 7 and 12-42; NFPA101.7.1.3

1.20.2. Occupant Load, NFPA101.7.3.1 and chapters 12-42.

1.20.3. Egress Capacity (stairs, corridors, ramps and doors) NFPA101.7.3.3

1.20.4. Number of Means of Egress, NFPA101.7.4 and chapters 12-42.

1.20.5. Dead end limits and Common Path of Travel, NFPA 101.7.5.1.6 and chapters 12-42.

1.20.6. Accessible Means of Egress (for accessible buildings), NFPA101.7.5.4

1.20.7. Measurement of Travel Distance to Exits, NFPA101.7.6 and chapters 12-42.

1.20.8. Discharge from Exits, NFPA101.7.7.2

1.20.9. Illumination of Means of Egress, NFPA101.7.8

1.20.10. Emergency Lighting, NFPA101.7.9

1.20.11. Marking of Means of Egress, NFPA101.7.10

1.21. Elevators, UFC 3-600-01, Chapter 6; IBC and ASME A17.1 - 2000,(Safety Code for Elevators and Escalators)

1.22. Accessibility Requirements, ADA and ABA Accessibility Guidelines for Buildings and Facilities

1.23. Certification of Fire Protection and Life Safety Code Requirements. (Note: Edit the Fire team membership if necessary). Preparers of this document certify the accuracy and completeness of the Fire Protection and Life Safety features for this project in accordance with the attached completed form(s).

1.24. Designer of Record. Certification of Fire protection and Life Safety Code Requirements. (Note: Edit the Fire team members if necessary). Preparers of this document certify the accuracy and completeness of the Fire Protection and Life Safety features of this project.

Fire Protection Engineer of Record:

Signature and Stamp

Date

OR

Architect of Record:

Signature and Stamp

Date

Mechanical Engineer of Record:

Signature and Stamp

Date

Electrical Engineer of Record:

Signature/Date

**ATTACHMENT E
LEED SUBMITTALS**

LEED Credit Paragraph	Contractor Check Here if Credit is Claimed	LEED-NC v3 Submittals (OCT09)	Provide for Credit Audit Only	REQUIRED DOCUMENTATION	Date Submitted (to be filled in by Contractor)	Government Reviewer's Use
PAR		FEATURE	DUE AT		DATE	REV
GENERAL						
		GENERAL - All calculations shall be in accordance with LEED 2009 Reference Guide.				
		GENERAL: Obtain excel version of this spreadsheet at http://en.sas.usace.army.mil/enWeb , "Engineering Criteria".				
		GENERAL - For all credits, narrative/comments may be added to describe special circumstances or considerations regarding the project's credit approach.				
		GENERAL - Include all required LEED drawings indicated below in contract drawings with applicable discipline drawings, labeled For Reference Only.				
		NOTE: Each submittal indicated with "****" differs from LEED certified project submittals by either having a different due date or being an added submittal not required by GBCI.				
		NOTE: Projects seeking LEED certification need only submit to GBCI whatever documentation is acceptable to GBCI (for example, licensed professional certifications). This checklist identifies what must be submitted to the Government for internal review purposes. Government review of LEED documentation in no way supercedes or modifies the requirements and rulings of GBCI for purposes of compliance with project requirement to obtain LEED certification.				
		GENERAL - Audit documentation may include but is not limited to what is indicated in this table.				
			Closeout	List of all Final Design submittals revised after final design to reflect actual closeout conditions. Revised Final Design submittals. - OR - Statement confirming that no changes have been made since final design that effect final design submittal documents.		Proj Engr (PE)
CATEGORY 1 - SUSTAINABLE SITES						
SSPR1		Construction Activity Pollution Prevention (PREREQUISITE)	**Final Design	List of drawings and specifications that address the erosion control, particulate/dust control and sedimentation control measures to be implemented.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			**Final Design	Narrative that indicates which compliance path was used (NPDES or Local standards) and describes the measures to be implemented on the project. If a local standard was followed, provide specific information to demonstrate that the local standard is equal to or more stringent than the NPDES program.		CIV
SS1		Site Selection	Final Design	Statement confirming that project does not meet any of the prohibited criteria.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design	X LEED Site plan drawing that shows all proposed development, line depicting boundary of all bodies of water and/or wetlands within 100 feet of project boundary and a line depicting 5' elevation above 100 year flood line that falls within project boundary. Not required if neither condition applies.		CIV
SS2		Development Density & Community Connectivity	Final Design	Option 1: LEED Site vicinity plan showing project site and surrounding development. Show density boundary or note drawing scale.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design	Option 1: Table indicating, for project site and all surrounding sites within density radius (keyed to site vicinity plan), site area and building area. Project development density calculation. Density radius calculation. Development density calculation within density radius.		CIV
			Final Design	Option 2: LEED Site vicinity plan showing project site, the 1/2 mile community radius, pedestrian walkways and the locations of the residential development(s) and Basic Services surrounding the project site.		CIV
			Final Design	Option 2: List (including business name and type) of all Basic Services facilities within the 1/2 mile radius, keyed to site vicinity plan.		CIV
SS3		Brownfield Redevelopment	Final Design	Narrative describing contamination and the remediation activities included in project. Include statement indicating how site was determined to be a brownfield.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
SS4.1		Alternative Transportation: Public Transportation Access	Final Design	Statement indicating which option for compliance applies. State whether public transportation is existing or proposed and, if proposed, cite source of this information.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design	Option 1: LEED Site vicinity plan showing project site, mass transit stops and pedestrian path to them with path distance noted.		CIV
			Final Design	Option 2: LEED Site vicinity plan showing project site, bus stops and pedestrian path to them with path distance noted.		CIV
SS4.2		Alternative Transportation: Bicycle Storage & Changing Rooms	Final Design	FTE calculation. Bicycle storage spaces calculation. Shower/changing facilities calculation.		CIV
			Final Design	List of drawings that show the location(s) of bicycle storage areas. Statement indicating distance from building entrance.		CIV
			Final Design	List of drawings that show the location(s) of shower/changing facilities and, if located outside the building, statement indicating distance from building entrance.		ARC

LEED Credit Paragraph	Contractor Check Here if Credit is Claimed	LEED-NC v3 Submittals (OCT09)	Provide for Credit Audit Only	REQUIRED DOCUMENTATION	Date Submitted (to be filled in by Contractor)	Government Reviewer's Use
PAR		FEATURE	DUE AT		DATE	REV
SS4.3		Alternative Transportation: Low Emitting & Fuel Efficient Vehicles	Final Design	Statement indicating which option for compliance applies. FTE calculation. Statement indicating total parking capacity of site.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design	Option 1: Low-emission & fuel-efficient vehicle calculation.		CIV
			Final Design	Option 1: List of drawings and specification references that show location and number of preferred parking spaces for low-emission & fuel-efficient vehicles and signage.		CIV
			Final Design	Option 1: Statement indicating quantity, make, model and manufacturer of low-emission & fuel-efficient vehicles to be provided. Statement confirming vehicles are zero-emission or indicating ACEEE vehicle scores.		CIV
			Final Design	Option 2: Low-emission & fuel-efficient vehicle parking calculation.		CIV
			Final Design	Option 2: List of drawings and specification references that show location and number of preferred parking spaces and signage.		CIV
			Final Design	Option 3: Low-emission & fuel-efficient vehicle refueling station calculation.		CIV
			Final Design	Option 3: List of drawings and specifications indicating location and number of refueling stations, fuel type and fueling capacity for each station for an 8-hour period.		CIV
			Closeout	X Option 3: Construction product submittals indicating what was provided and confirming compliance with respect to fuel type and fueling capacity for each station for an 8-hour period.		CIV
SS4.4		Alternative Transportation: Parking Capacity	Final Design	Statement indicating which option for compliance applies.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design	Option 1: Preferred parking calculation including number of spaces required, total provided, preferred spaces provided and percentage.		CIV
			Final Design	Option 2: FTE calculation. Preferred parking calculation including number of spaces provided, preferred spaces provided and percentage.		CIV
			Final Design	Options 1 and 2: List of drawings and specification references that show location and number of preferred parking spaces and signage.		CIV
			Final Design	Option 3: Narrative indicating number of spaces required and provided and describing infrastructure and support programs with description of project features to support them.		CIV
SS5.1		Site Development: Protect or Restore Habitat	**Final Design	Option 1: List of drawing and specification references that convey site disturbance limits.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			**Final Design	Option 2: LEED site plan drawing that delineates boundaries of each preserved and restored habitat area with area (sf) noted for each.		CIV
			**Final Design	Option 2: Percentage calculation of restored/preserved habitat to total site area. List of drawings and specification references that convey restoration planting requirements.		CIV
SS5.2		Site Development: Maximize Open Space	Final Design	Option 2: LEED site plan drawing delineating boundary of vegetated open space adjacent to building with areas of building footprint and designated open space noted.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
SS6.1		Stormwater Design: Quantity Control	Final Design	Statement indicating which option for compliance applies.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design	Option 1: Indicate pre-development and post-development runoff rate(cfs) and runoff quantity (cf) -OR - Narrative describing site conditions, measures and controls to be implemented to prevent excessive stream velocities and erosion.		CIV
			Final Design	Option 2: Indicate pre-development and post-development runoff rate(cfs) and runoff quantity (cf). Indicate percent reduction in each.		CIV
SS6.2		Stormwater Design: Quality Control	Final Design	For non-structural controls, list all BMPs used and, for each, describe the function of the BMP and indicate the percent annual rainfall treated. List all structural controls and, for each, describe the pollutant removal and indicate the percent annual rainfall treated.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
SS7.1		Heat Island Effect: Non-Roof	**Final Design	LEED site plan drawing indicating locations and quantities of each paving type, including areas of shaded pavement. Percentage calculation indicating percentage of reflective/shaded/open grid area.		CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		CIV

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SS7.2		Heat Island Effect: Roof	Final Design	Option 1: Percentage calculation indicating percentage of SRI compliant roof area. List of drawings and specification references that convey SRI requirements and roof slopes.		ARC
			Final Design	Option 1: List of specified roof materials indicating, for each, type, manufacturer, product name and identification if known, SRI value and roof slope.		ARC
			**Closeout	Option 1: List of installed roof materials indicating, for each, manufacturer, product name and identification, SRI value and roof slope.		PE
			Closeout	X Option 1: Manufacturer published product data or certification confirming SRI		PE
			Final Design	Option 2: Percentage calculation indicating percentage of vegetated roof area.		ARC
			Final Design	Option 3: Combined reflective and green roof calculation.		ARC
			Final Design	Option 3: List of specified roof materials indicating, for each, type, manufacturer, product name and identification if known, SRI value and roof slope.		ARC
			**Closeout	Option 3: List of installed roof materials indicating, for each, manufacturer, product name and identification, SRI value and roof slope.		PE
			Closeout	X Option 3: Manufacturer published product data or certification confirming SRI		PE
SS8		Light Pollution Reduction	Final Design	Interior Lighting: List of drawings and specification references that convey interior lighting requirements (location and type of all installed interior lighting, location of non-opaque exterior envelope surfaces, allowing confirmation that maximum candela value from interior fixtures does not intersect non-opaque building envelope surfaces). - OR - List of drawings and specification references that show automatic lighting controls compliance with credit requirement.		ELEC
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.		ELEC
			Final Design	Exterior Lighting: List of drawings and specification references that convey exterior lighting requirements (location and type of all site lighting and building facade/landscape lighting).		ELEC
			Final Design	Exterior Site Lighting Power Density (LPD): Tabulation for exterior site lighting indicating, for each location identification or description, units of measure, area or distance of the location, actual LPD using units consistent with ASHRAE 90.1, and the ASHRAE allowable LPD for that type of location. Percentage calculation of actual versus allowable LPD for all site lighting.		ELEC
			Final Design	Exterior Building Facade/Landscape Lighting Power Density (LPD): Tabulation for exterior building facade/landscape lighting indicating, for each location identification or description, units of measure, area or distance of the location, actual LPD using units consistent with ASHRAE 90.1, and the ASHRAE allowable LPD for that type of location. Percentage calculation of actual versus allowable LPD for all building facade/landscape lighting.		ELEC
			Final Design	Exterior Lighting IESNA Zone: Indicate which IESNA zone is applicable to the project.		ELEC
			Final Design	Exterior Lighting Site Lumen table indicating, for each fixture type, quantity installed, initial lamp lumens per luminaire, initial lamp lumens above 90 degrees from Nadir, total lamp lumens and total lamp lumens above 90 degrees. Percentage of site lamp lumens above 90 degrees from nadir to total lamp lumens.		ELEC
			Final Design	Exterior Lighting Narrative describing analysis used for addressing requirements for light trespass at site boundary and beyond.		ELEC
CATEGORY 2 – WATER EFFICIENCY						
WEPR1		Water Use Reduction: 20% Reduction	Final Design	Statement confirming which occupancy breakdown applies (default or special). For special occupancy breakdown, indicate source and explanation for ratio.		MEC
			Final Design	Occupancy calculation including male/female numbers for FTEs, visitors, students, customers, residential and other type occupants/users		MEC
			Final Design	Statement indicating percent of male restrooms with urinals. Statement indicating annual days of operation.		MEC

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			Final Design	Baseline flush fixture calculation spreadsheet indicating, for each fixture type, gender, flush rate, daily uses per person for each occupant type identified in occupancy calculation and annual baseline flush fixture water usage.				MEC
			Final Design	Design case flush fixture calculation spreadsheet indicating, for each fixture type, gender, fixture manufacturer, fixture model number, flush rate, percent of occupants using this fixture type, daily uses per person for each occupant type identified in occupancy calculation and annual design case flush fixture water usage.				MEC
			Closeout	X Manufacturer published product data or certification confirming fixture water usage.				PE
WE1.1		Water Efficient Landscaping: Reduce by 50%	Final Design	Statement indicating which option for compliance applies.				CIV
			**Final Design	Delineation and labeling of "LEED Project site boundary" on site plan.				CIV
			Final Design	Calculation indicating, for baseline and design case, total water applied, total potable water applied, total non-potable water applied. Design case percent potable water reduction. If nonpotable water is used, indicate source of nonpotable water.				CIV
			Final Design	List of landscape plan drawings.				CIV
			Final Design	Narrative describing landscaping and irrigation design strategies, including water use calculation methodology used to determine savings and, if non-potable water is used, specific information about source and available quantity.				CIV
WE1.2		Water Efficient Landscaping: No Potable Water Use or No Irrigation	Same as WE1.1	Same as WE1.1				CIV
WE2		Innovative Wastewater Technologies	Final Design	Statement confirming which option for compliance applies.				MEC
			Final Design	Statement confirming which occupancy breakdown applies (default or special). For special occupancy breakdown, indicate source and explanation for ratio.				MEC
			Final Design	Occupancy calculation including male/female numbers for FTEs, visitors, students, customers, residential and other type occupants/users				MEC
			Final Design	Statement indicating percent of male restrooms with urinals. Statement indicating annual days of operation.				MEC
			Final Design	Baseline flush fixture calculation spreadsheet indicating, for each fixture type, gender, flush rate, daily uses per person for each occupant type identified in occupancy calculation and annual baseline flush fixture water usage.				MEC
			Final Design	Design case flush fixture calculation spreadsheet indicating, for each fixture type, gender, fixture manufacturer, fixture model number, flush rate, percent of occupants using this fixture type, daily uses per person for each occupant type identified in occupancy calculation and annual design case flush fixture water usage.				MEC
			Final Design	Option 1: If onsite non-potable water is used, identify source(s), indicate annual quantity from each source and indicate total annual quantity from all onsite non-potable water sources.				MEC
			Final Design	Option 1: Summary calculation indicating baseline annual water consumption, design case annual water consumption, non-potable annual water consumption and total percentage annual water savings.				MEC
			Final Design	Option 2: Statement confirming on-site treatment of all generated wastewater to tertiary standards and all treated wastewater is either infiltrated or used on-site.				MEC
			Final Design	Option 2: List of drawing and specification references that convey design of on-site wastewater treatment features.				CIV
			Final Design	Option 2: On-site water treatment quantity calculation indicating all on-site wastewater source(s), annual quantity treated, annual quantity infiltrated and annual quantity re-used on site from each source and totals for annual quantity treated, annual quantity infiltrated and annual quantity re-used on site from all sources.				CIV
			Final Design	Option 2: Wastewater summary calculation indicating design case annual flush fixture water usage, annual on-site water treatment and percentage sewage conveyance reduction.				MEC
			Final Design	Narrative describing project strategy for reduction of potable water use for sewage conveyance, including specific information on reclaimed water usage and treated wastewater usage.				MEC
WE3		Water Use Reduction: 30% - 40% Reduction	Same as WEPR1	Same as WEPR1				MEC

CATEGORY 3 – ENERGY AND ATMOSPHERE

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EAPR1		Fundamental Commissioning of the Building Energy Systems (PREREQUISITE)	**Final Design	**Owner's Project Requirements document				ALL MEC, ELEC
			**Final Design	**Basis of Design document for commissioned systems				MEC, ELEC
			**Final Design	**Commissioning Plan				MEC, ELEC
			Closeout	Statement confirming all commissioning requirements have been incorporated into construction documents.				PE
			Closeout	Commissioning Report				PE
EAPR2		Minimum Energy Performance (PREREQUISITE)	Final Design	Statement listing the mandatory provisions of ASHRAE 90.1 that project meets relative to compliance with this prerequisite and indicating which compliance path was used.				MEC ELEC ARC
			Final Design	Statement indicating which compliance path option applies.				MEC
			Final Design	Option 1: Statement confirming simulation software capabilities and confirming assumptions and methodology.				MEC
			Final Design	Option 1: General information including simulation program, principal heating source, percent new construction and renovation, weather file, climate zone and Energy Star Target Finder score.				MEC
			Final Design	Option 1: Space summary listing, for each building use, the conditioned area, unconditioned area and total area and include total area for each category				MEC
			Final Design	Option 1: List of all simulation output advisory message data and show difference between baseline and proposed design				MEC
			Final Design	Option 1: Comparison summary for energy model inputs including description of baseline and design case energy model inputs, showing both by element type				MEC
			Final Design	Option 1: Energy type summary listing, for each energy type, utility rate description, units of energy and units of demand				MEC
			Final Design	Option 1: Statement indicating whether project uses on-site renewable energy. If yes, list all sources and indicate, for each source, backup energy type, annual energy generated, rated capacity and renewable energy cost				MEC
			Final Design	Option 1: If analysis includes exceptional calculation methods, statement describing how exceptional calculation measure cost savings is determined				MEC
			Final Design	Option 1: If analysis includes exceptional calculation methods, for each exceptional calculation method indicate energy types and, for each energy type, annual energy savings, annual cost savings, and brief descriptive narrative				MEC
			Final Design	Option 1: Baseline performance rating compliance report table indicating, for each energy end use, whether it is a process load, energy type, annual and peak energy demand for all four orientations. For each orientation indicate total annual energy use for each orientation and total annual process energy use.				MEC
			Final Design	Option 1: Baseline energy cost table indicating, for each energy type, annual cost for all four orientations and building total energy cost.				MEC
			Final Design	Option 1: Proposed Design performance rating compliance report table indicating, for each energy end use, whether it is a process load, energy type, annual and peak energy demand, baseline annual and peak energy demand and percent savings. Indicate total annual energy use and total annual process energy use for both proposed design and baseline and percent savings.				MEC
			Final Design	Option 1: Proposed Design energy cost table indicating, for each energy type, annual cost for all four orientations and building total energy cost.				MEC
			Final Design	Option 1: Energy cost and consumption by energy type report indicating, for each energy type, proposed design and baseline annual use and annual cost, percent savings annual use and annual cost. Indicate for renewable energy annual energy generated and annual cost. Indicate exceptional calculations annual energy savings and annual cost savings. Indicate building total annual energy use, annual energy cost for proposed design and baseline and indicate percent savings annual energy use and annual energy cost.				MEC

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			Final Design	Option 1: Compliance summaries from energy simulation software. If software does not produce compliance summaries provide output summaries and example input summaries for baseline and proposed design supporting data in the tables. Output summaries must include simulated energy consumption by end use and total energy use and cost by energy type. Example input summaries should represent most common systems and must include occupancy, use pattern, assumed envelope component sizes and descriptive features and assumed mechanical equipment types and descriptive features				MEC
			Final Design	Option 1: Energy rate tariff from project energy providers (only if not using LEED Reference Guide default rates)				MEC
EAPR3		Fundamental Refrigerant Management (PREREQUISITE)	Final Design	Statement indicating which option for compliance applies.				MEC
			Final Design	Option 2: Narrative describing phase out plan, including specific information on phase out dates and refrigerant quantities.				MEC
EA1		Optimize Energy Performance	Final Design	Statement indicating which compliance path option applies.				MEC
			Final Design	Option 1: Statement confirming simulation software capabilities and confirming assumptions and methodology.				MEC
			Final Design	Option 1: General information including simulation program, principal heating source, percent new construction and renovation, weather file, climate zone and Energy Star Target Finder score.				MEC
			Final Design	Option 1: Space summary listing, for each building use, the conditioned area, unconditioned area and total area and include total area for each category				MEC
			Final Design	Option 1: List of all simulation output advisory message data and show difference between baseline and proposed design				MEC
			Final Design	Option 1: Comparison summary for energy model inputs including description of baseline and design case energy model inputs, showing both by element type				MEC
			Final Design	Option 1: Energy type summary listing, for each energy type, utility rate description, units of energy and units of demand				MEC
			Final Design	Option 1: Statement indicating whether project uses on-site renewable energy. If yes, list all sources and indicate, for each source, backup energy type, annual energy generated, rated capacity and renewable energy cost				MEC
			Final Design	Option 1: If analysis includes exceptional calculation methods, statement describing how exceptional calculation measure cost savings is determined				MEC
			Final Design	Option 1: If analysis includes exceptional calculation methods, for each exceptional calculation method indicate energy types and, for each energy type, annual energy savings, annual cost savings, and brief descriptive narrative				MEC
			Final Design	Option 1: Baseline performance rating compliance report table indicating, for each energy end use, whether it is a process load, energy type, annual and peak energy demand for all four orientations. For each orientation indicate total annual energy use for each orientation and total annual process energy use.				MEC
			Final Design	Option 1: Baseline energy cost table indicating, for each energy type, annual cost for all four orientations and building total energy cost.				MEC
			Final Design	Option 1: Proposed Design performance rating compliance report table indicating, for each energy end use, whether it is a process load, energy type, annual and peak energy demand, baseline annual and peak energy demand and percent savings. Indicate total annual energy use and total annual process energy use for both proposed design and baseline and percent savings.				MEC
			Final Design	Option 1: Proposed Design energy cost table indicating, for each energy type, annual cost for all four orientations and building total energy cost.				MEC
			Final Design	Option 1: Energy cost and consumption by energy type report indicating, for each energy type, proposed design and baseline annual use and annual cost, percent savings annual use and annual cost. Indicate for renewable energy annual energy generated and annual cost. Indicate exceptional calculations annual energy savings and annual cost savings. Indicate building total annual energy use, annual energy cost for proposed design and baseline and indicate percent savings annual energy use and annual energy cost.				MEC

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			Final Design	Option 1: Compliance summaries from energy simulation software. If software does not produce compliance summaries provide output summaries and example input summaries for baseline and proposed design supporting data in the tables. Output summaries must include simulated energy consumption by end use and total energy use and cost by energy type. Example input summaries should represent most common systems and must include occupancy, use pattern, assumed envelope component sizes and descriptive features and assumed mechanical equipment types and descriptive features				MEC
			Final Design	Option 1: Energy rate tariff from project energy providers (only if not using LEED Reference Guide default rates)				MEC
EA2.1		On-Site Renewable Energy	Final Design	Statement indicating which compliance path option applies.				ELEC
			Final Design	List all on-site renewable energy sources and indicate, for each source, backup energy type, annual energy generated, rated capacity and renewable energy cost. Indicate total annual energy use (all sources), total annual energy cost (all sources) and percent renewable energy cost.				ELEC MEC
			Final Design	Option 1: Indicate, for renewable energy, proposed design total annual energy generated and annual cost.				ELEC MEC
			Final Design	Option 2: Indicate CBECS building type and building gross area. Provide the following CBECS data: median annual electrical intensity, median annual non-electrical fuel intensity, average electric energy cost, average non-electric fuel cost, annual electric energy use and cost, annual non-electric fuel use and cost.				ELEC MEC
			Final Design	Option 2: Narrative describing renewable systems and explaining calculation method used to estimate annual energy generated, including factors influencing performance.				ELEC MEC
EA2.2		On-Site Renewable Energy	Same as EA2.1	Same as EA2.1				ELEC MEC
EA2.3		On-Site Renewable Energy	Same as EA2.1	Same as EA2.1				ELEC MEC
EA3		Enhanced Commissioning	**Final Design	**Owner's Project Requirements document (OPR)				ALL
			**Final Design	**Basis of Design document for commissioned systems (BOD)				ELEC MEC
			**Final Design	**Commissioning Plan				ELEC MEC
			Closeout	Statement confirming all commissioning requirements have been incorporated into construction documents.				PE
			Closeout	**Commissioning Report				PE
			**Final Design	Statement by CxA confirming Commissioning Design Review				
			Closeout	Statement by CxA confirming review of Contractor submittals for compliance with OPR and BOD				PE
			Closeout	**Systems Manual				PE
			Closeout	Statement by CxA confirming completion of O&M staff and occupant training				PE
			Closeout	**Scope of work for post-occupancy review of building operation, including plan for resolution of outstanding issues				PE
			**Predesign	Statement confirming CxA qualifications and contractual relationships relative to work on this project, demonstrating that CxA is an independent third party.				MEC
EA4		Enhanced Refrigerant Management	Final Design	Refrigerant impact calculation table with all building data and calculation values as shown in LEED 2009 Reference Guide Example Calculations				MEC
			Final Design	Narrative describing any special circumstances or explanatory remarks				
			Closeout	X Cut sheets highlighting refrigerant data for all HVAC components.				PE
EA5		Measurement & Verification	Closeout	Statement indicating which compliance path option applies.				PE
			Closeout	Measurement and Verification Plan including Corrective Action Plan				PE
			Closeout	**Scope of work for post-occupancy implementation of M&V plan including corrective action plan.				PE
EA6		Green Power	Closeout	Statement indicating which compliance path option applies.				PE
			Closeout	Option 1: Indicate proposed design total annual electric energy usage				PE
			Closeout	Option 2: Indicate actual total annual electric energy usage				PE
			Closeout	Option 3: Calculation indicating building type, total gross area, median electrical intensity and annual electric energy use				PE

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			Closeout	Green power provider summary table indicating, for each purchase type, provider name, annual quantity green power purchased and contract term. Indicate total annual green power use and indicate percent green power				PE
			Closeout	Narrative describing how Green Power or Green Tags are purchased				PE
CATEGORY 4 – MATERIALS AND RESOURCES								
MRPR1		Storage & Collection of Recyclables (PREREQUISITE)	Final Design	Statement confirming that recycling area will accommodate recycling of plastic, metal, paper, cardboard and glass. Narrative indicating any other materials addressed and coordination with pickup.				ARC
MR1.1		Building Reuse: Maintain 55% of Existing Walls, Floors & Roof	**Final Design	If project includes a building addition, confirm that area of building addition does not exceed 2x the area of the existing building.				ARC
			**Final Design	Spreadsheet listing, for each building structural/envelope element, the existing area and reused area. Total percent reused.				ARC
MR1.2		Building Reuse: Maintain 75% of Existing Walls, Floors & Roof	Same as MR1.1	Same as MR1.1				ARC
MR1.3		Building Reuse: Maintain 95% of Existing Walls, Floors & Roof	Same as MR1.1	Same as MR1.1				ARC
MR1.4		Building Reuse: Maintain 50% of Interior Non-Structural Elements	**Final Design	If project includes a building addition, confirm that area of building addition does not exceed 2x the area of the existing building.				ARC
			**Final Design	Spreadsheet listing, for each building interior non-structural element, the existing area and reused area. Total percent reused.				ARC
MR2.1		Construction Waste Management: Divert 50% From Disposal	**Preconstruction	Waste Management Plan				PE
			**Construction Quarterly and Closeout	Spreadsheet calculations indicating material description, disposal/diversion location (or recycling hauler), weight, total waste generated, total waste diverted, diversion percentage				PE
			**Construction Quarterly and Closeout	Receipts/tickets for all items on spreadsheet				PE
MR2.2		Construction Waste Management: Divert 75% From Disposal	Same as MR2.1	Same as MR2.1				PE
MR3.1		Materials Reuse: 5%	Closeout	Statement indicating total materials value and whether default or actual.				PE
			Closeout	Spreadsheet calculations indicating, for each reused/salvaged material, material description, source or vendor, cost. Total reused/salvaged materials percentage.				PE
MR3.2		Materials Reuse: 10%	Same as MR3.1	Same as MR3.1				PE
MR4.1		Recycled Content: 10% (post-consumer + 1/2 pre-consumer)	Closeout	Statement indicating total materials value and whether default or actual.				PE
			Closeout	Spreadsheet calculations indicating, for each recycled content material, material name/description, manufacturer, cost, post-consumer recycled content percent, pre-consumer recycled content percent, source of recycled content data. Total post-consumer content materials cost, total pre-consumer content materials cost, total combined recycled content materials cost, recycled content materials percentage.				PE
			Final Design or NLT Preconstruction	**Purchasing Plan consisting of spreadsheet indicated above, filled in with estimated quantities to show strategy for achieving goal.				PE
			Closeout	X Manufacturer published product data or certification, confirming recycled content percentages in spreadsheet				PE
MR4.2		Recycled Content: 20% (post-consumer + 1/2 pre-consumer)	Same as MR4.1	Same as MR4.1				PE
MR5.1		Regional Materials: 10% Extracted, Processed & Manufactured Regionally	Closeout	Statement indicating total materials value and whether default or actual.				PE
			Closeout	Spreadsheet calculations indicating, for each regional material, material name/description, manufacturer, cost, percent compliant, harvest distance, manufacture distance, source of manufacture and harvest location data. Total regional materials cost, regional materials percentage.				PE
			Preconstruction	**Purchasing Plan consisting of spreadsheet indicated above, filled in with estimated quantities to show strategy for achieving goal.				PE
			Closeout	X Manufacturer published product data or certification confirming regional material percentages in spreadsheet				PE

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MR5.2		Regional Materials:20% Extracted, Processed & Manufactured Regionally	Same as MR5.1	Same as MR5.1				PE
MR6		Rapidly Renewable Materials	Closeout	Statement indicating total materials value and whether default or actual.				PE
			Closeout	Spreadsheet calculations indicating, for each rapidly renewable material, material name/description, manufacturer, cost, rapidly renewable content percent, rapidly renewable product value. Total rapidly renewable product value, rapidly renewable materials percentage.				PE
			Final Design	**Purchasing Plan consisting of spreadsheet indicated above, filled in with estimated quantities to show strategy for achieving goal.				ARC
			Closeout	X Manufacturer published product data or certification confirming rapidly renewable material percentages in spreadsheet				PE
MR7		Certified Wood	Closeout	Statement indicating total materials value and whether default or actual.				PE
			Closeout	Spreadsheet calculations indicating, for each certified wood material, material name/description, vendor, cost, wood component percent, certified wood percent of wood component, FSC chain of custody certificate number. Total certified wood product value, certified wood materials percentage.				PE
			Final Design or NLT Preconstruction	**Purchasing Plan consisting of spreadsheet indicated above, filled in with estimated quantities to show strategy for achieving goal.				PE
			Closeout	X Vendor invoices, FSC chain of custody certificates and manufacturer published product data or certification confirming all certified wood materials percentages in spreadsheet.				PE
INDOOR ENVIRONMENTAL QUALITY								
EQPR1		Minimum IAQ Performance (PREREQUISITE)	Final Design	Statement indicating which option for compliance applies, stating applicable criteria/requirement, and confirming that project has been designed to meet the applicable requirements.				MEC
			Final Design	Narrative describing the project's ventilation design, including specifics about fresh air intake volumes and special considerations.				MEC
EQPR2		Environmental Tobacco Smoke (ETS) Control (PREREQUISITE)	Final Design	Statement indicating which option for compliance applies, stating applicable criteria/requirement, and confirming that project has been designed to meet the applicable requirements.				ARC
			Final Design	List of drawing and specification references that convey conformance to applicable requirements (signage, exhaust system, room separation details, etc).				ARC
EQ1		Outdoor Air Delivery Monitoring	Final Design	Statement indicating which option for compliance applies and confirming that project has been designed to meet the applicable requirements.				MEC
			Final Design	List of drawing and specification references that convey conformance to applicable requirements.				MEC
			Final Design	Narrative describing the project's ventilation design and CO2 monitoring system, including specifics about monitors, operational parameters and setpoints.				MEC
			Closeout	X Cut sheets for CO2 monitoring system.				PE
EQ2		Increased Ventilation	Final Design	Statement indicating which option for compliance applies and confirming that project has been designed to meet the applicable requirements.				MEC
			Final Design	Narrative describing the project's ventilation design, including specifics about zone fresh air intake volumes and demonstrating compliance.				MEC
			Final Design	Option 2: Narrative describing design method used for determining natural ventilation design, including calculation methodology/model results and demonstrating compliance.				MEC
			Final Design	List of drawing and specification references that convey conformance to applicable requirements.				MEC
EQ3.1		Construction IAQ Management Plan: During Construction	**Preconstruction	Construction IAQ Management Plan				PE
			Closeout	Statement confirming whether air handling units were operated during construction				PE
			Closeout	Dated jobsite photos showing examples of IAQ management plan practices being implemented. Label photos to indicate which practice they demonstrate. Minimum one photo of each practice at each building.				PE

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			Closeout	Spreadsheet indicating, for each filter installed during construction, the manufacturer, model number, MERV rating, location installed, and if it was replaced immediately prior to occupancy.		PE
EQ3.2		Construction IAQ Management Plan: Before Occupancy	**Preconstruction	Construction IAQ Management Plan		PE
			Closeout	Statement indicating which option for compliance applies and confirming that required activities have occurred that meet the applicable requirements.		PE
			Closeout	Option 1a: Narrative describing the project's flushout process, including specifics about temperature, airflow and duration, special considerations (if any) and demonstrating compliance.		PE
			Closeout	Option 1b: Narrative describing the project's pre-occupancy and post-occupancy flushout processes, including specifics about temperature, airflow and duration, special considerations (if any) and demonstrating compliance.		PE
			Closeout	Option 2: Narrative describing the project's IAQ testing process, including specifics about contaminants tested for, locations, remaining work at time of test, retest parameters and special considerations (if any).		PE
			Closeout	Option 2: IAQ testing report demonstrating compliance.		PE
EQ4.1		Low Emitting Materials: Adhesives & Sealants	Closeout	Spreadsheet indicating, for each applicable indoor adhesive, sealant and sealant primer used, the manufacturer, product name/model number, VOC content, LEED VOC limit, and source of VOC data.		PE
			Closeout	Spreadsheet indicating, for each applicable indoor aerosol adhesive, the manufacturer, product name/model number, VOC content, LEED VOC limit, and source of VOC data - OR - Statement confirming no indoor aerosol adhesives were used for the project.		PE
			Closeout	Manufacturer published product data or certification confirming material VOCs in spreadsheet	X	PE
EQ4.2		Low Emitting Materials: Paints & Coatings	Closeout	Spreadsheet indicating, for each applicable indoor paint and coating used, the manufacturer, product name/model number, VOC content, LEED VOC limit, and source of VOC data.		PE
			Closeout	Spreadsheet indicating, for each applicable indoor anti-corrosive/anti-rust paint and coating used, the manufacturer, product name/model number, VOC content, LEED VOC limit, and source of VOC data - OR - Statement confirming no indoor anti-corrosive/anti-rust paints were used for the project .		PE
			Closeout	Manufacturer published product data or certification confirming material VOCs in spreadsheet	X	PE
EQ4.3		Low Emitting Materials: Flooring Systems	Closeout	Spreadsheet indicating, for each indoor flooring system used, the manufacturer, product name/model number, if it meets LEED requirement (yes/no) and source of LEED compliance data.		PE
			Closeout	Spreadsheet indicating, for each indoor carpet cushion used, the manufacturer, product name/model number, if it meets LEED requirement (yes/no) and source of LEED compliance data - OR - Statement confirming no indoor carpet cushion was used for the project.		PE
			Closeout	Manufacturer published product data or certification confirming material compliance label in spreadsheet	X	PE
EQ4.4		Low Emitting Materials: Composite Wood & Agrifiber Products	Closeout	Spreadsheet indicating, for each indoor composite wood and agrifiber product used, the manufacturer, product name/model number, if it contains added urea formaldehyde (yes/no) and source of LEED compliance data.		PE
			Closeout	Manufacturer published product data or certification confirming material urea formaldehyde in spreadsheet	X	PE
EQ5		Indoor Chemical & Pollutant Source Control	Closeout	Spreadsheet indicating, for each permanent entryway system used, the manufacturer, product name/model number and description of system.		PE
			Final Design	List of drawing and specification references that convey locations and installation methods for entryway systems.		ARC
			Final Design	Spreadsheet indicating, for each chemical use area, the room number, room name, description of room separation features (walls, floor/ceilings, openings) and pressure differential from surrounding spaces with doors closed - OR - Statement confirming that project includes no chemical use areas and that no hazardous cleaning materials are needed for building maintenance.		ARC MEC
			Final Design	If project includes chemical use areas: List of drawing and specification references that convey locations of chemical use areas, room separation features and exhaust system.		ARC MEC

LEED Credit Paragraph	Contractor Check Here if Credit is Claimed	LEED-NC v3 Submittals (OCT09)	Provide for Credit Audit Only	REQUIRED DOCUMENTATION	DATE	REV	Date Submitted (to be filled in by Contractor)	Government Reviewer's Use
PAR		FEATURE	DUE AT					
			Final Design	If project includes places where water and chemical concentrate mixing occurs: List of drawing and specification references that convey provisions for containment of hazardous liquid wastes OR - Statement confirming that project includes no places where water and chemical concentrate mixing occurs.				ARC MEC
			Closeout	If project includes chemical use areas: Spreadsheet indicating, for AHUs/mechanical ventilation equipment serving occupied areas, the manufacturer, model number, MERV rating, location installed, and if it was replaced immediately prior to occupancy (yes/no) - OR - Statement confirming that project does not use mechanical equipment for ventilation of occupied areas.				PE
EQ6.1		Controllability of Systems: Lighting	Final Design	Calculation indicating total number of individual workstations, number of workstations with individual lighting controls and the percentage of workstations with individual lighting controls.				ELEC
			Final Design	For each shared multi-occupant space, provide a brief description of lighting controls.				ELEC
			Final Design	Narrative describing lighting control strategy, including type and location of individual controls and type and location of controls in shared multi-occupant spaces.				ELEC
EQ6.2		Controllability of Systems: Thermal Comfort	Final Design	Calculation indicating total number of individual workstations, number of workstations with individual thermal comfort controls and the percentage of workstations with individual thermal comfort controls.				MEC
			Final Design	For each shared multi-occupant space, provide a brief description of thermal comfort controls.				MEC
			Final Design	Narrative describing thermal comfort control strategy, including type and location of individual and shared multi-occupant controls.				MEC
EQ7.1		Thermal Comfort: Design	Final Design	Design criteria spreadsheet indicating, for spring, summer, fall and winter, maximum indoor space design temperature, minimum indoor space design temperature and maximum indoor space design humidity.				MEC
			Final Design	Narrative describing method used to establish thermal comfort control conditions and how systems design addresses the design criteria, including compliance with the referenced standard.				MEC
EQ7.2		Thermal Comfort: Verification	Final Design	Narrative describing the scope of work for the thermal comfort survey, including corrective action plan development				MEC
			Final Design	List of drawing and specification references that convey permanent monitoring system.				MEC
EQ8.1		Daylight & Views: Daylight 75% of Spaces	Final Design	Option 2: Table indicating all regularly occupied spaces with space area and space area with compliant daylight zone. Sum of regularly occupied areas and regularly occupied areas with compliant daylight zone. Percentage calculation of areas with compliant daylight zone to total regularly occupied areas.				ARC
			Final Design	Option 1: Simulation model method, software and output data				ELEC
			Final Design	Option 1: Table indicating all regularly occupied spaces with space area, space area with minimum 25 footcandles daylighting illumination, and method of providing glare control. Sum of regularly occupied areas and regularly occupied areas with 25 fc daylighting. Percentage calculation of areas with 25 fc daylighting to total regularly occupied areas.				ELEC
			Final Design	For all occupied spaces excluded from the calculation, provide narrative indicating reasons for excluding the space.				ARC
			Final Design	List of drawing and specification references that convey exterior glazed opening head and sill heights, glazing performance properties and glare control/sunlight redirection devices.				ARC
			Closeout	X Manufacturer published product data or certification confirming glazing Tvis in spreadsheet				PE
EQ8.2		Daylight & Views: Views for 90% of Spaces	Final Design	Table indicating all regularly occupied spaces with space area and space area with access to views. Sum of regularly occupied areas and regularly occupied areas with access to views. Percentage calculation of areas with views to total regularly occupied areas.				ARC
			Final Design	For all occupied spaces excluded from the calculation, provide narrative indicating reasons for excluding the space.				ARC
			Final Design	LEED Floor plan drawings showing line of sight diagramming of views areas in each regularly occupied space. List of drawing/specification references that convey exterior glazed opening head and sill heights.				ARC

INNOVATION & DESIGN PROCESS

LEED Credit Paragraph	Contractor Check Here if Credit is Claimed	LEED-NC v3 Submittals (OCT09)	Provide for Credit Audit Only	REQUIRED DOCUMENTATION	DATE	REV
				Narrative describing intent, requirement for credit, project approach to the credit. List of drawings and specification references that convey implementation of credit. All other documentation that validates claimed credit.		
IDc1.1		Innovation in Design	Final Design			
IDc1.2		Innovation in Design	Final Design			
IDc1.3		Innovation in Design	Final Design			
IDc1.4		Innovation in Design	Final Design			
IDc2		LEED Accredited Professional	Final Design	Narrative indicating name of LEED AP, company name of LEED AP, description of LEED AP's role and responsibilities in the project.		ARC

ATTACHMENT F
Version 05-31-2011

BUILDING INFORMATION MODELING REQUIREMENTS

1.0 Section 1 - General

- 1.1. Definitions. See Section 7 for definitions of terms used in this document.
- 1.2. Submittal Format
 - 1.2.1. The Model shall be developed using Building Information Modeling (“BIM”) supplemented with Computer Aided Design (“CAD”) content as necessary to produce a complete set of Construction Documents. Printed design submittal drawings shall be ANSI D size, suitable for half-size scaled reproduction.
 - 1.2.2. BIM submittals shall conform to the requirements of Sections 3 and 4 below.
 - 1.2.3. For each Center of Standardization (CoS) facility type included in this Project, all Models and associated Facility Data shall be submitted in either Bentley Systems v8i BIM or Autodesk Revit 2010 format or higher. The submittals shall be fully operable, compatible, and editable within the native BIM tools.

2.0 Section 2 – Design Requirements

- 2.1. Use of BIM for Design. Contractor shall use either Bentley Systems or Autodesk Revit BIM application(s) and software(s) to develop Project designs consistent with the following requirements.
 - 2.1.1. Baseline Model. The Contractor will not be provided a baseline multi-discipline BIM Project Model.
 - 2.1.2. USACE BIM Workspace. If Contractor selects Bentley Systems BIM as the BIM platform of choice, the latest version of the USACE Bentley BIM Workspace must be used and can be downloaded from the CAD/BIM Technology Center website, currently <https://cadbim.usace.army.mil>. If Contractor selects Autodesk Revit as the BIM platform of choice, a USACE Revit Workspace will not be provided; Contractor can select which Revit Workspace to use.
 - 2.1.3. Reference. Refer to ERDC TR-06-10, “U.S. Army Corps of Engineers Building Information Modeling Road Map” from the CAD/BIM Technology Center website for more information on the USACE BIM implementation goals.
 - 2.1.4. Industry Foundation Class (IFC) Support. The Contractor’s selected BIM application(s) and software(s) must be consistent with the current IFC property sets. Any deviations from or additions to the IFC property sets for any new spaces, systems, and equipment must be submitted for Government acceptance.
 - 2.1.5. BIM Project Execution Plan.
 - 2.1.5.1. Develop a BIM Project Execution Plan (“Plan” or “PxP”) documenting the BIM uses, analysis technologies and workflows.
 - 2.1.5.2. Contractors shall utilize the link for the USACE BIM PROJECT EXECUTION PLAN (USACE PxP) Template located in Attachment H to develop an acceptable Plan.
- 2.2. BIM Requirements.

2.2.1. Facility Data. Develop the Facility Data to include material definitions and attributes that are necessary for the Project facility design and construction as described in Section 4.0. Additional data in support of Section 6.0 Contractor Electives is encouraged to be added to the Model.

2.2.2. Model Content. The Model and Facility Data shall include, at a minimum, the requirements of Section 4 below.

2.2.3. Model Granularity. Individual elements may vary in level of detail within the Model, but at a minimum must include all features that would be included on a quarter inch (1/4" = 1'0") scaled drawing (e.g., at least 1/16th, 1/8th and 1/4th), or on appropriately scaled civil drawings.

2.3. Output. Submitted Drawings (e.g., plans, elevations, sections, schedules, details, etc.) shall be derived (commonly known as extractions, views or sheets) from the Model and Facility Data. Drawings derived from the Model shall remain connected to the Model for the life of the Project and documented in the PxP. Drawings not derived from the Model shall also be documented in the PxP.

2.3.1. Drawings derived from the Model shall be compliant with the A/E/C CAD Standard. Deliver electronic CAD files used for the creation of the Construction Documents per requirements in Section 01 33 16, the criteria of the USACE Louisville District, and as noted herein.

2.3.2. The CAD file format specified for drawings shall not dictate which application(s) are used for development and execution of the Model and Facility Data. Application(s) used shall be documented in the PxP.

2.4. Quality Control Parameters. Implement quality control ("QC") parameters for the Model, including:

2.4.1. Model Standards Checks. QC validation ensures that the Project Facility Data set has no undefined, incorrectly defined or duplicated elements. Identify and report non-compliant elements and submit a corrective action plan. Provide the Government with detailed justification and request Government acceptance for any non-compliant element that the Contractor proposes to be allowed to remain in the Model.

2.4.2. CAD Standards Checks. QC checking ensures that the fonts, dimensions, line styles, levels and other construction document formatting issues are followed per requirements in Section 01 33 16. Identify and report non-compliant content and submit a corrective action plan.

2.4.3. Other Parameters. Develop such other QC parameters as Contractor deems appropriate for the Project and provide to the Government for acceptance.

2.5. Design and Construction Reviews. Perform design and construction reviews at each submittal stage under Section 3 to test the Model, including:

2.5.1. Visual Checks. Checking to ensure the design intent has been followed and that there are no unintended elements in the Model.

2.5.2. Interference Management Checks. Locate conflicting spatial data in the Model where two elements are occupying the same space. Log hard interferences (e.g., mechanical vs. structural, or mechanical vs. mechanical, overlaps in the same location) and soft interferences, (e.g., conflicts regarding equipment clearance, service access, fireproofing, insulation, code space requirements) in a written report and resolve.

2.5.3. IFC Coordination View. Provide an IFC Coordination View in IFC Express format for all deliverables. Provide exported property set data for all IFC supported named building elements.

2.5.4. Other Parameters. Develop other design and construction review parameters as the Contractor deems appropriate for the Project and provide to the Government for acceptance.

3.0 Section 3 – Submittal Requirements

3.1. General Submittal Requirements.

3.1.1. Provide submittals in compliance with the PxP deliverables at stages as described below.

3.1.2. For each Interim Design Submittal as set forth in Paragraphs 3.3 through 3.6, provide a Contractor-certified written report confirming that consistency checks as identified in Paragraphs 2.4 and 2.5 above have been completed. This report shall be discussed as part of the review process and shall address cross-discipline interferences, if any.

3.1.3. At each Interim Design Submittal as set forth in Paragraphs 3.3 through 3.6, provide the Government with:

3.1.3.1. The Model, Facility Data, Workspace and CAD Data files in the native BIM/CAD format.

3.1.3.2. A copy of the Model in an interactive review format such as Bentley Navigator, Autodesk Navisworks, Adobe 3D PDF 7.0 (or later), Google Earth KMZ or other format per PxP requirements. The format for reviews can change between submittals.

3.1.3.3. A list of all submitted electronic files including a description, directory, and file name for each file submitted. For all CAD printed sheets, include a list of the sheet titles and sheet numbers. Identify which files have been produced from the Model and Facility Data.

3.1.4. The Government shall confirm acceptability of all submittals identified in Section 3 in coordination with the USACE Geographic BIM Manager.

3.2. Initial Design Conference Submittal.

3.2.1. Submit a digital copy of the PxP where, in addition to Paragraph 3.1.4, the USACE Geographic District BIM Manager will coordinate with the USACE CoS BIM Manager to confirm acceptability of the Plan or advise as to additional processes or activities necessary to be incorporated into the PxP.

3.2.2. Within thirty (30) days after the acceptance of the PxP, conduct a demonstration to review the Plan for clarification, and to verify the functionality of planned Model technology workflow and processes. If modifications are required, the Contractor shall complete the modifications and resubmit the PxP performing a subsequent demonstration for Government acceptance. There will be no payment for design or construction until the PxP is completed and accepted by the Government. The Government may also withhold payment if there is design and construction for unacceptable performance in executing the accepted PxP.

3.3. Interim Design Submittals.

3.3.1. BIM and CAD Data. Submit the Model with Facility Data per the requirements identified in Paragraphs 2.2 and 2.3 as applicable to the Interim Design package(s).

3.4. Final Design Submissions and Design Complete Submittals.

3.4.1. BIM and CAD Data. Submit the Model with Facility Data per the requirements identified in Paragraphs 2.2 and 2.3. Acceptance according to Paragraph 3.1.4 is required before commencement of construction, as described in Paragraph 3.7.6 of Section 01 33 16.

3.5. Construction Submittals – Over-The-Shoulder Progress Reviews. Periodic quality control meetings or construction progress review meetings shall include quality control reviews on the implementation and use of the Model, including interference management and design change tracking information.

3.6. Final As-Built BIM and CAD Data Submittal. Submit the final Model, Facility Data, and CAD files reflecting as-built construction conditions for Government acceptance, as specified in Section 01 78 02.00 10, PROJECT CLOSEOUT.

4.0 Section 4 – BIM Model Minimum Requirements and Output

4.1. General Provisions. The Model shall be developed to include the systems described below as they would be built, the processes of installing them, and to reflect final as-built construction conditions. The deliverable Model at the Interim Design Stage and at the Final Design Stage (“released for construction”) shall be developed to include as many of the systems described below as are necessary and appropriate at that design stage.

4.2. Architectural/Interior Design. The Architectural systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4”=1’0”) scaled drawing. Additional minimum Model requirements include:

4.2.1. Spaces. The Model shall include spaces defining actual net square footage and net volume, and holding data to develop the room finish schedule including room names and numbers. Include program information to verify design space against programmed space, using this information to validate area quantities.

4.2.2. Walls and Curtain Walls. Each wall shall be depicted to the exact height, length, width and ratings (thermal, acoustic, fire) to properly reflect wall types. The Model shall include all walls, both interior and exterior, and the necessary intelligence to produce accurate plans, sections and elevations depicting these design elements.

4.2.3. Doors, Windows and Louvers. Doors, windows and louvers shall be depicted to represent their actual size, type and location. Doors and windows shall be modeled with the necessary intelligence to produce accurate window and door schedules.

4.2.4. Roof. The Model shall include the roof configuration, drainage system, penetrations, specialties, and the necessary intelligence to produce accurate plans, building sections and generic wall sections where roof design elements are depicted.

4.2.5. Floors. The floor slab(s) shall be developed in the Structural Model and then referenced by the Architectural Model.

4.2.6. Ceilings. All heights and other dimensions of ceilings, including soffits, ceiling materials, or other special conditions shall be depicted in the Model with the necessary intelligence to produce accurate plans, building sections and wall sections where ceiling design elements are depicted.

4.2.7. Vertical Circulation. All continuous vertical components (i.e., non-structural shafts, architectural stairs, handrails and guardrails) shall be accurately depicted and shall include the necessary intelligence to produce accurate plans, elevations and sections in which such design elements are referenced.

4.2.8. Architectural Specialties. All architectural specialties (i.e., toilet room accessories, toilet partitions, grab bars, lockers, and display cases) and millwork (i.e., cabinetry and counters) shall be accurately depicted with the necessary intelligence to produce accurate plans, elevations, sections and schedules in which such design elements are referenced.

- 4.2.9. Signage. The Model shall include all signage and the necessary intelligence to produce accurate plans and schedules.
- 4.2.10. Schedules. Provide door, window, hardware sets using BHMA designations, flooring, wall finish, and signage schedules from the Model, indicating the type, materials and finishes used in the design.
- 4.3. Furniture. The furniture Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing, and have necessary intelligence to produce accurate plans. Representation of furniture elements is to be 2D. Contractor may provide a minimal number of 3D representations as examples. Examples of furniture include, but are not limited to, desks, furniture systems, seating, tables, and office storage.
- 4.3.1. Furniture Coordination. Furniture that makes use of electrical, data or other features shall include the necessary intelligence to produce coordinated documents and data.
- 4.4. Equipment. The Model may vary in level of detail for individual elements. Equipment shall be depicted to meet layout requirements with the necessary intelligence to produce accurate plans and schedules, indicating the configuration, materials, finishes, mechanical, and electrical requirements.. Examples of equipment include but are not limited to copiers, printers, refrigerators, ice machines and microwaves.
- 4.4.1. Schedules. Provide furniture and equipment schedules from the model indicating the materials, finishes, mechanical, and electrical requirements.
- 4.5. Structural. The Structural systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing. Additional minimum Model requirements include:
- 4.5.1. Foundations. All necessary foundation and/or footing elements, with necessary intelligence to produce accurate plans and elevations.
- 4.5.2. Floor Slabs. Structural floor slabs shall be depicted with all necessary recesses, curbs, pads, closure pours, and major penetrations accurately depicted.
- 4.5.3. Structural Steel. All steel columns, primary and secondary framing members, and steel bracing for the roof and floor systems (including decks), including all necessary intelligence to produce accurate structural steel framing plans, related building/wall sections, and schedules.
- 4.5.4. Cast-in-Place Concrete. All walls, columns, beams, including necessary intelligence to produce accurate plans and building/wall sections, depicting cast-in-place concrete elements.
- 4.5.5. Expansion/Contraction Joints. Joints shall be accurately depicted.
- 4.5.6. Stairs. All framing members for stair systems, including necessary intelligence to produce accurate plans and building/wall sections depicting stair design elements.
- 4.5.7. Shafts and Pits. All shafts and pits, including necessary intelligence to produce accurate plans and building/wall sections depicting these design elements.
- 4.5.8. Openings and Penetrations. All major openings and penetrations that would be included on a quarter inch (1/4"=1'0") scaled drawing.
- 4.6. Mechanical. The Mechanical systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0")

scaled drawing. Small diameter (less than 1-1/2" NPS) field-routed piping is not required to be depicted in the Model. Additional minimum Model requirements include:

4.6.1. HVAC. All necessary heating, ventilating, air-conditioning and specialty equipment, including air distribution for supply, return, ventilation and exhaust ducts, control systems, registers, diffusers, grills, and hydronic baseboards with necessary intelligence to produce accurate plans, elevations, building/wall sections and schedules.

4.6.1.1. Mechanical Piping. All necessary piping and fixture layouts, and related equipment, including necessary intelligence to produce accurate plans, elevations, building/wall sections, and schedules.

4.6.2. Plumbing. All necessary plumbing piping and fixture layouts, floor and area drains, and related equipment, including necessary intelligence to produce accurate plans, elevations, building/wall sections, riser diagrams, and schedules.

4.6.3. Equipment Clearances. All Mechanical equipment clearances shall be modeled for use in interference management and maintenance access requirements.

4.6.4. Elevator Equipment. All necessary equipment and control systems, including necessary intelligence to produce accurate plans, sections and elevations depicting these design elements.

4.7. Electrical/Telecommunications. The Electrical and Telecommunications systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing. Small diameter (less than 1-1/2"Ø) field-routed conduit is not required to be depicted in the Model. Additional minimum Model requirements include:

4.7.1. Interior Electrical Power and Lighting. All necessary interior electrical components (i.e., lighting, receptacles, special and general purpose power receptacles, lighting fixtures, panelboards, cable trays and control systems), including necessary intelligence to produce accurate plans, details and schedules. Lighting and power built into furniture/equipment shall be modeled.

4.7.2. Special Electrical. All necessary special electrical components (i.e., security, mass notification, public address, nurse call and other special electrical occupancy sensors, and control systems), including necessary intelligence to produce accurate plans, details and schedules.

4.7.3. Grounding. All necessary grounding components (i.e., lightning protection systems, static grounding systems, communications grounding systems, and bonding), including necessary intelligence to produce accurate plans, details and schedules.

4.7.4. Telecommunications. All existing and new telecommunications service controls and connections, both above ground and underground, with necessary intelligence to produce accurate plans, details and schedules. Cable tray routing shall be modeled without detail of cable contents.

4.7.5. Exterior Building Lighting. All necessary exterior lighting including all lighting fixtures, relevant existing and proposed support utility lines and equipment with necessary intelligence to produce accurate plans, details and schedules.

4.7.6. Equipment Clearances. All Electrical equipment clearances shall be modeled for use in interference management and maintenance access requirements.

4.8. Fire Protection. The fire protection system Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing. Additional minimum Model requirements include:

4.8.1. Fire Protection System. All relevant fire protection components (i.e., branch piping, sprinkler heads, fittings, drains, pumps, tanks, sensors, control panels) with necessary intelligence to produce accurate plans, elevations, building/wall sections, riser diagrams, and schedules. All fire protection piping shall be modeled.

4.8.2. Fire Alarms. Fire alarm/mass notification devices and detection system shall be indicated with necessary intelligence to produce accurate plans depicting them.

4.9. Civil. The Civil Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a one inch (1"=100') scaled drawing. Additional minimum Model requirements include:

4.9.1. Terrain (DTM). All relevant site conditions and proposed grading, including necessary intelligence to produce accurate Project site topographical plans and cross sections.

4.9.2. Drainage. All existing and new drainage piping, including upgrades thereto, including necessary intelligence to produce accurate plans and profiles for the Project site.

4.9.3. Storm Water and Sanitary Sewers. All existing and new sewer structures and piping, including upgrades thereto, with necessary connections to mains or other distribution points as appropriate, including necessary intelligence to produce accurate plans and profiles .

4.9.4. Utilities. All necessary new utilities connections from the Project building(s) to the existing or newly-created utilities, and all existing above ground and underground utility conduits, including necessary intelligence to produce accurate plans and site-sections.

4.9.5. Roads and Parking. All necessary roadways, parking lots, and parking structures, including necessary intelligence to produce accurate plans, profiles and cross-sections.

5.0 Section 5 - Ownership and Rights in Data

5.1. Ownership. The Government has ownership of and rights at the date of Closeout Submittal to all CAD files, BIM Model, and Facility Data developed for the Project in accordance with FAR Part 27, clauses incorporated in Section 00 72 00, Contract Clauses and Special Contract Requirement 1.14 GOVERNMENT RE-USE OF DESIGN (Section 00 73 00). The Government may make use of this data following any deliverable.

6.0 Section 6 – Contractor Electives

6.1. Applicable Criteria. If the Contractor elected to include one or more of the following features as an elective in its accepted contract proposal for additional credit, as described in the proposal submission requirements and evaluation criteria, the requirements of paragraphs 6.2 through 6.5 are as applicable for those elective feature(s) that will be included in the project.

6.2. COBIE Compliance. The Model and Facility Data for the Project shall fulfill Construction Operations Building Information Exchange (COBIE) requirements on the Whole Building Design Guide website (www.wbdg.org) , including all requirements for the indexing and submission of Portable Document Format (PDF) and other appropriate records that would otherwise be printed and submitted in compliance with Project operations and maintenance handover requirements.

6.3. Project Scheduling using the Model. In the PxP and during the Initial Design Conference Submittal Demonstration, provide an overview of the use of BIM in the development and support of the Project construction schedule.

6.3.1. Submittal Requirements. During the Stages identified in Paragraphs 3.3 through 3.6, the Contractor shall deliver the construction schedule derived from the Model.

6.3.1.1. Construction Submittals – Over-The-Shoulder Progress Reviews. Periodic quality control meetings or construction progress review meetings shall include quality control reviews on the implementation and use of the Model for Project scheduling.

6.4. Cost Estimating. In the PxP and during the Initial Design Conference Submittal Demonstration, provide an overview of the use of BIM in the development and support of cost estimating, or other costing applications such as comparative cost analysis for proposed changes and estimate validation.

6.4.1. Submittal Requirements. During the Stages identified in Paragraphs 3.3 through 3.6, the Contractor shall deliver cost estimating information derived from the Model.

6.4.2. Project Completion. At Project completion, the Contractor shall provide an Micro Computer Aided Cost Estimating System Generation II (“MII”) Cost Estimate that follows the USACE Cost Engineering Military Work Breakdown System (“WBS”), a modified Uniformat, to at least the sub-systems level and uses quantity information supplied directly from Model output to the maximum extent possible, though other “gap” quantity information will be included by the contractor as necessary for a complete and accurate Cost Estimate. (See Paragraph 6.4.2.2).

6.4.2.1. Sub system level extracted quantities from the Model for use within the Estimate shall be provided according to how detailed line items or tasks should be installed/built so that accurate costs can be developed and/or reflected. When developing a Model, the contractor shall be cognizant of construction sequencing at the beginning stages of Model development, such as recognizing tasks performed on the first floor versus the same task on higher floors that will be more labor intensive and, therefore, need to have a separate quantity and be priced differently. Tasks and their extracted quantities from the Model shall be broken down by their location (proximity in the structure) as well as the complexity of installation.

6.4.2.2. At all design Stages it shall be acknowledged that BIM output will not generate all quantities that are necessary in order to develop a complete and accurate cost estimate of the Project based on the design alone. (An example of this would be plumbing that is less than 1.5" diameter and, therefore, not expected to be modeled due to permitted level of design granularity; this information is commonly referred to as “The Gap”. Quantities addressing “The Gap” and their associated costs shall be included in the final Project actual Cost Estimates as well even though not derived directly from the Model data).

6.5. Other Analyses and Reports. Structural, energy and efficiency, EPACT 2005 & EISA 2007, lighting design, daylighting, electrical power, psychrometric processing, shading, programming, LEED, fire protection, code compliance, Life Cycle Cost, acoustic, plumbing and other analyses that may be generated from the Model or reports summarizing the data compiled from these analyses shall be submitted in the form established by contractor in its accepted PxP.

7.0 Definitions

7.1. The following definitions apply specifically in the context of this attachment only.

7.2. “Model”: An electronic, three-dimensional representation of facility elements with associated intelligent attribute data (“Facility Data”).

7.3. “Facility Data”: The non-graphical information attached to objects in the Model that defines various characteristics of the object. Facility Data can include properties such as parametric values that drive physical sizes, material definitions and characteristics (e.g. wood, metal), manufacturer data, industry standards (e.g. AISC steel properties), and project identification numbers. Facility Data can also

define supplementary physical entities that are not shown graphically in the Model, such as insulation around a duct, or hardware on a door.

7.4. “Workspace”: A collection of content libraries and supporting files that define and embody a BIM standard. A workspace includes BIM libraries such as wall types, standard steel shapes, furniture, HVAC fittings, and sprinkler heads. It also contains sheet libraries such as print/plot configurations, font and text style libraries, and sheet borders and title blocks. The USACE has developed Workspaces specific to USACE BIM standards; these workspaces are dependent on specific versions of the BIM applications they serve. All USACE BIM Workspaces can be downloaded from the CAD/BIM Technology Center (<https://cadbim.usace.army.mil>). In some cases, there is a specific Workspace for a given CoS Facility Standard Design.

“IFC”: Industry Foundation Class, a standard and file format used for the exchange of BIM data; see www.iai-tech.org. Note: In the context of this attachment, IFC does not mean “Issued For Construction.”

ATTACHMENT G**DESIGN SUBMITTAL DIRECTORY AND SUBDIRECTORY FILE ARRANGEMENT**

Organize electronic design submittal files in a subdirectory/file structure in accordance with the following table.

The Contractor may suggest a slightly different structure, subject to the discretion of the government.

Design Submittal Directory and Subdirectory File Arrangement.

Directory	Sub-Directory	Sub-Directory or Files	Files
Submittal/Package Name	Narratives	PDF file or files with updated design narrative for each applicable design discipline	
	Drawings	PDF (subdirectory)	Single PDF file with all applicable drawing sheets - bookmarked by sheet number and name
		BIM (subdirectory) See Attachment F.	BIM project folder (with files) per the USACE Workspace. Include an Excel drawing index file with each drawing sheet listed by sheet #, name and corresponding dgn file name (Final Design & Design Complete only)
	Design Analysis & Calculations	Individual PDF files containing design analysis and calculations for each discipline applicable to the submittal	
		PDF file with Fire Protection and Life Safety Code Review checklist	
	LEED	PDF file with updated Leed Check List	
		PDF file or files with LEED Templates for each point with applicable documentation included in each file.	
		LEED SUBMITTALS	
	Energy Analysis	PDF with baseline energy consumption analysis	
		PDF with actual building energy consumption analysis	
	Specifications	Single PDF file with table of contents and all applicable specifications sections.	
		Submittal Register (Final Design & Design Complete submittal only)	
	Design Quality Control	PDF file or files with DQC checklist(s) and/or statements	
	Building Rendering(s)	PDF file of rendering for each building type included in contract (Final Design & Design Complete).	

ATTACHMENT H
USACE BIM Project Execution Plan (PxP) Template Version 1.0

This template is a tool that is provided to assist in the development of a USACE BIM Project Execution Plan as required per contract. The template provides a standard format for organizations to establish their general means and methods for meeting the scope and deliverable requirements in Attachment F. It was adapted from the buildingSMART alliance™ (bSa) Project "BIM Project Execution Planning" as developed by The Computer Integrated Construction (CIC) Research Group of The Pennsylvania State University. The bSa project is sponsored by The Charles Pankow Foundation, Construction Industry Institute (CII), Penn State Office of Physical Plant (OPP), and The Partnership for Achieving Construction Excellence (PACE). The template can be found at the following link:

https://mrsi.usace.army.mil/rfp/Shared%20Documents/USACE_BIM_PXP_TEMPLATE_V1.0.pdf

Please note: Instructions and examples to assist with the completion of this template are currently in grey. The text can and should be modified to suit the needs of the organization filling out the template. If modified, the format of the text should be changed to match the rest of the document. This can be completed, in most cases, by selecting the normal style in the template styles.

**SECTION 01 45 01.10
QUALITY CONTROL SYSTEM (QCS)**

1.0 GENERAL

- 1.1. CORRESPONDENCE AND ELECTRONIC COMMUNICATIONS
- 1.2. QCS SOFTWARE
- 1.3. SYSTEM REQUIREMENTS
- 1.4. RELATED INFORMATION
- 1.5. CONTRACT DATABASE
- 1.6. DATABASE MAINTENANCE
- 1.7. IMPLEMENTATION
- 1.8. DATA SUBMISSION VIA COMPUTER DISKETTE OR CD-ROM
- 1.9. MONTHLY COORDINATION MEETING
- 1.10. NOTIFICATION OF NONCOMPLIANCE

1.0 GENERAL

The Government will use the Resident Management System for Windows (RMS) to assist in its monitoring and administration of this contract. The Contractor shall use the Government-furnished Construction Contractor Module of RMS, referred to as QCS, to record, maintain, and submit various information throughout the contract period. The Contractor module, user manuals, updates, and training information can be downloaded from the RMS web site. This joint Government-Contractor use of RMS and QCS will facilitate electronic exchange of information and overall management of the contract. QCS provides the means for the Contractor to input, track, and electronically share information with the Government in the following areas:

- Administration
- Finances
- Quality Control
- Submittal Monitoring
- Scheduling
- Import/Export of Data
- Request for Information
- Accident Reporting
- Safety Exposure Manhours

1.1. CORRESPONDENCE AND ELECTRONIC COMMUNICATIONS

For ease and speed of communications, both Government and Contractor will exchange correspondence and other documents in electronic format. Correspondence, pay requests and other documents comprising the official contract record shall also be provided in paper format, with signatures and dates where necessary. Paper documents will govern, in the event of discrepancy with the electronic version.

1.2. OTHER FACTORS

Particular attention is directed to Contract Clause, "Schedules for Construction Contracts", Contract Clause, "Payments", Section 01 32 01.00 10, PROJECT SCHEDULE, Section 01 33 00, SUBMITTAL PROCEDURES, and Section 01 45 04.00 10, CONTRACTOR QUALITY CONTROL, which have a direct relationship to the reporting to be accomplished through QCS. Also, there is no separate payment for establishing and maintaining the QCS database; all costs associated therewith shall be included in the contract pricing for the work.

1.3. QCS SOFTWARE

QCS is a Windows-based program that can be run on a stand-alone personal computer or on a network. The Government will make available the QCS software to the Contractor after award of the construction contract. Prior to the Pre-Construction Conference, the Contractor shall be responsible to download, install and use the latest version of the QCS software from the Government's RMS Internet Website. Upon specific justification and request by the Contractor, the Government can provide QCS on CD-ROM. Any program updates of QCS will be made available to the Contractor via the Government RMS Website as they become available.

1.4. SYSTEM REQUIREMENTS

The following listed hardware and software is the minimum system configuration that the Contractor shall have to run QCS:

- (a) Hardware
- IBM-compatible PC with 1000 MHz Pentium or higher processor
 - 256 MB RAM for workstation / 512+ MB RAM for server

- 1 GB hard drive disk space for sole use by the QCS system
- Compact disk (CD) Reader, 8x speed or higher
- SVGA or higher resolution monitor (1024 x 768, 256 colors)
- Mouse or other pointing device
- Windows compatible printer (Laser printer must have 4+ MB of RAM)
- Connection to the Internet, minimum 56K BPS

(b) Software

- MS Windows 2000 or higher
- MS Word 2000 or newer
- Latest version of : Netscape Navigator, Microsoft Internet Explorer, or other browser that supports HTML 4.0 or higher
- Electronic mail (E-mail), MAPI compatible
- Virus protection software that is regularly upgraded with all issued manufacturer's updates

1.5. RELATED INFORMATION

1.5.1. QCS USER GUIDE

After contract award, the Contractor shall download instructions for the installation and use of QCS from the Government RMS Internet Website. In case of justifiable difficulties, the Government will provide the Contractor with a CD-ROM containing these instructions.

1.5.2. CONTRACTOR QUALITY CONTROL (CQC) TRAINING

The use of QCS will be discussed with the Contractor's QC System Manager during the mandatory CQC Training class.

1.6. CONTRACT DATABASE

Prior to the pre-construction conference, the Government will provide the Contractor with basic contract award data to use for QCS. The Government will provide data updates to the Contractor as needed, generally by using the government's SFTP repository built into QCS import/export function. These updates will generally consist of submittal reviews, correspondence status, QA comments, and other administrative and QA data.

1.7. DATABASE MAINTENANCE

The Contractor shall establish, maintain, and update data for the contract in the QCS database throughout the duration of the contract. The Contractor shall establish and maintain the QCS database at the Contractor's site office. Data updates to the Government, e.g., daily reports, submittals, RFI's, schedule updates, payment requests, etc. shall be submitted using the government's SFTP repository built into QCS export function. If permitted by the Contracting Officer, email or CD-ROM may be used instead (see Paragraph DATA SUBMISSION VIA CD-ROM). The QCS database typically shall include current data on the following items:

1.7.1. ADMINISTRATION

1.7.1.1. Contractor Information

The database shall contain the Contractor's name, address, telephone numbers, management staff, and other required items. Within 14 calendar days of receipt of QCS software from the Government, the Contractor shall deliver Contractor administrative data in electronic format.

1.7.1.2. Subcontractor Information

The database shall contain the name, trade, address, phone numbers, and other required information for all subcontractors. A subcontractor must be listed separately for each trade to be performed. Each subcontractor/trade shall be assigned a unique Responsibility Code, provided in QCS. Within 14 calendar days of receipt of QCS software from the Government, the Contractor shall deliver subcontractor administrative data in electronic format.

1.7.1.3. Correspondence

All Contractor correspondence to the Government shall be identified with a serial number. Correspondence initiated by the Contractor's site office shall be prefixed with "S". Letters initiated by the Contractor's home (main) office shall be prefixed with "H". Letters shall be numbered starting from 0001. (e.g., H-0001 or S-0001). The Government's letters to the Contractor will be prefixed with "C".

All Requests For Information (RFI) shall be exchanged using the Built-in RFI generator and tracker in QCS.

1.7.1.4. Equipment

The Contractor's QCS database shall contain a current list of equipment planned for use or being used on the jobsite, including the most recent and planned equipment inspection dates.

1.7.1.5. Management Reporting

QCS includes a number of reports that Contractor management can use to track the status of the project. The value of these reports is reflective of the quality of the data input, and is maintained in the various sections of QCS. Among these reports are: Progress Payment Request worksheet, QA/QC comments, Submittal Register Status, Three-Phase Inspection checklists.

1.7.2. FINANCES

1.7.2.1. Pay Activity Data

The QCS database shall include a list of pay activities that the Contractor shall develop in conjunction with the design and construction schedule. The sum of all pay activities shall be equal to the total contract amount, including modifications. Pay activities shall be grouped by Contract Line Item Number (CLIN), and the sum of the activities shall equal the amount of each CLIN. The total of all CLINs equals the Contract Amount.

1.7.2.2. Payment Requests

All progress payment requests shall be prepared using QCS. The Contractor shall complete the payment request worksheet prompt payment certification, and payment invoice in QCS. The work completed under the contract, measured as percent or as specific quantities, shall be updated at least monthly. After the update, the Contractor shall generate a payment request report using QCS. The Contractor shall submit the payment request, prompt payment certification, and payment invoice with supporting data by using the government's SFTP repository built into QCS export function. If permitted by the Contracting Officer, E-mail or a CD-ROM may be used. A signed paper copy of the approved payment request is also required, which shall govern in the event of discrepancy with the electronic version.

1.7.3. Quality Control (QC)

QCS provides a means to track implementation of the 3-phase QC Control System, prepare daily reports, identify and track deficiencies, document progress of work, and support other contractor QC requirements. The Contractor shall maintain this data on a daily basis. Entered data will automatically output to the QCS generated daily report. The Contractor shall provide the Government a Contractor

Quality Control (CQC) Plan within the time required in Section 01 45 04.00 10, CONTRACTOR QUALITY CONTROL. Within seven calendar days of Government acceptance, the Contractor shall submit a QCS update reflecting the information contained in the accepted CQC Plan: schedule, pay activities, features of work, submittal register, QC requirements, and equipment list.

1.7.3.1. Daily Contractor Quality Control (CQC) Reports

QCS includes the means to produce the Daily CQC Report. The Contractor may use other formats to record basic QC data. However, the Daily CQC Report generated by QCS shall be the Contractor's official report. Data from any supplemental reports by the Contractor shall be summarized and consolidated onto the QCS-generated Daily CQC Report. Daily CQC Reports shall be submitted as required by Section 01 45 04.00 10, CONTRACTOR QUALITY CONTROL. Reports shall be submitted electronically to the Government within 24 hours after the date covered by the report. The Contractor shall also provide the Government a signed, printed copy of the daily CQC report.

1.7.3.2. Deficiency Tracking

The Contractor shall use QCS to track deficiencies. Deficiencies identified by the Contractor will be numerically tracked using QC punch list items. The Contractor shall maintain a current log of its QC punch list items in the QCS database. The Government will log the deficiencies it has identified using its QA punch list items. The Government's QA punch list items will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of both QC and QA punch list items.

1.7.3.3. QC Requirements

The Contractor shall develop and maintain a complete list of QC testing and required structural and life safety special inspections required by the International Code Council (ICC), transferred and installed property, and user training requirements in QCS. The Contractor shall update all data on these QC requirements as work progresses, and shall promptly provide this information to the Government via QCS.

1.7.3.4. Three-Phase Control Meetings

The Contractor shall maintain scheduled and actual dates and times of preparatory and initial control meetings in QCS.

1.7.3.5. Labor and Equipment Hours

The Contractor shall log labor and equipment exposure hours on a daily basis. This data will be rolled up into a monthly exposure report.

1.7.3.6. Accident/Safety Tracking Reporting

The Government will issue safety comments, directions, or guidance whenever safety deficiencies are observed. The Government's safety comments will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of the safety comments. In addition, the Contractor shall utilize QCS to advise the Government of any accidents occurring on the jobsite. This supplemental entry is not to be considered as a substitute for completion of mandatory notification and reports, e.g., ENG Form 3394 and OSHA Form 300.

1.7.3.7. Features of Work

The Contractor shall include a complete list of the features of work in the QCS database. A feature of work may be associated with multiple pay activities. However, each pay activity (see subparagraph "Pay Activity Data" of paragraph "Finances") will only be linked to a single feature of work.

1.7.3.8. Hazard Analysis

The Contractor shall use QCS to develop a hazard analysis for each feature of work included in its CQC Plan. The hazard analysis shall address any hazards, or potential hazards, that may be associated with the work

1.7.4. Submittal Management

The Government will provide the submittal register form, ENG Form 4288, SUBMITTAL REGISTER, in electronic format. The Contractor and Designer of Record (DOR) shall develop and maintain a complete list of all submittals, including completion of all data columns and shall manage all submittals. Dates on which submittals are received and returned by the Government will be included in its export file to the Contractor. The Contractor shall use QCS to track and transmit all submittals. ENG Form 4025, submittal transmittal form, and the submittal register update, ENG Form 4288, shall be produced using QCS. QCS and RMS will be used to update, store and exchange submittal registers and transmittals, but will not be used for storage of actual submittals.

1.7.5. Schedule

The Contractor shall develop a design and construction schedule consisting of pay activities, in accordance with Section 01 32 01.00 10, PROJECT SCHEDULE, as applicable. This schedule shall be input and maintained in the QCS database either manually or by using the Standard Data Exchange Format (SDEF) (see Section 01 32 01.00 10 PROJECT SCHEDULE). The updated schedule data shall be included with each pay request submitted by the Contractor.

1.7.5.1. Import/Export of Data

QCS includes the ability to export Contractor data to the Government and to import submittal register and other Government-provided data from RMS, and schedule data using SDEF.

1.8. IMPLEMENTATION

Contractor use of QCS as described in the preceding paragraphs is mandatory. The Contractor shall ensure that sufficient resources are available to maintain its QCS database, and to provide the Government with regular database updates. QCS shall be an integral part of the Contractor's management of quality control.

1.9. DATA SUBMISSION VIA COMPUTER DISKETTE OR CD-ROM

The Government-preferred method for Contractor's submission of QCS data is by using the government's SFTP repository built into QCS export function.. Other data should be submitted using E-mail with file attachment(s). For locations where this is not feasible, the Contracting Officer may permit use of CD-ROM for data transfer. Data on CDs shall be exported using the QCS built-in export function. If used, CD-ROMs will be submitted in accordance with the following:

1.9.1. File Medium

The Contractor shall submit required data on CD-ROMs. They shall conform to industry standards used in the United States. All data shall be provided in English.

1.9.2. Disk Or Cd-Rom Labels

The Contractor shall affix a permanent exterior label to each diskette and CD-ROM submitted. The label shall indicate in English, the QCS file name, full contract number, contract name, project location, data date, name and telephone number of person responsible for the data.

1.9.3. File Names

The files will be automatically named by the QCS software. The naming convention established by the QCS software shall not be altered in any way by the Contractor.

1.10. MONTHLY COORDINATION MEETING

The Contractor shall update the QCS database each workday. At least monthly, the Contractor shall generate and submit an export file to the Government with schedule update and progress payment request. As required in Contract Clause "Payments", at least one week prior to submittal, the Contractor shall meet with the Government representative to review the planned progress payment data submission for errors and omissions.

The Contractor shall make all required corrections prior to Government acceptance of the export file and progress payment request. Payment requests accompanied by incomplete or incorrect data submittals will be returned. The Government will not process progress payments until an acceptable QCS export file is received.

1.11. NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the requirements of this specification. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification.

End of Section 01 45 01.10

**SECTION 01 45 04.00 10
CONTRACTOR QUALITY CONTROL**

1.0 GENERAL

1.1. REFERENCES

1.2. PAYMENT

2.0 PRODUCTS (NOT APPLICABLE)

3.0 EXECUTION

3.1. GENERAL REQUIREMENTS

3.2. QUALITY CONTROL PLAN

3.3. COORDINATION MEETING

3.4. QUALITY CONTROL ORGANIZATION

3.5. SUBMITTALS AND DELIVERABLES

3.6. CONTROL

3.7. TESTS

3.8. COMPLETION INSPECTION

3.9. DOCUMENTATION

3.10. NOTIFICATION OF NONCOMPLIANCE

1.0 GENERAL

1.1. REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Refer to the latest edition, as of the date of the contract solicitation.

- ASTM INTERNATIONAL (ASTM)
- ASTM D 3740 Minimum Requirements for Agencies
Engaged in the Testing and/or Inspection
of Soil and Rock as Used in Engineering
Design and Construction
- ASTM E 329 Agencies Engaged in the Testing
and/or Inspection of Materials Used in
Construction
- U.S. ARMY CORPS OF ENGINEERS (USACE)
ER 1110-1-12 Quality Management

1.2. PAYMENT

There will be no separate payment for providing and maintaining an effective Quality Control program. Include all costs associated therewith in the applicable unit prices or lump-sum prices contained in the Contract Line Item Schedule.

2.0 PRODUCTS (Not Applicable)

3.0 EXECUTION

3.1. GENERAL REQUIREMENTS

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract Clause titled "Inspection of Construction." The quality control system shall consist of plans, procedures, and organization necessary to produce an end product, which complies with the contract requirements. The system shall cover all design and construction operations, both onsite and offsite, and shall be keyed to the proposed design and construction sequence. The site project superintendent is responsible for the quality of work on the job and is subject to removal by the Contracting Officer for non-compliance with the quality requirements specified in the contract. The site project superintendent in this context shall be the highest level manager at the site, responsible for the overall site activities, including but not limited to quality and production. The site project superintendent shall maintain a physical presence at the site at all times, except as otherwise acceptable to the Contracting Officer, and shall be responsible for all construction and construction related activities at the site. Different contractors have different names for the on-site overall project supervisor. For clarification, the term "site project superintendent" refers to the Contractor's senior site representative or "on-site manager", or other similar title, as those terms are used in contract Clause 52.236-7, "Superintendence by the Contractor" and in the Division 00 Section(s) of the solicitation for this contract or task order, or elsewhere in the contract. It does not refer to a construction superintendent, unless that person is also the Contractor's permanently assigned senior site representative in charge of all on-site activities.

3.2. QUALITY CONTROL PLAN

Furnish for Government review, not later than 30 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause titled "Inspection of Construction." The plan shall identify personnel, procedures, control, instructions, tests, records, and forms to be used. The Government will consider an interim plan for the first 30 days of operation. Design and construction may begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. The Government will not permit work outside of the features of work included in an accepted interim plan to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started. Where the applicable Code issued by the International Code Council calls for an inspection by the Building Official, the Contractor shall include the inspections in the Quality Control Plan and shall perform the inspections. The Designer of Record shall develop a program for any special inspections required by the applicable International Codes and the Contractor shall perform these inspections, using qualified inspectors. Include the special inspection plan in the QC Plan.

3.2.1. Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all design and construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents subcontractors, designers of record, consultants, architect/engineers (AE), fabricators, suppliers, and purchasing agents:

3.2.1.1. A description of the quality control organization. Include a chart showing lines of authority and an acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. A CQC System Manager shall report to the project superintendent or someone higher in the contractor's organization.

3.2.1.2. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function. Also include those responsible for performing and documenting the inspections required by the International Codes and the special inspection program developed by the designer of record.

3.2.1.3. A copy of the letter to the CQC System Manager, signed by an authorized official of the firm, which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Furnish copies of these letters.

3.2.1.4. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents subcontractors, designers of record, consultants, architect engineers (AE), offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

3.2.1.5. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. Use only Government approved Laboratory facilities.

3.2.1.6. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

3.2.1.7. Procedures for tracking design and construction deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.

3.2.1.8. Reporting procedures, including proposed reporting formats.

3.2.1.9. A list of the definable features of work. A definable feature of work is a task, which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable feature under a particular section. This list will be agreed upon during the coordination meeting.

3.2.1.10. A list of all inspections required by the International Codes and the special inspection program required by the code and this contract.

3.2.2. Additional Requirements for Design Quality Control (DQC) Plan

The following additional requirements apply to the Design Quality Control (DQC) plan:

3.2.2.1. The Contractor's QCP Plan shall provide and maintain a Design Quality Control (DQC) Plan as an effective quality control program which will assure that all services required by this design-build contract are performed and provided in a manner that meets professional architectural and engineering quality standards. As a minimum, competent, independent reviewers identified in the DQC Plan shall review all documents. Use personnel who were not involved in the design effort to produce the design to perform the independent technical review (ITR). The ITR is intended as a quality control check of the design. Include, at least, but not necessarily limited to, a review of the contract requirements (the accepted contract or task order proposal and amended RFP), the basis of design, design calculations, the design configuration management documentation and check the design documents for errors, omissions, and for coordination and design integration. The ITR team is not required to examine, compare or comment concerning alternate design solutions but should concentrate on ensuring that the design meets the contract requirements. Correct errors and deficiencies in the design documents prior to submitting them to the Government.

3.2.2.2. Include in the DQC Plan the discipline-specific checklists to be used during the design and quality control of each submittal. Submit these completed checklists at each design phase as part of the project documentation.

3.2.2.3. A Design Quality Control Manager, who has the responsibility of being cognizant of and assuring that all documents on the project have been coordinated, shall implement the DQC Plan. This individual shall be a person who has verifiable engineering or architectural design experience and is a registered professional engineer or architect. Notify the Government, in writing, of the name of the individual, and the name of an alternate person assigned to the position.

3.2.2.4. Develop and maintain effective, acceptable design configuration management (DCM) procedures to control and track all revisions to the design documents after the Interim Design Submission through submission of the As-Built documents. Include the DCM plan as a subset of the DQC Plan. See Section 'Design After Award'.

3.2.3. Acceptance of Plan

Government acceptance of the Contractor's plan is required prior to the start of design and construction. Acceptance is conditional and will be predicated on satisfactory performance during the design and construction. The Government reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

3.2.4. Notification of Changes

After acceptance of the CQC Plan, notify the Government in writing of any proposed change. Proposed changes are subject to Government acceptance.

3.3. COORDINATION MEETING

After the Postaward Conference, before start of design or construction, and prior to acceptance by the Government of the CQC Plan, the Contractor and the Government shall meet and discuss the Contractor's quality control system. Submit the CQC Plan for review a minimum of 7 calendar days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, design activities, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. The Government will prepare minutes of the meeting for signature by both parties. . The minutes shall become a part of the contract file. There may be occasions when either party will call for subsequent conferences to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

3.4. QUALITY CONTROL ORGANIZATION

3.4.1. Personnel Requirements

The requirements for the CQC organization are a CQC System Manager, a Design Quality Manager, and sufficient number of additional qualified personnel to ensure contract compliance. The CQC organization shall also include personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly. The Contractor's CQC staff shall maintain a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure contract compliance. The CQC staff shall be subject to acceptance by the Contracting Officer. Provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Promptly furnish complete records of all letters, material submittals, shop drawing submittals, schedules and all other project documentation to the CQC organization. The CQC organization shall be responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Contracting Officer.

3.4.2. CQC System Manager

Identify as CQC System Manager an individual within the onsite work organization who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a graduate engineer, graduate architect, or a BA/BS graduate of an ACCE accredited construction management college program. The CQC system Manager may alternately be an engineering technician with at least 2 years of college and an ICC certification as a Commercial Building Inspector (Residential Building Inspector certification will be required for Military Family Housing projects). In addition, the CQC system manager shall have a minimum of 5 years construction experience on construction similar to this contract. The CQC System Manager shall be on the site at all times during construction and shall be employed by the prime Contractor. Assign the CQC System Manager no other duties (except may also serve as Safety and Health Officer, if qualified and if allowed by Section 00 73 00, or by Section 00 73 10 if this is a task order). Identify an alternate for the CQC System Manager in the plan to serve in the event of the System Manager's absence. The requirements for the alternate shall be the same as for the designated CQC System Manager but the alternate may have other duties in addition to serving in a temporary capacity as the acting QC manager.

3.4.3. CQC Personnel

3.4.3.1. In addition to CQC personnel specified elsewhere in the contract provide specialized CQC personnel to assist the CQC System Manager in accordance with paragraph titled Area Qualifications.

3.4.3.2. These individuals may be employees of the prime or subcontractor; be responsible to the CQC System Manager; **are not intended to be full time, but must be physically present at the construction site during work on their areas of responsibility**; have the necessary education and/or

experience in accordance with the experience matrix listed herein. These individuals may perform other duties but must be allowed sufficient time to perform their assigned quality control duties as described in the Quality Control Plan. **One person may cover more than one area, provided that they are qualified to perform QC activities for the designated areas below and provided that they have adequate time to perform their duties:**

3.4.4. Experience Matrix

3.4.4.1. Area Qualifications

3.4.4.1.1. Civil - Graduate Civil Engineer or (BA/BS) graduate in construction management with 4 years experience in the type of work being performed on this project or engineering technician with 5 yrs related experience.

3.4.4.1.2. Mechanical - Graduate Mechanical Engineer or (BA/BS) graduate in construction management with 4 yrs related experience or engineering technician with an ICC certification as a Commercial Mechanical Inspector with 5 yrs related experience.

3.4.4.1.3. Electrical - Graduate Electrical Engineer or (BA/BS) graduate in construction management with 4 yrs related experience or engineering technician with an ICC certification as a Commercial Electrical Inspector with 5 yrs related experience.

3.4.4.1.4. Structural - Graduate Structural Engineer or (BA/BS) graduate in construction management with 4 yrs related experience or person with an ICC certification as a Reinforced Concrete Special Inspector and Structural Steel and Bolting Special Inspector (as applicable to the type of construction involved) with 5 yrs related experience.

3.4.4.1.5. Plumbing - Graduate Mechanical Engineer or (BA/BS) graduate in construction management with 4 yrs related experience, or person with an ICC certification as a Commercial Plumbing Inspector with 5 yrs related experience.

3.4.4.1.6. Concrete, Pavements and Soils Materials Technician (present while performing tests) with 2 yrs experience for the appropriate area

3.4.4.1.7. Testing, Adjusting and Balancing Specialist must be a member (TAB) Personnel of AABC or an experienced technician of the firm certified by the NEBB (present while testing, adjusting, balancing).

3.4.4.1.8. Design Quality Control Manager Registered Architect or Professional Engineer (not required on the construction site)

3.4.4.1.9. Registered Fire Protection Engineer with 4 years related experience or engineering technician with 5 yrs related experience (but see requirements for Fire Protection Engineer of Record to witness final testing in Section 01 10 00, paragraph 5.10, Fire Protection).

3.4.4.1.10. QC personnel assigned to the installation of the telecommunication system or any of its components shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification. In lieu of BICSI certification, QC personnel shall have a minimum of 5 years experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products. QC personnel shall witness and certify the testing of telecommunications cabling and equipment.

3.4.5. Additional Requirement

In addition to the above experience and/or education requirements the CQC System Manager shall have completed the course entitled "Construction Quality Management for Contractors". This course is periodically offered at TBD. Inquire of the District or Division sponsoring the course for fees and other expenses involved, if any, for attendance at this course.

3.4.6. Organizational Changes

When it is necessary to make changes to the CQC staff, the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

3.5. SUBMITTALS AND DELIVERABLES

Make submittals as specified in Section 01 33 00 **SUBMITTAL PROCEDURES**. The CQC organization shall certify that all submittals and deliverables are in compliance with the contract requirements.

3.6. CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. The CQC organization shall conduct at least three phases of control for each definable feature of the construction work as follows:

3.6.1. Preparatory Phase

Perform this phase prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase shall include:

3.6.1.1. A review of each paragraph of applicable specifications, reference codes, and standards. Make a copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field at the preparatory inspection. Maintain these copies in the field, available for use by Government personnel until final acceptance of the work.

3.6.1.2. A review of the contract drawings.

3.6.1.3. A check to assure that all materials and/or equipment have been tested, submitted, and approved.

3.6.1.4. Review of provisions that have been made to provide required control inspection and testing.

3.6.1.5. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.

3.6.1.6. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

3.6.1.7. A review of the appropriate activity hazard analysis to assure safety requirements are met.

3.6.1.8. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

3.6.1.9. A check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.

3.6.1.10. Discussion of the initial control phase.

3.6.1.11. Notify the Government at least 24 hours in advance of beginning the preparatory control phase. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. Document the results of the preparatory phase actions by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

3.6.2. Initial Phase

Accomplish this phase at the beginning of a definable feature of work. Include the following actions:

3.6.2.1. Check work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.

3.6.2.2. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.

3.6.2.3. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.

3.6.2.4. Resolve all differences.

3.6.2.5. Check safety to include compliance with and upgrading of the Accident Prevention plan and activity hazard analysis. Review the activity analysis with each worker.

3.6.2.6. Notify the Government at least 24 hours in advance of beginning the initial phase. The CQC System Manager shall prepare and attach to the daily CQC report separate minutes of this phase. Indicate exact location of initial phase for future reference and comparison with follow-up phases.

3.6.2.7. Repeat the initial phase any time acceptable specified quality standards are not being met.

3.6.3. Follow-up Phase

Perform daily checks to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Conduct final follow-up checks and correct deficiencies prior to the start of additional features of work which may be affected by the deficient work. Do not build upon nor conceal non-conforming work.

3.6.4. Additional Preparatory and Initial Phases

Conduct additional preparatory and initial phases on the same definable features of work if: the quality of on-going work is unacceptable; if there are changes in the applicable CQC staff, onsite production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity; or if other problems develop.

3.7. TESTS

3.7.1. Testing Procedure

Perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements and project design documents. Upon request, furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of a Corps of Engineers approved testing laboratory, or establish an approved testing laboratory at the project

site. The Contractor may elect to use a laboratory certified and accredited by the Concrete and cement Reference Laboratory (CCRL) or by AASHTO Materials Reference Laboratory (AMRL) for testing procedures that those organizations certify. The Contractor shall perform the following activities and record and provide the following data:

3.7.1.1. Verify that testing procedures comply with contract requirements and project design documents.

3.7.1.2. Verify that facilities and testing equipment are available and comply with testing standards.

3.7.1.3. Check test instrument calibration data against certified standards.

3.7.1.4. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

3.7.1.5. Include results of all tests taken, both passing and failing tests, recorded on the CQC report for the date taken. Include specification paragraph reference, location where tests were taken, and the sequential control number identifying the test. If approved by the Contracting Officer, actual test reports may be submitted later with a reference to the test number and date taken. Provide an information copy of tests performed by an offsite or commercial test facility directly to the Contracting Officer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

3.7.2. Testing Laboratories

3.7.2.1. Capability Check

The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel shall meet criteria detailed in ASTM D 3740 and ASTM E 329.

3.7.2.2. Capability Recheck

If the selected laboratory fails the capability check, the Government will assess the Contractor a charge of \$1,375 to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the contract amount due the Contractor.

3.7.3. Onsite Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

3.7.4. Furnishing or Transportation of Samples for Government Quality Assurance Testing

The Contractor is responsible for costs incidental to the transportation of samples or materials. Deliver samples of materials for test verification and acceptance testing by the Government to the Corps of Engineers Laboratory, f.o.b., at the following address:

- For delivery by mail:
U.S. Army Engineer Research and Development Center
Geotechnical & Structures Laboratory Material Testing Center (GS-E)
3909 Halls Ferry Road

- Vicksburg, MS 39180-6199
For other deliveries:
U.S. Army Engineer Research and Development Center
Geotechnical & Structures Laboratory Material Testing Center (GS-E)
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

The area or resident office will coordinate, exact delivery location, and dates for each specific test.

3.8. COMPLETION INSPECTION

3.8.1. Punch-Out Inspection

Near the end of the work, or any increment of the work established by a time stated in the SPECIAL CONTRACT REQUIREMENTS Clause, "Commencement, Prosecution, and Completion of Work", or by the specifications, the CQC Manager shall conduct an inspection of the work. Prepare a punch list of items which do not conform to the approved drawings and specifications and include in the CQC documentation, as required by paragraph DOCUMENTATION. The list of deficiencies shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the Government that the facility is ready for the Government Pre-Final inspection.

3.8.2. Pre-Final Inspection

As soon as practicable after the notification above, the Government will perform the pre-final inspection to verify that the facility is complete and ready to be occupied. A Government Pre-Final Punch List may be developed as a result of this inspection. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected before notifying the Government, so that a Final inspection with the customer can be scheduled. Correct any items noted on the Pre-Final inspection in a timely manner. Accomplish these inspections and any deficiency corrections required by this paragraph within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate completion dates.

3.8.3. Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Representative shall attend the final acceptance inspection. Additional Government personnel including, but not limited to, those from Base/Post Civil Facility Engineer user groups and major commands may also attend. The Government will formally schedule the final acceptance inspection based upon results of the Pre-Final inspection. Provide notice to the Government at least 14 days prior to the final acceptance inspection and include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the contract clause titled "Inspection of Construction".

3.9. DOCUMENTATION

3.9.1. Maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers using

government-provided software, QCS (see Section 01 45 01.10). The report includes, as a minimum, the following information:

3.9.1.1. Contractor/subcontractor and their area of responsibility.

3.9.1.2. Operating plant/equipment with hours worked, idle, or down for repair.

3.9.1.3. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.

3.9.1.4. Test and/or control activities performed with results and references to specifications/drawings requirements. Identify the applicable control phase (Preparatory, Initial, Follow-up). List deficiencies noted, along with corrective action.

3.9.1.5. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.

3.9.1.6. Submittals and deliverables reviewed, with contract reference, by whom, and action taken.

3.9.1.7. Offsite surveillance activities, including actions taken.

3.9.1.8. Job safety evaluations stating what was checked, results, and instructions or corrective actions.

3.9.1.9. Instructions given/received and conflicts in plans and/or specifications.

3.9.1.10. Provide documentation of design quality control activities. For independent design reviews, provide, as a minimum, identity of the ITR team, the ITR review comments, responses and the record of resolution of the comments.

3.9.2. Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. Furnish the original and one copy of these records in report form to the Government daily within 24 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, submit one report for every 7 days of no work and on the last day of a no work period. Account for all calendar days throughout the life of the contract. The first report following a day of no work shall be for that day only. The CQC System Manager shall sign and date reports. The report shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel. The Contractor may submit these forms electronically, in lieu of hard copy.

3.10. NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

End of Section 01 45 04.00 10

**SECTION 01 50 02
TEMPORARY CONSTRUCTION FACILITIES**

1.0 OVERVIEW

1.1. GENERAL REQUIREMENTS

1.2. AVAILABILITY AND USE OF UTILITY SERVICES

1.3. BULLETIN BOARD, PROJECT SIGN, AND PROJECT SAFETY SIGN

1.4. PROTECTION AND MAINTENANCE OF TRAFFIC

1.5. MAINTENANCE OF CONSTRUCTION SITE

1.6. GOVERNMENT FIELD OFFICE

1.0 OVERVIEW

1.1. GENERAL REQUIREMENTS

1.1.1. Site Plan

Prepare a site plan indicating the proposed location and dimensions of any area to be fenced and used by the Contractor, the number of trailers to be used, avenues of ingress/egress to the fenced area and details of the fence installation. Identify any areas which may have to be graveled to prevent the tracking of mud. Also indicate if the use of a supplemental or other staging area is desired.

1.2. AVAILABILITY AND USE OF UTILITY SERVICES

1.2.1. See Section 00 72 00, Contract Clauses and Section 00 73 00, Special Contract Requirements, for Utility Availability requirements.

1.2.2. Sanitation

Provide and maintain within the construction area minimum field-type sanitary facilities approved by the Contracting Officer. Government toilet facilities will not be available to Contractor's personnel.

1.2.3. Telephone

Make arrangements and pay all costs for desired telephone facilities.

1.3. BULLETIN BOARD, PROJECT SIGN, AND PROJECT SAFETY SIGN

1.3.1. Bulletin Board

Immediately upon beginning of onsite work, provide a weatherproof glass-covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract, Wage Rate Information poster, and other information approved by the Contracting Officer. Locate the bulletin board at the project site in a conspicuous place easily accessible to all employees, as approved by the Contracting Officer. Display legible copies of the aforementioned data until work is completed. Remove the bulletin board from the site upon completion of the project.

1.3.2. Project and Safety Signs

Erect a project sign and a site safety sign with informational details as provided by the Government at the Post award conference, within 15 days prior to any work activity on project site. Update the safety sign data daily, with light colored metallic or non-metallic numerals. Remove the signs from the site upon completion of the project. Engineer Pamphlet EP 310-1-6a contains the standardized layout and construction details for the signs. It can be found through a GOOGLE Search or try the US Army Corps of Engineers Techinfo Website at <http://www.hnd.usace.army.mil/techinfo/>. Click on Publications then go to Engineer Pamphlets and select EP 310-1-6a.

1.4. PROTECTION AND MAINTENANCE OF TRAFFIC

Provide access and temporary relocated roads as necessary to maintain traffic. Maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Take measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment and the work, and the erection and maintenance of adequate warning, danger, and direction signs, as required by the State and local authorities having jurisdiction. Protect the traveling public from damage to person and property.

The Contractor's traffic on roads selected for hauling material to and from the site shall interfere as little as possible with public traffic. Investigate the adequacy of existing roads and the allowable load limit on these roads. Repair any damage to roads caused by construction operations.

1.4.1. Haul Roads

The Contractor shall, at its own expense, construct access and haul roads necessary for proper prosecution of the work under this contract. Construct haul roads with suitable grades and widths. Avoid sharp curves, blind corners, and dangerous cross traffic. Provide necessary lighting, signs, barricades, and distinctive markings for the safe movement of traffic. The method of dust control, although optional, shall be adequate to ensure safe operation at all times. Location, grade, width, and alignment of construction and hauling roads shall be subject to approval by the Contracting Officer. Provide adequate lighting to assure full and clear visibility for full width of haul road and work areas during any night work operations. Remove haul roads designated by the Contracting Officer upon completion of the work and restore those areas.

1.4.2. Barricades

Erect and maintain temporary barricades to limit public access to hazardous areas. Barricades shall be required whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic. Securely place barricades clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

1.5. MAINTENANCE OF CONSTRUCTION SITE

Mow grass and vegetation located within the boundaries of the construction site for the duration of the project, from NTP to contract completion. Edge or neatly trim grass and vegetation along fences, buildings, under trailers, and in areas not accessible to mowers from NTP to contract completion.

1.6. GOVERNMENT FIELD OFFICE

1.6.1. Resident Engineer's Office

Provide the Government Resident Engineer with an office, approximately 300 square feet in floor area, co-located on the project site with the Contractor's office and providing space heat, air conditioning, electric light and power, power and communications outlets and toilet facilities consisting of at least one lavatory and at least one water closet complete with connections to water and sewer mains. Provide a mail slot in the door or a lockable mail box mounted on the surface of the door. Provide outlets for 1 government phones and same number of LAN connections for Government computers. Coordinate with the Resident Engineer for locations. Provide a conference room with space large enough for 0 personnel to hold meetings. Provide a minimum of two outlets per government work station and at least one outlet per 10 feet of wall space for other government equipment. Provide at least twice weekly janitorial service. Remove the office facilities upon completion of the work and restore those areas. Connect and disconnect utilities in accordance with local codes and to the satisfaction of the Contracting Officer.

1.6.2. Trailer-Type Mobile Office

The Contractor may, at its option, furnish and maintain a trailer-type mobile office acceptable to the Contracting Officer and providing as a minimum the facilities specified above. Securely anchor the trailer to the ground at all four corners to guard against movement during high winds, per EM 385-1-1.

End of Section 01 50 02

**SECTION 01 57 20.00 10
ENVIRONMENTAL PROTECTION**

1.0 GENERAL REQUIREMENTS

- 1.1. SUBCONTRACTORS
- 1.2. ENVIRONMENTAL PROTECTION PLAN
- 1.3. PROTECTION FEATURES
- 1.4. ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS
- 1.5. NOTIFICATION

2.0 PRODUCTS (NOT USED)

3.0 EXECUTION

- 3.1. LAND RESOURCES
- 3.2. WATER RESOURCES
- 3.3. AIR RESOURCES
- 3.4. CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL
- 3.5. RECYCLING AND WASTE MINIMIZATION
- 3.6. HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES
- 3.7. BIOLOGICAL RESOURCES
- 3.8. INTEGRATED PEST MANAGEMENT
- 3.9. PREVIOUSLY USED EQUIPMENT
- 3.10. MILITARY MUNITIONS
- 3.11. TRAINING OF CONTRACTOR PERSONNEL
- 3.12. POST CONSTRUCTION CLEANUP

1.0 GENERAL REQUIREMENTS

Minimize environmental pollution and damage that may occur as the result of construction operations. Protect the environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire duration of this contract. Comply with all applicable environmental Federal, State, and local laws and regulations. The Contractor shall be responsible for any delays resulting from failure to comply with environmental laws and regulations

1.1. SUBCONTRACTORS

Ensure compliance with this section by subcontractors.

1.2. ENVIRONMENTAL PROTECTION PLAN

1.2.1. The purpose of the Environmental Protection Plan is to present a comprehensive overview of known or potential environmental issues which the Contractor must address during construction. Define issues of concern within the Environmental Protection Plan as outlined in this section. Address each topic in the plan at a level of detail commensurate with the environmental issue and required construction task(s). Identify and discuss topics or issues which are not identified in this section, but which the Contractor considers necessary, after those items formally identified in this section. Prior to commencing construction activities or delivery of materials to the site, submit the Plan for review and Government approval. The Contractor shall meet with the Government prior to implementation of the Environmental Protection Plan, for the purpose of discussing the implementation of the initial plan; possible subsequent additions and revisions to the plan including any reporting requirements; and methods for administration of the Contractor's Environmental Plans. Maintain and keep the Environmental Protection Plan current onsite.

1.2.2. Compliance

No requirement in this Section shall be construed as relieving the Contractor of any applicable Federal, State, and local environmental protection laws and regulations. During Construction, the Contractor shall be responsible for identifying, implementing, and submitting for approval any additional requirements to be included in the Environmental Protection Plan.

1.2.3. Contents

The plan shall include, but shall not be limited to, the following:

1.2.3.1. Name(s) of person(s) within the Contractor's organization who is(are) responsible for ensuring adherence to the Environmental Protection Plan.

1.2.3.2. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site, if applicable

1.2.3.3. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel

1.2.3.4. Description of the Contractor's environmental protection personnel training program

1.2.3.5. An erosion and sediment control plan which identifies the type and location of the erosion and sediment controls to be provided. Include monitoring and reporting requirements to assure that the control measures are in compliance with the erosion and sediment control plan, Federal, State, and local laws and regulations. A Storm Water Pollution Prevention Plan (SWPPP) may be substituted for this plan.

1.2.3.6. Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on the site

1.2.3.7. Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Include measures to minimize the amount of mud transported onto paved public roads by vehicles or runoff.

1.2.3.8. Work area plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Include measures for marking the limits of use areas including methods for protection of features to be preserved within authorized work areas.

1.2.3.9. Drawing showing the location of on-installation borrow areas.

1.2.3.10. A spill control plan shall include the procedures, instructions, and reports to be used in the event of an unforeseen spill of a substance regulated by 40 CFR 68, 40 CFR 302, 40 CFR 355, and/or regulated under State or Local laws and regulations. The spill control plan supplements the requirements of EM 385-1-1. This plan shall include as a minimum:

(a) The name of the individual who will report any spills or hazardous substance releases and who will follow up with complete documentation. This individual shall immediately notify the Government and the local Fire Department in addition to the legally required Federal, State, and local reporting channels (including the National Response Center 1-800-424-8802) if a reportable quantity is released to the environment. The plan shall contain a list of the required reporting channels and telephone numbers.

(b) The name and qualifications of the individual who will be responsible for implementing and supervising the containment and cleanup

(c) Training requirements for Contractor's personnel and methods of accomplishing the training

(d) A list of materials and equipment to be immediately available at the job site, tailored to cleanup work of the potential hazard(s) identified.

(e) The names and locations of suppliers of containment materials and locations of additional fuel oil recovery, cleanup, restoration, and material-placement equipment available in case of an unforeseen spill emergency

(f) The methods and procedures to be used for expeditious contaminant cleanup

1.2.3.11. A solid waste management plan identifying waste minimization, collection, and disposals methods, waste streams (type and quantity), and locations for solid waste diversion/disposal including clearing debris and C&D waste that is diverted (salvaged, reused, or recycled). Detail the contractor's actions to comply with, and to participate in, Federal, state, regional, local government, and installation sponsored recycling programs to reduce the volume of solid waste at the source. Identify any subcontractors responsible for the transportation, salvage and disposal of solid waste. Submit licenses or permits for solid waste disposal sites that are not a commercial operating facility. Attach evidence of the facility's ability to accept the solid waste to this plan. A construction and demolition waste management plan, similar to the plan specified in the UFGS 01 74 19 (formerly 01572) may be used as the non-hazardous solid waste management plan. Provide a Non-Hazardous Solid Waste Diversion Report. Submit the report on the first working day after the first quarter that non-hazardous solid waste has been disposed and/or diverted and each quarter thereafter (e.g. the first working day of January, April, July, and October) until the end of the project. Additionally, a summary report, with all data fields, is required at the end of the project. The report shall indicate the total type and amount of waste generated, total type and amount of waste diverted, type and amount of waste sent to waste-to-energy facility and alternative daily cover, in tons along with the percent that was diverted. Maintain, track and report construction and demolition waste data in a manner such that the installation can enter the data into the Army SWAR database, which separates data by type of material. A cumulative report in LEED Letter Template format may be used but must be modified to include the date disposed of/diverted and include

the above stated diversion data. NOTE: The Solid Waste Diversion Reports are separate documentation than the LEED documentation.

1.2.3.12. DELETED.

1.2.3.13. An air pollution control plan detailing provisions to assure that dust, debris, materials, trash, etc., do not become air borne and travel off the project site.

1.2.3.14. A contaminant prevention plan that: identifies potentially hazardous substances to be used on the job site; identifies the intended actions to prevent introduction of such materials into the air, water, or ground; and details provisions for compliance with Federal, State, and local laws and regulations for storage and handling of these materials. In accordance with EM 385-1-1, include a copy of the Material Safety Data Sheets (MSDS) and the maximum quantity of each hazardous material to be on site at any given time in the contaminant prevention plan. Update the plan as new hazardous materials are brought on site or removed from the site. Reference this plan in the storm water pollution prevention plan, as applicable.

1.2.3.15. A waste water management plan that identifies the methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines. If a settling/retention pond is required, include the design of the pond including drawings, removal plan, and testing requirements for possible pollutants. If land application will be the method of disposal for the waste water, include a sketch showing the location for land application along with a description of the pretreatment methods to be implemented and any required permits. If surface discharge will be the method of disposal, include a copy of the permit and associated documents as an attachment prior to discharging the waste water. If disposal is to a sanitary sewer, include documentation that the waste water treatment plant Operator has approved the flow rate, volume, and type of discharge.

1.2.3.16. A historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on the project site: and/or identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be onsite or in the area are discovered during construction. Include methods to assure the protection of known or discovered resources and shall identify lines of communication between Contractor personnel and the Government.

1.2.3.17. A pesticide treatment plan, updated, as information becomes available. Include: sequence of treatment, dates, times, locations, pesticide trade name, EPA registration numbers, authorized uses, chemical composition, formulation, original and applied concentration, application rates of active ingredient (i.e. pounds of active ingredient applied), equipment used for application and calibration of equipment. The Contractor is responsible for Federal, State, Regional and Local pest management record keeping and reporting requirements as well as any additional Installation specific requirements. Follow AR 200-1, Chapter 5, Pest Management, Section 5-4, "Program Requirements" for data required to be reported to the Installation.

1.3. PROTECTION FEATURES

This paragraph supplements the Contract Clause PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES AND IMPROVEMENTS. Prior to start of any onsite construction activities, the Contractor and the Government shall make a joint condition survey. Immediately following the survey, the Contractor shall prepare a brief report including a plan describing the features requiring protection under the provisions of the Contract Clauses, which are not specifically identified on the drawings as environmental features requiring protection along with the condition of trees, shrubs and grassed areas immediately adjacent to the site of work and adjacent to the Contractor's assigned storage area and access route(s), as applicable. Both the Contractor and the Government will

sign this survey, upon mutual agreement as to its accuracy and completeness. The Contractor develop a plan that depicts how it will protect those environmental features included in the survey report and any indicated on the drawings, regardless of interference which their preservation may cause to the Contractor's work under the contract.

1.4. ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

Any deviations, requested by the Contractor, from the drawings, plans and specifications which may have an environmental impact will be subject to approval by the Government and may require an extended review, processing, and approval time. The Government reserves the right to disapprove alternate methods, even if they are more cost effective, if the Government determines that the proposed alternate method will have an adverse environmental impact.

1.5. NOTIFICATION

The Government will notify the Contractor in writing of any observed noncompliance with Federal, State or local environmental laws or regulations, permits, and other elements of the Contractor's Environmental Protection plan. The Contractor shall, after receipt of such notice, inform the Government of the proposed corrective action and take such action when approved by the Government. The Government may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the Contractor for any such suspensions. This is in addition to any other actions the Government may take under the contract, or in accordance with the Federal Acquisition Regulation or Federal Law.

2.0 PRODUCTS (NOT USED)

3.0 EXECUTION

3.1. LAND RESOURCES

Confine all activities to areas defined by the drawings and specifications. Prior to the beginning of any construction, identify any land resources to be preserved within the work area. Except in areas indicated on the drawings or specified to be cleared, do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval. Do not attach or fasten any ropes, cables, or guys to any trees for anchorage unless specifically authorized. Provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs. Remove all stone, soil, or other materials displaced into uncleared areas..

3.1.1. Work Area Limits

Prior to commencing construction activities, mark the areas that need not be disturbed under this contract. Mark or fence isolated areas within the general work area which are not to be disturbed. Protect monuments and markers before construction operations commence. Where construction operations are to be conducted during darkness, any markers shall be visible in the dark. Personnel shall be knowledgeable of the purpose for marking and/or protecting particular objects.

3.1.2. Landscape

Clearly identify trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved by marking, fencing, or wrapping with boards, or any other approved techniques. Restore landscape features damaged or destroyed during construction operations outside the limits of the approved work area.

3.1.3. Erosion and Sediment Controls

Provide erosion and sediment control measures in accordance with Federal, State, and local laws and regulations. Coordinate with approving authorities (federal, state, etc.) for specific requirements to be included in the plan. The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's construction activities. Keep the area of bare soil exposed at any one time by construction operations to a minimum necessary. Construct or install temporary and permanent erosion and sediment control best management practices (BMPs). BMPs may include, but not be limited to, vegetation cover, stream bank stabilization, slope stabilization, silt fences, construction of terraces, interceptor channels, sediment traps, inlet and outfall protection, diversion channels, and sedimentation basins. Remove any temporary measures after the area has been stabilized.

3.1.4. Contractor Facilities and Work Areas

Place field offices, staging areas, stockpile storage, and temporary buildings in areas designated on the drawings or as directed by the Government. Make only approved temporary movement or relocation of Contractor facilities. Provide erosion and sediment controls for on-site borrow and spoil areas to prevent sediment from entering nearby waters. Control temporary excavation and embankments for plant and/or work areas to protect adjacent areas.

3.2. WATER RESOURCES

Monitor construction activities to prevent pollution of surface and ground waters. Do not apply toxic or hazardous chemicals to soil or vegetation unless otherwise indicated. Monitor all water areas affected by construction activities. For construction activities immediately adjacent to impaired surface waters, the Contractor shall be capable of quantifying sediment or pollutant loading to that surface water when required by state or federally issued Clean Water Act permits.

3.2.1. Stream Crossings

Stream crossings shall allow movement of materials or equipment without violating water pollution control standards of the Federal, State, and local governments or impede state-designated flows.

3.2.2. Wetlands

Do not enter, disturb, destroy, or allow discharge of contaminants into any wetlands.

3.3. AIR RESOURCES

Comply with all Federal and State air emission and performance laws and standards for equipment operation, activities, or processes.

3.3.1. Particulates

Control dust particles; aerosols and gaseous by-products from construction activities; and processing and preparation of materials, such as from asphaltic batch plants, including weekends, holidays and hours when work is not in progress. Maintain excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and other work areas within or outside the project boundaries free from particulates which would cause the Federal, State, and local air pollution standards to be exceeded or which would cause a hazard or a nuisance. Sprinkling, chemical treatment of an approved type, baghouse, scrubbers, electrostatic precipitators or other methods are permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated to keep the disturbed area damp at all times. Provide sufficient, competent equipment available to accomplish these tasks. Perform particulate control as the work proceeds and whenever a particulate nuisance or hazard occurs. Comply with all State and local visibility regulations.

3.3.2. Odors

Control odors from construction activities at all times. Odors shall not cause a health hazard and shall be in compliance with State regulations and/or local ordinances.

3.3.3. Sound Intrusions

Keep construction activities under surveillance and control to minimize environment damage by noise. Comply with the provisions of the state and Installation rules.

3.3.4. Burning

Burning is not allowed on the project site unless specified in other sections of the specifications or by written authorization. Specific times, locations, and manners of burning shall be subject to approval.

3.4. CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL

Disposal of wastes shall be as directed below, unless otherwise specified in other sections and/or shown on the drawings.

3.4.1. Solid Wastes

Place solid wastes (excluding clearing debris) in containers which are emptied on a regular schedule. Conduct handling, storage, and disposal to prevent contamination. Employ segregation measures so that no hazardous or toxic waste will become co-mingled with solid waste. Transport solid waste off Government property and dispose of it in compliance with Federal, State, and local requirements for solid waste disposal. The minimum acceptable off-site solid waste disposal option is a Subtitle D RCRA permitted landfill. Verify that the selected transporters and disposal facilities have the necessary permits and licenses to operate. Comply with Federal, State, and local laws and regulations pertaining to the use of landfill areas.

3.4.2. Chemicals and Chemical Wastes

Dispense chemicals, ensuring no spillage to the ground or water. Perform and document periodic inspections of dispensing areas to identify leakage and initiate corrective action. The Government may periodically review this documentation. Collect chemical waste in corrosion resistant, compatible containers. Monitor and remove collection drums to a staging or storage area when contents are within 6 inches of the top. Classify, manage, store, and dispose of wastes in accordance with Federal, State, and local laws and regulations.

3.4.3. Contractor Generated Hazardous Wastes/Excess Hazardous Materials

Hazardous wastes are defined in 40 CFR 261, or are as defined by applicable state and local regulations. Hazardous materials are defined in 49 CFR 171 - 178. At a minimum, manage and store hazardous waste in compliance with 40 CFR 262. Take sufficient measures to prevent spillage of hazardous and toxic materials during dispensing. Segregate hazardous waste from other materials and wastes; protect it from the weather by placing it in a safe covered location and take precautionary measures, such as berming or other appropriate measures, against accidental spillage. Store, describe, package, label, mark, and placard hazardous waste and hazardous material in accordance with 49 CFR 171 - 178, state, and local laws and regulations. Transport Contractor generated hazardous waste off Government property in accordance with the Environmental Protection Agency and the Department of Transportation laws and regulations. Dispose of hazardous waste in compliance with Federal, State and local laws and regulations. Immediately report spills of hazardous or toxic materials to the Government and the Facility Environmental Office. Contractor will be responsible for cleanup and cleanup costs due to spills.

Contractor is responsible for the disposition of Contractor generated hazardous waste and excess hazardous materials.

3.4.4. Fuel and Lubricants

Conduct storage, fueling and lubrication of equipment and motor vehicles in a manner that affords the maximum protection against spill and evaporation. Manage and store fuel, lubricants and oil in accordance with all Federal, State, Regional, and local laws and regulations.

3.5. RECYCLING AND WASTE MINIMIZATION

Participate in State and local government sponsored recycling programs. The Contractor is further encouraged to minimize solid waste generation throughout the duration of the project. Line and berm fueling areas and establish storm water control structures at discharge points for site run-off. Keep a liquid containment clean-up kit available at the fueling area.

3.6. HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

Existing historical, archaeological, and cultural resources within the Contractor's work area are shown on the drawings. Protect and preserve these resources during the life of the Contract. Temporarily suspend all activities that may damage or alter such resources, if any previously unidentified or unanticipated historical, archaeological, and cultural resources are discovered or found during excavation or other construction activities. Resources covered by this paragraph include but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rock or coral alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such discovery or find, notify the Government so that the appropriate authorities may be notified and a determination made as to their significance and what, if any, special disposition of the finds should be made. Cease all activities that may result in impact to or the destruction of these resources. Secure the area and prevent employees or other persons from trespassing on, removing, or otherwise disturbing such resources.

3.7. BIOLOGICAL RESOURCES

Minimize interference with, disturbance to, and damage to fish, wildlife, and plants, including their habitat. Protect threatened and endangered animal and plant species including their habitat in accordance with Federal, State, Regional, and local laws and regulations.

3.8. INTEGRATED PEST MANAGEMENT

Coordinate, through the Government, with the Installation Pest Management Coordinator (IPMC) at the earliest possible time prior to pesticide application, in order to minimize impacts to existing fauna and flora. Discuss integrated pest management strategies with the IPMC and receive concurrence from the IPMC, through the COR, prior to the application of any pesticide associated with these specifications. Give IPMC personnel the opportunity to be present at all meetings concerning treatment measures for pest or disease control and during application of the pesticide. The use and management of pesticides are regulated under 40 CFR 152 - 186.

3.8.1. Pesticide Delivery and Storage

Deliver pesticides, approved for use on the Installation, to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses.

3.8.2. Qualifications

Use the services of a subcontractor for pesticide application whose principal business is pest control. The subcontractor shall be licensed and certified in the state where the work is to be performed.

3.8.3. Pesticide Handling Requirements

Formulate, treat with, and dispose of pesticides and associated containers in accordance with label directions.

3.8.4. Application

A state certified pesticide applicator shall apply pesticides in accordance with EPA label restrictions and recommendations.

3.9. PREVIOUSLY USED EQUIPMENT

Clean all previously used construction equipment prior to bringing it onto the project site. Ensure that the equipment is free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds. Consult with the USDA jurisdictional office for additional cleaning requirements.

3.10. MILITARY MUNITIONS

Immediately stop work in that area and immediately inform the Government, in the event military munitions, as defined in 40 CFR 260, are discovered or uncovered.

3.11. TRAINING OF CONTRACTOR PERSONNEL

Train personnel in all phases of environmental protection and pollution control. Conduct environmental protection/pollution control meetings for all Contractor personnel prior to commencing construction activities. Conduct additional meetings for new personnel and when site conditions change. The training and meeting agenda shall include methods of detecting and avoiding pollution; familiarization with statutory and contractual pollution standards; installation and care of devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental protection/pollution control; anticipated hazardous or toxic chemicals or wastes, and other regulated contaminants; recognition and protection of archaeological sites, artifacts, wetlands, and endangered species and their habitat that are known to be in the area.

3.12. POST CONSTRUCTION CLEANUP

Clean up all areas used for construction in accordance with Contract Clause: "Cleaning Up". Unless otherwise instructed in writing, obliterate all signs of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. Grade, fill and seed the entire disturbed area, unless otherwise indicated.

**SECTION 01 62 35
RECYCLED/RECOVERED MATERIAL**

1.0 GENERAL

1.1. REFERENCES

1.2. OBJECTIVES

1.3. EPA DESIGNATED ITEMS INCORPORATED IN THE WORK

1.4. EPA PROPOSED ITEMS INCORPORATED IN THE WORK

1.5. EPA LISTED ITEMS USED IN CONDUCT OF THE WORK BUT NOT INCORPORATED IN THE WORK

1.0 GENERAL

1.1. REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

- U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
- 40 CFR 247 Comprehensive Procurement Guideline for Products Containing Recovered Materials

1.2. OBJECTIVES

Government procurement policy is to acquire, in a cost effective manner, items containing the highest percentage of recycled and recovered materials practicable consistent with maintaining a satisfactory level of competition without adversely affecting performance requirements or exposing suppliers' employees to undue hazards from the recovered materials. The Environmental Protection Agency (EPA) has designated certain items which must contain a specified percent range of recovered or recycled materials. The Contractor shall make all reasonable efforts to use recycled and recovered materials in providing the EPA designated products and in otherwise utilizing recycled and recovered materials in the execution of the work.

1.3. EPA DESIGNATED ITEMS INCORPORATED IN THE WORK

Materials that have been designated by EPA as being products which are or can be made with recovered or recycled materials, when incorporated into the work under this contract, shall contain at least the minimum percentage of recycled or recovered materials indicated by EPA unless adequate justification (non-availability) for non-use is provided. When a designated item is specified as an option to a non-designated item, the designated item requirements apply only if the designated item is used in the work.

1.4. EPA PROPOSED ITEMS INCORPORATED IN THE WORK

Products other than those designated by EPA are still being researched and are being considered for future Comprehensive Procurement Guideline (CPG) designation. It is recommended that these items, when incorporated in the work under this contract, contain the highest practicable percentage of recycled or recovered materials, provided specified requirements are also met.

1.5. EPA LISTED ITEMS USED IN CONDUCT OF THE WORK BUT NOT INCORPORATED IN THE WORK

There are many products listed in 40 CFR 247 which have been designated or proposed by EPA to include recycled or recovered materials that may be use by the Contractor in performing the work but will not be incorporated into the work. These products include office products, temporary traffic control products, and pallets. It is recommended that these non-construction products, when used in the conduct of the work, contain the highest practicable percentage of recycled or recovered materials and that these products be recycled when no longer needed.

End of Section 01 62 35

**SECTION 01 78 02.00 10
CLOSEOUT SUBMITTALS**

1.0 OVERVIEW

1.1. SUBMITTALS

1.2. PROJECT RECORD DOCUMENTS

1.3. EQUIPMENT DATA

1.4. CONSTRUCTION WARRANTY MANAGEMENT

1.5. MECHANICAL TESTING, ADJUSTING, BALANCING, AND COMMISSIONING

1.6. OPERATION AND MAINTENANCE MANUALS

1.7. FIELD TRAINING

1.8. PRICING OF CONTRACTOR-FURNISHED AND INSTALLED PROPERTY AND
GOVERNMENT-FURNISHED CONTRACTOR-INSTALLED PROPERTY

1.9. LEED REVIEW MEETINGS

1.10. RED ZONE MEETING

1.11. FINAL CLEANING

1.12. INTERIM FORM DD1354 "TRANSFER AND ACCEPTANCE OF MILITARY REAL PROPERTY

EXHIBIT 1 SAMPLE RED ZONE MEETING CHECKLIST

1.0 OVERVIEW

1.1. SUBMITTALS

Government approval is required for any submittals with a "G" designation; submittals not having a "G" designation are for Designer of Record approval or for information only. Submit the following in accordance with Section 01 33 00 submittals:

SD-02 Shop Drawings

- As-Built Drawings - G
 - Drawings showing final as-built conditions of the project. Provide electronic drawing files as specified in Section 01 33 16, 3 sets of blue-line prints and one set of the approved working as-built drawings.

SD-03 Product Data

- As-Built Record of Equipment and Materials
 - Two copies of the record listing the as-built materials and equipment incorporated into the construction of the project.
- Construction Warranty Management Plan
 - Three sets of the construction warranty management plan containing information relevant to the warranty of materials and equipment incorporated into the construction project, including the starting date of warranty of construction. Furnish with each warranty the name, address, and telephone number of each of the guarantor's representatives nearest to the project location.
- Warranty Tags
 - Two record copies of the warranty tags showing the layout and design.
- Final Cleaning
 - Two copies of the listing of completed final clean-up items.

1.2. PROJECT RECORD DOCUMENTS

1.2.1. As-Built Drawings – G

An as-built drawing is a construction drawing revised to reflect the final as-built conditions of the project as a result of modifications and corrections to the project design required during construction. The final as-built drawings shall not have the appearance of marked up drawings, but that of professionally prepared drawings as if they were the "as designed" drawings.

1.2.2. Maintenance of As-Built Drawings

1.2.2.1. The Configuration Management Plan shall describe how the Contractor will maintain up-to-date drawings, how it will control and designate revisions to the drawings and specifications (In accordance with Special Contract Requirement: ***Deviating from the Accepted Design*** and Section 01 33 16: ***Design after Award***, the Designer of Record's approval is necessary for any revisions to the accepted design).

1.2.2.2. Make timely updates, carefully maintaining a record set of working as-built drawings at the job site, marked in red, of all changes and corrections from the construction drawings. Enter changes and corrections on drawings promptly to reflect "Current Construction". Perform this update no less frequently

than weekly for the blue line drawings and update no less frequently than quarterly for the CADD/CAD and BIM files, which were prepared previously in accordance with Section 01 33 16. Include a confirmation that the as-builts are up to date with the submission of the monthly project schedule.

1.2.2.3. If the DB Contractor fails to maintain the as-built drawings as required herein, the Government will retain from the monthly progress payment, an amount representing the estimated monthly cost of maintaining the as-built drawings. Final payment with respect to separately priced facilities or the contract as a whole will be withheld until the Contractor submits acceptable as-built drawings and the Government approves them.

1.2.2.4. The marked-up set of drawings shall reflect any changes, alterations, adjustments or modifications. Changes must be reflected on all sheets affected by the change. Changes shall include marking the drawings to reflect structural details, foundation layouts, equipment sizes, and other extensions of design.

1.2.2.5. Typically, room numbers shown on the drawings are selected for design convenience and do not represent the actual numbers intended for use by the end user. Final as-built drawings shall reflect actual room numbers adopted by the end user.

1.2.2.6. If there is no separate contract line item (CLIN) for as-built drawings, the Government will withhold the amount of \$35,000, or 1% of the present construction value, whichever is the greater, until the final as-built drawing submittal has been approved by the Government.

1.2.3. Underground Utilities

The drawings shall indicate, in addition to all changes and corrections, the actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, the as-built drawings shall show, by offset dimensions to two permanently fixed surface features, the end of each run including each change in direction. Locate Valves, splice boxes and similar appurtenances by dimensioning along the utility run from a reference point. Record average elevation of the top of each run or underground structure..

1.2.4. Partial Occupancy

For projects where portions of construction are to be occupied or activated before overall project completion, including portions of utility systems, supply as-built drawings for those portions of the facility being occupied or activated at the time the facility is occupied or activated. Show this same as-built information previously furnished on the final set of as-built drawings.

1.2.5. As-Built Conditions That are Different From the construction Drawings

Accurately reflect all as-built conditions that are different, such as dimensions, road alignments and grades, and drainage and elevations, from the construction drawings on each drawing. If the as-built condition is accurately reflected on a shop drawing, then furnish that shop drawing in CADD format. Reference the final as-built construction drawing the shop drawing file that includes the as-built information. In turn, the shop drawing shall reference the applicable construction as-built drawing. Delete any options shown on drawings and not selected clearly reflect options selected on final as-built drawings.

1.2.6. Additional As-Built Information that Exceeds the Detail Shown on the construction Drawings:

These as-built conditions include those that reflect structural details, foundation layouts, equipment, sizes, mechanical and electrical room layouts and other extensions of design, that were not shown in the project design documents because the exact details were not known until after the time of approved shop

drawings. It is recognized that these shop drawing submittals (revised showing as-built conditions) will serve as the as-built record without actual incorporation into the construction drawings, piping, and equipment drawings. Include locations of all explorations, logs of all explorations, and results of all laboratory testing, including those provided by the Government. Furnish all such shop drawings in CADD /CADformat. Include fire protection details, such as wiring, performed for the design of the project.

1.2.7. Final As-Built Drawings

Submit final as-built CADD/CAD and BIM Model(s) and Facility Data files at the time of Beneficial Occupancy of the project or at a designated phase of the project. In the event the Contractor accomplishes additional work after this submittal, which changes the as-built conditions, submit a new DVD with all drawing sheets and three blue-line copies of affected sheets which depict additional changes.

1.2.8. Title Blocks

In accordance with the configuration management plan, clearly mark title blocks to indicate final as-built drawings.

1.2.9. Other As-Built Documents

Provide scans of all other documents such as design analysis, catalog cuts, certification documents that are not available in native electronic format in an organized manner in Adobe.pdf format.

1.2.9.1. LEED Documentation

Update LEED documentation on at least a monthly basis and have it available for review by the Government on the jobsite at all times during construction. Submit the final LEED Project Checklist(s), final LEED submittals checklist and complete project documentation, verifying the final LEED score and establishing the final rating. Provide full support to the validation review process, including credit audits. See also the LEED documentation requirements in Section 01 33 16, DESIGN AFTER AWARD.

1.2.9.2. GIS Documentation

Provide final geo-referenced GIS database of the new building footprint along with any changes made to exterior of the building. The intent of capturing the final building footprint and exterior modifications in a GIS database is to provide the installation with a data set of the comprehensive changes made to the landscape as a result of the construction project. The Government will incorporate this data set into the installations existing GIS MasterPlan or Enterprise GIS system. The GIS database deliverable shall follow a standard template provided to the Contractor by the Government, adhere to detailed specifications outlined in ECB No 2006-15, and be documented using the Federal Geographic Data Committee (FGDC) metadata standard.

1.3. EQUIPMENT DATA

1.3.1. Real Property Equipment

Provide an Equipment-in-Place list of all installed equipment furnished under this contract. Include all information usually listed on manufacturer's name plate. Include the cost of each piece of installed property F.O.B. construction site. For each of the items which is specified herein to be guaranteed for a specified period from the date of acceptance thereof, provide the following information: The name, serial and model number address of equipment supplier, or manufacturer originating the guaranteed item. The Contractor's guarantee to the Government of these items will not be limited by the terms of any manufacturer's guarantee to the Contractor. Furnish the list as one (1) reproducible and three (3) copies

thirty (30) calendar days before completion of any segment of the contract work which has an incremental completion date.

1.3.2. Maintenance and Parts Data

Furnish a brochure, catalog cut, parts list, manufacturer's data sheet or other publication showing detailed parts data on all other equipment subject to repair and maintenance procedures not otherwise required in Operations and Maintenance Manuals specified elsewhere in this contract. Distribution of directives shall follow the same requirements as listed in paragraph above.

1.3.3. Construction Specifications

Furnish permanent electronic files of final as-built construction specifications, including modifications thereto, with the as-built drawings.

1.4. CONSTRUCTION WARRANTY MANAGEMENT

1.4.1. Prior to the end of the one year warranty, the Government may conduct an infrared roof survey on any project involving a membrane roofing system. This survey will be conducted in accordance with ASTM C1153-90, "Standard Practice for Location of Wet Insulation in Roofing Systems Using Infrared Imaging". The Contractor shall replace all damaged materials and locate and repair sources of moisture penetration.

1.4.2. Management

1.4.2.1. Warranty Management Plan

Develop a warranty management plan containing information relevant to the clause **Warranty of Construction** in FAR 52.246-21. Submit the warranty management plan for Government approval at least 30 days before the planned pre-warranty conference. In the event of phased turn-over of the contract, update the Warranty Management Plan as necessary to include latest information required. Include all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan shall be in narrative form and contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesmen, or of engineering background, not necessarily familiar with this contract. The term "status" as indicated below shall include due date and whether item has been submitted or was accomplished. Submit warranty information made available during the construction phase prior to each monthly pay estimate. Assemble information in a binder and turn over to the Government upon acceptance of the work. The construction warranty period shall begin on the date of project acceptance and shall continue for the full product warranty period. The Contractor, Government, including the Customer Representative shall jointly conduct warranty inspections, 4 months and 9 months, after acceptance. The warranty management plan shall include, but shall not be limited to, the following information:

- (1) Roles and responsibilities of all personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of the contractors, subcontractors, manufacturers or suppliers involved.
- (2) Listing and status of delivery of all Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, and for all commissioned systems such as fire protection and alarm systems, sprinkler systems, lightning protection systems, etc.
- (3) A list for each warranted equipment, item, feature of construction or system indicating:
 - (i) Name of item.
 - (ii) Model and serial numbers.
 - (iii) Location where installed.

- (iv) Name and phone numbers of manufacturers or suppliers.
- (v) Names, addresses and telephone numbers of sources of spare parts.
- (vi) Warranties and terms of warranty. Include one-year overall warranty of construction. Indicate those items, which have extended warranties with separate warranty expiration dates.
- (vii) Cross-reference to warranty certificates as applicable.
- (viii) Starting point and duration of warranty period.
- (ix) Summary of maintenance procedures required to continue the warranty in force.
- (x) Cross-reference to specific pertinent Operation and Maintenance manuals.
- (xi) Organization, names and phone numbers of persons to call for warranty service.
- (xii) Typical response time and repair time expected for various warranted equipment.
- (4) The Contractor's plans for attendance at the 4 and 9 month post-construction warranty inspections conducted by the Government.
- (5) Procedure and status of tagging of all equipment covered by extended warranties.
- (6) Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

1.4.3. Performance Bond

1.4.3.1. The Contractor's Performance Bond will remain effective throughout the construction warranty period.

1.4.3.2. In the event the Contractor or his designated representative(s) fails to commence and diligently pursue any work required under this clause, and in a manner pursuant to the requirements thereof, the Government shall have a right to demand that said work be performed under the Performance Bond by making written notice on the surety. If the surety fails or refuses to perform the obligation it assumed under the Performance Bond, the Government shall have the work performed by others, and after completion of the work, may make demand for reimbursement of any or all expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.

1.4.3.3. In the event sufficient funds are not available to cover the construction warranty work performed by the Government at the Contractor's expense, the Government will have the right to recoup expenses from the bonding company.

1.4.3.4. Following oral or written notification of required warranty repair work, the Contractor will respond as dictated by para. 1.4.5. Written verification will follow oral instructions. Failure of the Contractor to respond will be cause for the Government to proceed against the Contractor as outlined in the paragraph 1.4.5.5 and/or above.

1.4.4. Pre-Warranty Conference

Prior to contract completion, or completion of any phase or portion of contract to be turned over, and at a time designated by the Contracting Officer, the Contractor shall meet with the Government to develop a mutual understanding with respect to the requirements of this clause. Communication procedures for Contractor notification of warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Government for the execution of the construction warranty shall be established/reviewed at this meeting. In connection with these requirements and at the time of the Contractor's quality control completion inspection, the Contractor will furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue warranty work action on behalf of the Contractor. This point of contact will be located within the local service area of the warranted construction, will be continuously

available, and will be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of his responsibilities in connection with other portions of this provision.

1.4.5. Contractor's Response to Warranty Service Requirements.

Following Government oral or written notification, which may include authorized installation maintenance personnel, the Contractor shall respond to warranty service requirements in accordance with the "Warranty Service Priority List" and the three categories of priorities listed below. Submit a report on any warranty item that has been repaired during the warranty period. The report shall include the cause of the problem, date reported, corrective action taken, and when the repair was completed. If the Contractor does not perform the construction warranty within the timeframe specified, the Government will perform the work and backcharge the construction warranty payment item established.

1.4.5.1. First Priority Code 1 Perform onsite inspection to evaluate situation, and determine course of action within 4 hours, initiate work within 6 hours and work continuously to completion or relief.

1.4.5.2. Second Priority Code 2 Perform onsite inspection to evaluate situation, and determine course of action within 8 hours, initiate work within 24 hours and work continuously to completion or relief.

1.4.5.3. Third Priority Code 3 All other work to be initiated within 3 work days and work continuously to completion or relief.

1.4.5.4. The "Warranty Service Priority List" is as follows:

- Code 1 - Air Conditioning System
 - (a) Buildings with computer equipment.
 - (b) Barracks, mess halls (entire building down).
- Code 2 - Air Conditioning Systems
 - (a) Recreational support.
 - (b) Air conditioning leak in part of building, if causing damage.
 - (c) Air conditioning system not cooling properly
 - (d) Admin buildings with Automated Data Processing (ADP) equipment not on priority list.
- Code 1 - Doors
 - (a) Overhead doors not operational.
- Code 1 - Electrical
 - (a) Power failure (entire area or any building operational after 1600 hours).
 - (b) Traffic control devices.
 - (c) Security lights.
 - (d) Smoke detectors and fire alarm systems
 - (e) Power or lighting failure to an area, facility, portion of a facility, which may adversely impact health, safety, security, or the installation's mission requirement, or which may result in damage to property.
- Code 2 - Electrical
 - (a) Power failure (no power) for unoccupied buildings or portions thereof or branch circuits within occupied buildings, not listed as Code 1.
 - (a) Receptacle and lights, not listed as code 1.

- Code 3 - Electrical
 - (a) Street, parking area lights
- Code 1 - Gas
 - (a) Leaks and breaks.
 - (b) No gas to cantonment area.
- Code 1 - Heat
 - (a) Area power failure affecting heat.
 - (b) Heater in unit not working.
- Code 2 Heat
 - (a) All heating system failures not listed as Code 1.
- Code 3 - Interior
 - (a) Floor damage
 - (b) Paint chipping or peeling
- Code 1 - Intrusion Detection Systems - N/A.
- Code 2 - Intrusion Detection Systems other than those listed under Code 1
- Code 1 - Kitchen Equipment
 - (a) Dishwasher.
 - (b) All other equipment hampering preparation of a meal.
- Code 2 - Kitchen Equipment
 - (a) All other equipment not listed under Code 1.
- Code 2 - Plumbing
 - (a) Flush valves not operating properly
 - (b) Fixture drain, supply line commode, or water pipe leaking.
 - (c) Commode leaking at base.
- Code 3 - Plumbing
 - (a) Leaking faucets
- Code 1 - Refrigeration
 - (a) Mess Hall.
 - (b) Medical storage.
- Code 2 - Refrigeration
 - (a) Mess hall - other than walk-in refrigerators and freezers.
- Code 1 - Roof Leaks
 - (a) Temporary repairs will be made where major damage to property is occurring.
- Code 2 - Roof Leaks
 - (a) Where major damage to property is not occurring, check for location of leak during rain and complete repairs on a Code 2 basis.
- Code 1 - Sprinkler System

- (a) All sprinkler systems, valves, manholes, deluge systems, and air systems to sprinklers.
 - Code 1 - Tank Wash Racks (Bird Baths)
- (a) All systems which prevent tank wash.
 - Code 1 - Water (Exterior)
- (a) Normal operation of water pump station.
 - Code 2 - Water (Exterior)
- (a) No water to facility.
 - Code 1 - Water, Hot (and Steam)
- (a) Barracks (entire building).
 - Code 2 - Water, Hot
- (a) No hot water in portion of building listed under Code 1

1.4.5.5. Should parts be required to complete the work and the parts are not immediately available, the Contractor shall have a maximum of 12 hours after arrival at the job site to provide the Government, with firm written proposals for emergency alternatives and temporary repairs for Government participation with the Contractor to provide emergency relief until the required parts are available on site for the Contractor to perform permanent warranty repair. The Contractor's proposals shall include a firm date and time that the required parts shall be available on site to complete the permanent warranty repair. The Government will evaluate the proposed alternatives and negotiate the alternative considered to be in the best interest of the Government to reduce the impact of the emergency condition. Alternatives considered by the Government will include the alternative for the Contractor to "Do Nothing" while waiting until the required parts are available to perform permanent warranty repair. Negotiating a proposal which will require Government participation and the expenditure of Government funds shall constitute a separate procurement action by the using service.

1.4.6. Equipment Warranty Identification Tags

1.4.6.1. Provide warranty identification tags at the time of installation and prior to substantial completion shall provide warranty identification tags on all Contractor and Government furnished equipment which the Contractor has installed.

- (a) The tags shall be suitable for interior and exterior locations, resistant to solvents, abrasion, and to fading caused by sunlight, precipitation, etc. These tags shall have a permanent pressure-sensitive adhesive back, and they shall be installed in a position that is easily (or most easily) noticeable. Tag each component of contractor furnished equipment that has differing warranties on its components.
- (b) Submit sample tags, representing how the other tags will look, for Government review and approval.
- (c) Tags for Warranted Equipment: The tag for this equipment shall be similar to the following: Exact format and size will be as approved.

EQUIPMENT WARRANTY - CONTRACTOR FURNISHED EQUIPMENT

MFG NAME

MODEL NO.

SERIAL NO.

CONTRACT NO.

CONTRACTOR NAME

CONTRACTOR WARRANTY EXPIRES

MFG WARRANTY(IES) EXPIRE

EQUIPMENT WARRANTY - GOVERNMENT FURNISHED EQUIPMENT

MFG NAME

MODEL NO.

SERIAL NO.

CONTRACT NO.

DATE EQUIP PLACED IN SERVICE

MFG WARRANTY(IES) EXPIRE

(d) If the manufacturer's name (MFG), model number and serial number are on the manufacturer's equipment data plate and this data plate is easily found and fully legible, this information need not be duplicated on the equipment warranty tag

1.4.6.2. Execution: Complete the required information on each tag and install these tags on the equipment by the time of and as a condition of final acceptance of the equipment.

1.5. MECHANICAL TESTING, ADJUSTING, BALANCING, AND COMMISSIONING

Submit; all reports, statements, certificates, and completed checklists for testing, adjusting, balancing, and commissioning of mechanical systems prior to final inspection and transfer of the completed facility for approval, as specified in applicable technical specification sections.

1.6. OPERATION AND MAINTENANCE MANUALS

1.6.1. General Requirements

1.6.1.1. Inasmuch as the operations and maintenance manuals are required to operate and maintain the facility, the operations and maintenance (O&M) manuals will be considered a requirement prior to substantial completion of any facility to be turned over to the Government. Beneficial occupancy of all or portions of a facility prior to substantial completion will not relieve the Contractor of liquidated damages, if substantial completion exceeds the required completion date.

1.6.1.2. Provide one permanent electronic copy on CD-ROM and 2 hard copies of the Equipment Operating, Maintenance, and Repair Manuals. Provide separate manuals for each utility system as defined hereinafter. Submit Operations and Maintenance manuals for approval before field training or 90 days before substantial completion (whichever occurs earlier). If there is no separate CLIN for O&M Manuals, the Government will withhold an amount representing \$20,000, as non-progressed work, until submittal and approval of all O&M manuals are complete.

1.6.2. Definitions

1.6.2.1. Equipment

A single piece of equipment operating alone or in conjunction with other equipment to accomplish a system function.

1.6.2.2. System

A combination of one or more pieces of equipment which function together to accomplish an intended purpose (i.e. HVAC system is composed of many individual pieces of equipment such as fans, motors, compressors, valves, sensors, relays, etc.)

1.6.3. Hard Cover Binders

The manuals shall be hard cover with posts, or 3-ring binders, so sheets may be easily substituted. Print the following identification on the cover: the words "EQUIPMENT OPERATING, MAINTENANCE, AND REPAIR MANUALS," the project name, building number, and an indication of utility or systems covered, the name of the Contractor, and the Contract number. Manuals shall be approximately 8-1/2 by 11-inches with large sheets folded in and capable of being easily pulled out for reference. All manuals for the project must be similar in appearance, and be of professional quality.

1.6.4. Warning Page

Provide a warning page to warn of potential dangers (if they exist, such as high voltage, toxic chemicals, flammable liquids, explosive materials, carcinogens, high pressures, etc.). Place the warning page inside the front cover and in front of the title page. Include any necessary Material Safety Data Sheets (MSDS) here.

1.6.5. Title Page

The title page shall include the same information shown on the cover and show the name of the preparing firm and the date of publication.

1.6.6. Table of Contents

Each volume of the set of manuals for this project shall include a table of contents, for the entire set, broken down by volume.

1.6.7. GENERAL

Organize manuals according to the following format, and include information for each item of equipment. Submit a draft outline and table of contents for approval at 50% contract completion.

TABLE OF CONTENTS

PART I: Introduction

- Equipment Description
- Functional Description
- Installation Description

PART II: Operating Principles

PART III: Safety

PART IV: Preventive Maintenance

- Preventive Maintenance Checklist, Lubrication
- Charts and Diagrams

PART V: Spare Parts Lists

- Troubleshooting Guide
- Adjustments
- Common Repairs and Parts Replacement

PART VI: Illustrations

1.6.7.1. Part I-Introduction

Part I shall provide an introduction, equipment or system description, functional description and theory of operation, and installation instructions for each piece of equipment. Include complete instructions for uncrating, assembly, connection to the power source and pre-operating lubrication in the installation instructions as applicable. Illustrations, including wiring and cabling diagrams, are required as appropriate in this section. Include halftone pictures of the equipment in the introduction and equipment description, as well as system layout drawings with each item of equipment located and marked. Do not use copies of previously submitted shop drawings in these manuals.

1.6.7.2. Part II-Operating Principles

Part II shall provide complete instructions for operating the system, and each piece of equipment. Illustrations, halftone pictures, tables, charts, procedures, and diagrams are required when applicable. This will include step-by-step procedures for start-up and shutdown of both the system and each component piece of equipments, as well as adjustments required to obtain optimum equipment performance, and corrective actions for malfunctions. Show performance sheets and graphs showing capacity data, efficiencies, electrical characteristics, pressure drops, and flow rates here, also. Marked-up catalogs or catalog pages do not satisfy this requirement. Present performance information as concisely as possible with only data pertaining to equipment actually installed. Include actual test data collected for Contractor performance here.

1.6.7.3. Part III-Safety

Part III shall contain the general and specific safety requirements peculiar to each item of equipment. Repeat safety information as notes cautions and warnings in other sections where appropriate to operations described.

1.6.7.4. Part IV-Preventive Maintenance

Part IV shall contain a troubleshooting guide, including detailed instructions for all common adjustments and alignment procedures, including a detailed maintenance schedule. Also include a diagnostic chart showing symptoms and solutions to problems. Include test hookups to determine the cause, special tools and test equipment, and methods for returning the equipment to operating conditions. Information may be in chart form or in tabular format with appropriate headings. Include instructions for the removal, disassembly, repair, reassembly, and replacement of parts and assemblies where applicable and the task is not obvious.

1.6.7.5. Part V-Spare Parts List

Part V shall contain a tabulation of description data and parts location illustrations for all mechanical and electrical parts. The heading of the parts list shall clearly identify the supplier, purchase order number, and equipment. Include the unit price for each part. List parts by major assemblies, and arrange the listing in columnar form. Include names and addresses of the nearest manufacturer's representatives, as well as any special warranty information. Provide a list of spare parts that are recommended to be kept in stock by the Government installation.

1.6.7.6. Part VI-Illustrations

Part VI shall contain assembly drawings for the complete equipment or system and for all major components. Include complete wiring diagrams and schematics. Other illustrations, such as exploded views, block diagrams, and cutaway drawings, are required as appropriate.

1.6.8. Framed Instructions

Post framed instructions are required for substantial completion. Post framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, including equipment, ductwork, piping valves, dampers, and control sequence at a location near the equipment described. Prepare condensed operating instructions explaining preventive maintenance procedures methods of checking the system for normal safe operation, valve schedule and procedures for safely starting and stopping the system in type form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. Submit proposed diagrams, instructions, and other sheets prior to posting. Post the framed instructions before field training.

1.6.9. (Reserved. See 1.7 for Field Training)

1.6.10. System/Equipment Requirements

1.6.10.1. Facility Heating System

Provide information on the following equipment: boilers, water treatment, chemical feed pumps and tanks, converters, heat exchangers, pumps, unit heaters, fin-tube radiation, air handling units (both heating only and heating and cooling), and valves (associated with heating systems).

1.6.10.2. Air-Conditioning Systems

Provide information in chillers, packaged air-conditioning equipment, towers, water treatment, chemical feed pumps and tanks, air-cooled condensers, pumps, compressors, air handling units, and valves (associated with air-conditioning systems).

1.6.10.3. Temperature Control and HVAC Distribution Systems

Provide all information described for the following equipment: valves, fans, air handling units, pumps, boilers, converters and heat exchangers, chillers, water cooled condensers, cooling towers, and fin-tube radiation, control air compressors, control components (sensors, controllers, adapters and actuators), and flow measuring equipment.

1.6.10.4. Central Heating Plants

Provide the information described for the following equipment: boilers, converters, heat exchangers, pumps, fans, steam traps, pollution control equipment, chemical feed equipment, control systems, fuel handling equipment, de-aerators, tanks (flash, expansion, return waters, etc.), water softeners, and valves.

1.6.10.5. Heating Distribution Systems

Provide the information described for the following equipment: valves, fans, pumps, converters and heat exchangers, steam traps, tanks (expansion, flash, etc.), and piping systems.

1.6.10.6. Exterior Electrical Systems

Provide information on the following equipment: power transformers, relays, reclosers, breakers, and capacitor bank controls.

1.6.10.7. Interior Electrical Systems

Provide information on the following equipment: relays, motor control centers, switchgear, solid state circuit breakers, motor controller, EPS lighting systems, wiring diagrams and troubleshooting flow chart on control systems, and special grounding systems.

1.6.10.8. Energy Monitoring and Control Systems

The maintenance manual shall include descriptions of maintenance for all equipment, including inspection, periodic preventative maintenance, fault diagnosis, and repair or replacement of defective components.

1.6.10.9. Domestic Water Systems

Provide the identified information on the following equipment: tanks, unit process equipment, pumps, motors, control and monitoring instrumentation, laboratory test equipment, chemical feeders, valves, switching gear, and automatic controls.

1.6.10.10. Wastewater Treatment Systems

Provide the identified information on the following equipment: tanks, unit process equipment, pumps, motors, control and monitoring instrumentations, laboratory test equipment chemical feeders, valves, scrapers, skimmers, comminutors, blowers, switching gear, and automatic controls.

1.6.10.11. Fire Protection Systems

Provide information on the following equipment: alarm valves, manual valves, regulators, foam and gas storage tanks, piping materials, sprinkler heads, nozzles, pumps, and pump drivers.

1.6.10.12. Fire Alarm and Detection Systems

(1) The maintenance manual shall include description of maintenance for all equipment, including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.

(2) Provide all software; database with complete identification of programmable portions of system equipment and devices, and all other system programming data on all modes of the system; connecting cables; and proprietary equipment necessary for the operation, maintenance, testing, repair and programming, etc. of the system and that may be required for implementation of future changes to the fire system (additional and/or relocated initiating devices, notification devices, etc.

(3) Provide all system and equipment technical data and computer software with the requisite rights to Government use, in accordance with the applicable contract clauses.

(4) Training shall include software and programming required for the effective operation, maintenance, testing, diagnostics and expansion of the system.

1.6.10.13. Plumbing Systems

Provide information on the following equipment: water heaters, valves, pressure regulators backflow preventors, piping materials, and plumbing fixtures.

1.6.10.14. Liquid Fuels Systems

Provide information on the following equipment: tanks, automatic valves manual valves, filter separators, pumps, mechanical loading arms, nozzles, meters, electronic controls, electrical switch gear, and fluidic controls.

1.6.10.15. Cathodic Protection Systems

Provide information on the following material and equipment: rectifiers, meters, anodes, anode backfill, anode lead wire, insulation material and wire size, automatic controls (if any), rheostats, switches, fuses and circuit breakers, type and size of rectifying elements, type of oil in oil-immersed rectifiers, and rating of shunts.

1.6.10.16. Generator Installations

Provide information on the following equipment: generator sets, automatic transfer panels, governors, exciters, regulators starting systems, switchgear, and protective devices.

1.6.10.17. Miscellaneous Systems

Provide information on the following: communication and ADP systems, security and intrusion alarm, elevators, material handling, active solar, photovoltaic, nurse call, paging, intercom, closed circuit TV, irrigation, sound and material delivery systems, kitchen, refrigeration, disposal, ice making equipment, and other similar type special systems not otherwise specified.

1.6.10.18. Laboratory, Environmental and Pollution Control Systems

Provide information on the following equipment: wet scrubbers, quench chambers, scrub tanks, liquid oil separators, and fume hoods.

1.7. FIELD TRAINING

Field Training is a requirement for substantial completion. Conduct a training course for the operating staff for each particular system. Conduct the training is to be conducted during hours of normal working time after the system is functionally complete. The field instructions shall cover all of the items contained in the Equipment Operating, Maintenance and Repair Manuals. The training will include both classroom and "hands-on" training. Submit a lesson plan outlining the information to be discussed during training periods. Submit this lesson plan for approval 90 days before contract completion before the field training occurs. Record training on DVD and furnish to the Government within ten (10) days following training. Document all training and furnish a list of all attendees.

1.8. PRICING OF CONTRACTOR-FURNISHED AND INSTALLED PROPERTY AND GOVERNMENT-FURNISHED CONTRACTOR-INSTALLED PROPERTY

Promptly furnish and require any sub-contractor or supplier to furnish, in like manner, unit prices and descriptive data required by the Government for Property Record purposes of fixtures and equipment furnished and/or installed by the Contractor or sub-contractor, except prices do not need to be provided for Government-Furnished Property.

1.9. LEED REVIEW MEETINGS

1.9.1. Pre-Closeout Meeting. Approximately 30 days before submittal of LEED closeout documentation, the Contractor and the Government's project delivery team (including Installation representative) will meet to review the documentation, determine which, if any, credits will be audited and identify any corrections/missing items prior to the closeout LEED documentation submittal.

1.9.2. Approximately 14 days after submittal of LEED closeout documentation, the Contractor and the Government's project delivery team (including Installation representative) will meet to review the LEED closeout documentation. The review conference will include discussion of and resolution of all review comments to ensure consensus on achievement of credits and satisfactory documentation. At the review conference a final score will be determined and endorsed in writing by all parties.

1.10. RED ZONE MEETING

At approximately 80% of contract completion or 60 days before the anticipated Beneficial Occupancy Date (BOD), whichever occurs first, the Contractor and the Government's project delivery team will conduct what is known as the Red Zone Meeting to discuss the close-out process, to schedule the events and review responsibilities for actions necessary to produce a timely physical, as well as fiscal, project close-out. The Red Zone meeting derives its name from the football term used to describe the team effort to move the ball the last 20 yards into the end zone. The close-out of a construction project sometimes can be equally as hard and most definitely requires the whole team's efforts. The ACO will chair the meeting. If not already provided, shortly before the meeting, the Contractor shall provide an electronic copy or access to the CADD as-built drawings, completed commensurate with the amount of work completed at the time of the Red Zone Meeting, as an indicator of the Contractors' understanding of and ability to meet the USACE CADD Standards and to ensure that the Contractor is making progress with CADD As-Built requirements. EXHIBIT 1 is a generic meeting checklist.

1.11. FINAL CLEANING

Clean the premises in accordance with FAR clause 52.236-12 and additional requirements stated here. Remove stains, foreign substances, and temporary labels from surfaces. Vacuum carpet and soft surfaces. Clean equipment and fixtures to a sanitary condition. Clean or replace filters of operating equipment if cleaning isn't possible or practicable. Remove debris from roofs, drainage systems, gutters, and downspouts. Sweep paved areas and rake clean landscaped areas. Remove waste, surplus materials, and rubbish from the site. Remove all temporary structures, barricades, project signs, fences and construction facilities. Submit a list of completed clean-up items on the day of final inspection.

1.12. INTERIM FORM DD1354 "TRANSFER AND ACCEPTANCE OF MILITARY REAL PROPERTY

Near the completion of Project, but a minimum of 60 days prior to final acceptance of the work, complete, update draft provided with the final design package(s) (see Section 01 33 16, paragraph 3.7.5) and submit an accounting of all installed property on Interim Form DD1354 "Transfer and Acceptance of Military Real Property." Include any additional assets/improvements/alterations and cost updates from the Draft DD Form 1354. Contact the COR for any project specific information necessary to complete the DD Form 1354. This form will be a topic for the Red Zone Meeting discussed above. For information purposes, a blank DD Form 1354 (fill-able) in ADOBE (PDF) may be obtained at the following web site: <http://www.dtic.mil/whs/directives/infomgt/forms/eforms/dd1354.pdf> Submit the completed Checklist for Form DD1354 of Government-Furnished and Contractor-Furnished/Contractor Installed items. Attach this list to the updated DD Form 1354. Instructions for completing the form may be obtained through the US Army Corps of Engineers TECHINFO Website at <http://www.hnd.usace.army.mil/techinfo/> under publications, in Unified Facilities Criteria UFC 1-300-08.

EXHIBIT 1

SAMPLE

Red Zone Meeting Checklist

Date: _____

Contract No.		
Description / Location		
Contractor		
Contracting Officer		
Action	Completion Milestone	√
Inspections		
Fire		
Safety		
Pre-final		
Mechanical Test & Balance		
Commissioning		
Landscaping Complete		
Erosion Control		
Beneficial Occupancy Date (BOD)		
Furniture Installation		
Comm Installation		
As-Built Drawings		
Provide all O&M manuals, tools, shop drawings, spare parts, etc. to customer		
Training of O&M Personnel		
Provide Warranty documents to Customer		
Contract completion		
Final Inspection		

User move-in		
DD Form 1354, Transfer of Real Property completed & signed		
Ribbon cutting		
Payroll Clearances		
DD Form 2626 - Construction Contractor Performance Evaluation		
DD Form 2631 – A-E Performance Rated after Construction		
Status of Pending Mods and REA's/Claims		
Final Payment Completed		
Release of Claims		
Return of Unobligated Funds		
Move Project from CIP to General Ledger		
Financial completion		

End of Section 01 78 02.00 10

APPENDIX A
Geotechnical Information

Geotechnical Exploration Proposed MH-47 Hangar Addition

*Fort Campbell, Kentucky
TTL Project No. 100811080*



Prepared by:

TTL

geotechnical • analytical • materials • environmental



Report
of
Geotechnical Exploration

TTL Project No. 100811080

August 16, 2011

Proposed MH-47 Hangar Addition
Fort Campbell, Kentucky



geotechnical • analytical • materials • environmental

5010 Linbar Drive Suite 153
Nashville, Tennessee 37211
Telephone 615.331.7770
Facsimile 615.331.7771

Decatur, Montgomery, Tuscaloosa, ALABAMA
Albany, Valdosta, GEORGIA
Nashville, TENNESSEE
www.TTLusa.com

September 7, 2011

Mr. Stephen W. Schultz, P.E., P.S.
Barge, Waggoner, Sumner & Cannon, Inc.
8280 Yankee Street
Dayton, OH 45458-1806

**Re: Report of Geotechnical Exploration for 100% Site Design
Fort Campbell MH47 Hangar
Fort Campbell, Kentucky
TTL Project Number 100811080**

Mr. Schultz:

We have completed a geotechnical exploration for the above referenced project and herewith present the data along with our comments and recommendations. The purposes of the study are to provide information regarding the subsurface conditions present and to develop recommendations pertaining to the geotechnical aspects of site preparation and design.

DESIGN CONSIDERATIONS

The planned project is to consist of the construction of improvements to the existing 160th SOAR installation located within the northern half of the Fort Campbell Military Installation in Fort Campbell, Kentucky. The construction will take place adjacent to the existing Freedom Ramp and existing hangar structures. Specifically, we understand that the proposed construction will be separated into two distinct construction zones.

MH-47 Hangar Area

- New hangar structure encompassing approximately 80,000 square feet in plan area
- Subsurface utilities
- Low Impact Development (LID) Stormwater management structures and bio-retention basins
- Approximately 230 new parking spaces and access drives for automobile traffic
- Approximately 375,000 square feet of new ramp and helipad area

We have not been provided with proposed grades. However, based on the existing site grades, we expect that cuts and fills of up to 5 feet each will be required across the areas proposed for construction.

We have not been provided with actual traffic volumes or expected vehicle passes for the proposed paved areas. However, based on the plan documents, we expect that as much as 600 vehicles per day can be expected within each new hangar parking and drive area. Within the proposed ramp and taxi-way areas, we expect traffic to include helicopter traffic, re-fueling trucks, airplane traffic. For the purposes of providing pavement design recommendations, we have assumed the following traffic frequencies.

MH-47 Hangar Area

- 20 MH-47G passes per day
- 5 C-17 aircraft passes per day

We have developed our exploration and have based our recommendations upon the above stated design criteria. If the actual expected traffic differs significantly or is altered, we should be allowed to review our recommendations in light of that information.

We will discuss the exploration, testing, site and subsurface conditions and recommendations for each project site separately below.

EXPLORATION AND TESTING

A total of 24 soil borings were advanced within this portion of the project site. The borings were located in the field using surveying equipment and the boring elevations were estimated using available topographic data. Therefore, boring elevations should be considered approximate. Specifically, 4 soil borings were advanced within the limits of proposed hangar structure to a depth of 15 feet below the existing ground surface. Sixteen borings were advanced within the limits of proposed ramp to depths of 10 feet below the existing ground surface, while the remaining 4 soil borings were advanced within proposed automobile parking and drive areas to a depth of 5 feet below the existing ground surface. In addition, a hand auger boring was advanced at location MH-47-INF2 in order to obtain subsurface information for laboratory testing to estimate infiltration rates. The overburden encountered at each boring location was drive-sampled in general accordance with ASTM D 1586 "Penetration Test and Split-Barrel Sampling of Soil."

Soil Resistivity Testing

Soil resistivity was also measured on site during our exploration. Soil resistivity is a commonly used indicator of the corrosivity of soil. Resistivity is the reciprocal of conductivity, therefore, the lower the resistivity value the easier electrical current will flow through the soil. The American Society for Testing and Materials (ASTM), among others generally correlate resistivity and corrosivity based on the following (or some similar) relationship:

Table 1: General Resistivity/Corrosivity Relationship

Resistivity (ohm-cm)	Corrosivity
< 500	Highly Corrosive
500-1,000	Severely Corrosive
1,000-2,000	Moderately Corrosive
2,000-10,000	Mildly Corrosive
>10,000	Relatively Un-Corrosive

Resistivity testing was conducted at two locations on site using Wenner 4-pin method. Specifically, the resistivity was measured within the southern half of the areas proposed for construction in the vicinity of the proposed barracks facility. Refer to the following table for the results of the testing.

Table 2: Resistivity Test Results-

MH-47 Hangar	
Depth (ft)	Resistivity (ohm-cm)
5	6,472
10	6,780

Infiltration Testing

Borings S-1 and S-2, as shown on the appended plan, were conducted within the limits of proposed low impact storm-water structures. Accordingly, the saturated infiltration rate was determined at each of these locations using a combination of estimates based on laboratory testing results and field double ring infiltrometer testing. The results of the infiltration testing are recorded below in Table 3.

Table 3: Infiltration Test Results

INF-1		INF-2	
Depth (ft)	Saturated Infiltration Rate (inches/hour)	Depth (ft)	Saturated Infiltration Rate (inches/hour)
0-2	0.60	0-2	0.70
2-depth	0.12	2-depth	0.17

A member of our professional staff visually classified the overburden and logged the split spoon samples obtained. Select soil samples were subjected to laboratory testing in order to determine the soil's fundamental engineering characteristics including Atterberg limits, particle size distribution, natural moisture content, unconfined compressive strength, unit weight, one dimensional consolidation characteristics, pH, California Bearing Ratio (CBR), resistivity, soil radon concentration, and standard Proctor. Results of the laboratory tests are appended. Soil descriptions along with lithological changes are shown graphically on the individual boring logs contained in the Appendix. The samples not consumed during laboratory testing will be retained until acceptance of the report by the United States government.

Radon Testing

Resistivity testing was conducted on two soil samples obtained at boring locations and depths listed below. Refer to the following table for the results of the testing.

Table 4: Radon Test Results

Boring Location	Depth	Radon Concentration Bq/m ³
MH-1	1-2.5	48.2
RWP-2	1-2.5	34.1

SITE AND SUBSURFACE CONDITIONS

Existing Site Conditions

The area proposed for construction is located to the northeast and southeast of the existing Freedom Ramp within the confines of the 160th SOAR area at Fort Campbell, Kentucky. Specifically, the areas proposed for automobile parking and driving are generally maintained as grassy lawns. A triangular, grass lined channel which directs surface water away toward the southeast is present immediately adjacent to the Freedom Ramp. The area currently proposed for hangar construction currently consists of a combination of concrete ramp and grassy lawn and also contains chain length fencing, hardstands, storage bays, and utilities.

Topographically, the site demonstrates as much as 6 feet of relief as the ground surface generally slopes downward from the southeast towards the northwest. Based on existing grades, surface water drainage is judged to be fair to poor across the grass covered site areas and good across the concrete covered site areas.

Condition of Existing Site Infrastructure

The existing site infrastructure within the areas proposed for construction including concrete pavements and the adjacent structure (Building 7262) appear to be performing satisfactorily, with no significant distress observed. We understand that distress related to Alkali-Silicate Reaction has occurred within some rigid (concrete pavements) at Fort Campbell in the past.

Subsurface Conditions

At the locations explored, the borings generally encountered a surficial interval of topsoil and vegetation varying from 4 to 8 inches in thickness. At boring RWH-2, a surficial interval of concrete measuring approximately 7 inches in thickness was observed.

Below the surficial intervals and extending to the depths explored, the borings encountered medium to very stiff consistency, silty to slightly silty, reddish brown to dark reddish brown, residual clay (classified as CL or CH based on the United Soil Classification System) with trace to some gravel sized chert fragments in the soil matrix. At 4 of the 24 borings (MH-PK-3, RMP-6, RMP-7, and RMP-9), fill material consisting of soft to stiff, silty to very silty, grayish brown to reddish brown clay extending from the topsoil and vegetation to depths of 3 to 6 feet below the existing ground surface. Based on our observations, we expect that fill material observed within the proposed ramp location was likely used to fill in a low lying area or pond, while the fill material within the proposed parking and drive areas was placed during the original construction. Overall, the exploration encountered soft consistency soils in 3 borings locations and medium consistency soils in 11 boring locations. The majority of soft and medium consistency soils observed (9 out of 14 locations) were encountered within the upper 3 feet of overburden.

Borings MH-1 through MH-4 were terminated at a depth of 15 feet below the existing ground surface, while borings RMP-1 through RMP-16 were terminated at depths of 10 feet below the existing ground surface. The remaining borings advanced with the parking and drive areas were extended to depths of 5 feet below the existing ground surface.

Laboratory Testing

Natural moisture content testing indicated moisture contents varying from approximately 20% to 37% and generally increasing with depth. Atterberg limits testing indicated liquid limits (LL) varying from 43 to 65 with plasticity indices (PI) varying from 21 to 38, indicating CL and CH material based on the United Soil Classification System. Unconfined compressive strength testing conducted on a Shelby tube sample obtained at boring MH-3 resulted in unconfined compressive strengths of 5.87 ksf and dry unit weight of 98.9 pcf, respectively. A bulk sample was obtained from auger cuttings at borings RMP-3 and RMP-4

and was subjected to standard Proctor testing (ASTM D 698) which indicated a maximum dry density (MDD) of 102 pcf and optimum moisture content of 20.5%. A California Bearing Ratio (CBR) test was performed on the bulk sample which indicated a CBR of 4.5%. Soil pH was tested on samples obtained at borings RMP-3 (3.5-5 feet), MH-4 (1-2.5 feet), and RMP-1 (1-2.5 feet) with values of 6.5., 5.9, and 6.4 obtained, respectively. In addition to the above described Wenner 4-pin resistivity testing, soil resistivity was tested individually at borings MH-3 at a depth of 1-2.5 feet below the existing ground surface with a resistivity value of 6,661 ohm-cm obtained. Grain size distribution testing conducted on samples from borings RMP-10 and RMP-14 indicated that 79 to 81 percent of the soil particles were finer (smaller) than a United States Sieve Number 200. Laboratory test results is appended to this report.

Frost Depth

Based on our research, we recommend that the site design proceed with the understanding that frost will extend to depths of not more than 18 inches below the exterior ground surface during winter months.

Site Geology

Based on our review of published geologic literature, the site is underlain by Mississippian Aged limestone of the St. Louis Formation. The limestone of the St. Louis Formation is brownish-gray, thickly bedded with numerous chert beds and nodules interbedded in its matrix. The soil overburden is typically 20 to 40 feet thick and weathers to very cherty reddish-brown clay (moderate to highly plastic).

Upon completion of drilling, each boring was dry. Further, 24 hours after completion of drilling, each boring was dry. Based on our experience within this geologic setting, we expect the "true" groundwater elevation to be below the depths explored. However, pockets of "perched" or trapped water are common within this setting, particularly following periods of wet weather.

COMMENTS AND RECOMMENDATIONS

Sinkhole Risks

As noted, a historic sinkhole was identified immediately north of the proposed Rotary Wheel Hangar. In addition, the site is located in a geologic setting that is considered to have a risk associated with the development of sinkholes, caves and other karst conditions, and several karst features are present within the limits of Fort Campbell and the general vicinity. Any construction project within this geologic setting must continue in recognition of the fact that undetected cavities could exist within the subsurface and be capable of causing ground subsidence and settlement of earth-supported structures. Therefore, we offer the following comments to reduce the level of sinkhole related risk with respect to project design and construction.

- Control storm water drainage by properly grading the site to promote complete and rapid runoff of surface water away from construction areas and avoid the ponding of water in open excavations.
- Construct underground and underslab plumbing systems in a leak proof manner.
- To the extent practicable, provide for overland or piped discharge of storm water.
- Thoroughly investigate any area of suspected sinkhole development, such as areas of abnormally thick topsoil deposits, low lying areas, locations of soil collapse or voids within the overburden.
- It has been our experience that undetected sinkholes are more likely to appear during construction activities once site drainage has been altered. Where incipient sinkholes are

detected, perform remedial treatment under the direction of the geotechnical engineer who must provide recommendations based on inspection of the actual conditions encountered.

Site Preparation

Initially, the existing site structures within the limits of the proposed construction area should be razed. Subsequently or concurrently, the remaining portions of the site should be stripped of topsoil, vegetation, concrete pavement and basestone or other unsuitable materials. Stripping should extend at least 10 feet beyond the lateral limits of the proposed construction (where possible). Based on our exploratory borings, stripping depths are expected to vary from 4 inches to 8 inches in order to remove the topsoil and vegetation from the proposed construction areas, while stripping depths are expected to approximate 7 inches in order to remove portions of the existing concrete pavement. Thicker stripping intervals may be encountered at isolated locations between our borings. In any case, the underlying soil subgrade should be exposed across the construction area. Stripping should also include the complete removal of near surface underground utilities and foundation elements. Abandoned utility trenches or foundation excavations should be backfilled with engineered fill in accordance with the recommendations provided in this report. Stripped topsoil may be stockpiled for re-use within proposed landscaped areas but should be isolated on site to prevent its incorporation into any fill.

Discussion of Existing Fill

As mentioned, fill was encountered at 4 of the borings (MH-PK-3, RMP-6, RMP-7, and RMP-9) extending to depths of 3 to 6 feet below the existing ground surface. Additional intervals of fill may be present between our borings. We expect that fill material was placed in conjunction with the existing construction; however, we have not been provided with information concerning how or when the fill material was placed and although the materials encountered did not consist of very soft or organic materials, such materials may be present at locations between our borings in any event. There are risks associated with supporting new construction on undocumented fill material. Specifically, the geotechnical risk is the potential for new construction to experience distress associated with the settlement of underlying fill materials due to the weight of the new construction. The type of distress that is possible includes, but is not limited to cracking of masonry, misalignment of doors and windows, ponding of water on the roof, faulting and cracking of the slab on grade, and cracking and movement within paved areas. The only way to eliminate the risk associated with the existing fill is to completely remove these materials from the limits of the proposed construction.

However, based on the fill thickness, consistency, and constituents exposed at the exploratory locations, it is our opinion that the existing fill may remain in place provided the material demonstrates stability during proof-roll testing as described below and the owner understands and is willing to accept the above described risks associated with the potential for unknown constituents to be present within the fill profile at locations between our borings. At a minimum, we recommend that the actual conditions exposed in the field during grading activities and foundation construction be observed by a professional geotechnical engineer. Additional field tests including hand auger borings or test pits may be required to identify unsuitable materials and to provide additional recommendations as necessary. In any case, soft, organic, or other deleterious materials exposed will likely require removal, and we recommend that the owner plan a contingency for subgrade repair during site grading and foundation construction.

Site Preparation Testing

Following stripping operations, upon achieving the desired subgrade elevation within cut areas and prior to the placement of any fill within fill areas, we recommend that the exposed soil or basestone subgrade (if present) be proof-rolled with heavy, rubber-tired construction equipment, such as a fully loaded, tandem axle dump truck in order to identify any unstable areas. Identified unstable areas should be

repaired in order to expose a firm stratum. Repair activities should initially consist of scarifying, moisture conditioning, and then compacting unstable surficial soils to provide a firm stratum. However, this process may be difficult to accomplish depending on prevailing weather conditions and if the thickness of unstable soils exceeds 12 inches. Otherwise, unstable soils may need to be undercut to a firm bearing stratum and the resulting over-excavation be backfilled with compacted fill in accordance with the recommendations of this report.

Based on the results of the exploration, approximately 1/3 of the borings exposed soft or medium consistency soils within the upper 2.5 feet of overburden. Soft and medium consistency soils ('N'-values of 0 to 8) may demonstrate instability necessitating subgrade repair as previously described depending on their moisture content at the time of construction. In addition, the ground surface across the area proposed for construction is relatively flat, demonstrating only fair to poor drainage. This condition tends to lead to surficial soils becoming wet, soft, and unstable during periods of wet weather. Although our exploration was conducted during a period typical for high temperatures and low precipitation, meteorological data indicates that a number of precipitation events occurred across the site prior to our exploration, and we expect the soft to medium consistency surficial soils are due to a combination of relatively poor drainage and recent rainfall. Accordingly, we expect that the majority of unstable areas identified during proof-roll testing may be stabilized through scarification and moisture conditioning as described above. In any case, we recommend that a contingency be planned for stabilizing surficial soils during grading.

Further, prevailing weather conditions will *significantly* affect the amount of subgrade repair. Accordingly, we recommend grading activities be conducted during the driest, warmest times of the year, if possible. In addition, the contractor should maintain the site in a positively drained condition both during and after construction. Ponding water can lead to the deterioration of the subgrade requiring repair of the softened soil. On-site soils within areas proposed for construction softened as a result of ponded water should be repaired as described above. In any case, actual repair quantities can only be determined based on technical observation in the field at the time of construction.

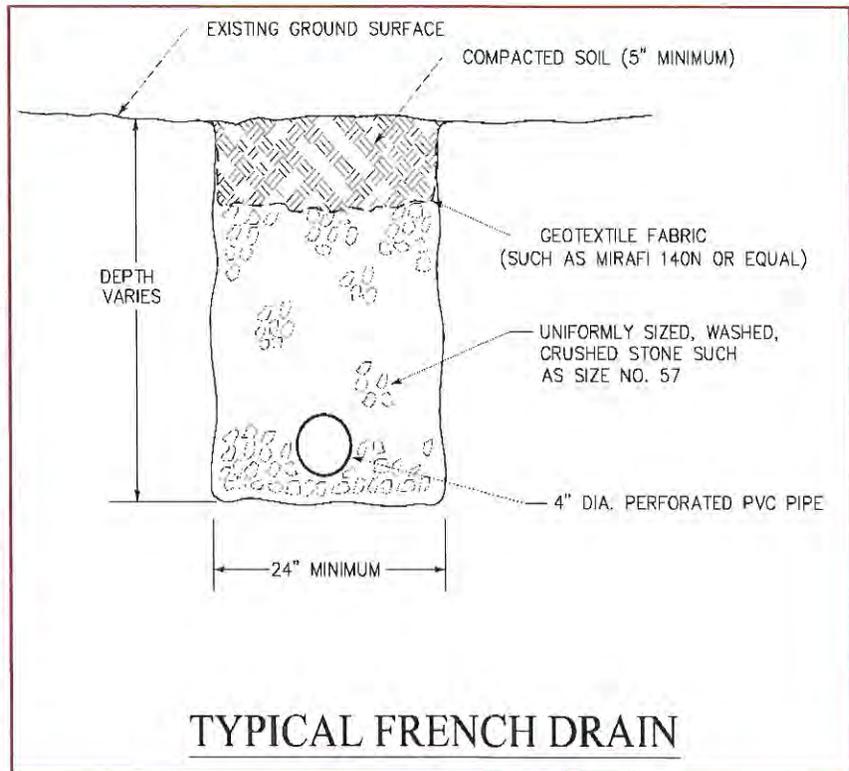
Engineered Fill

We expect that the on-site clay is suitable for re-use as engineered fill where minor fills are required within new parking and drive areas. However, a borrow source will be required in order to achieve the proposed grades within the proposed building area. Any off-site should be approved by this office prior to its use as fill on-site. Generally, any soil designated for use as engineered fill should consist of a low to moderate plasticity clay (CL) having a plasticity index (PI) between 15 and 30 percent. Soil fill should be placed in lifts not exceeding eight (8) inches in loose, un-compacted thickness and then compacted to at least 95% of the soil's maximum dry density as determined by ASTM D 1557 (modified Proctor). In addition, the moisture content of soil fill should be within 3 percent of the optimum moisture content, and the fill must demonstrate stability under the influence of heavy equipment upon compaction.

Based on the results of lab testing, some of the on site soils demonstrate a high plasticity (PI > 30). High plasticity soil may exhibit a potential for modest volume changes (shrink and swell) upon fluctuations in their moisture content, therefore, precautions must be taken in order to reduce the risk associated with volumetric changes of these materials if used as fill. If it is necessary to utilize highly plastic soil as fill material because of the unavailability of preferred material, we recommend that the moisture content be maintained at or within 3% above the optimum moisture content while that soil is being placed as fill. Moreover, care should be taken to avoid over-compaction of the fill to densities greater than 100% of the specified index. It would be prudent to attempt to limit the potential for high plasticity soils to be placed within the upper 2 feet of fill underlying concrete pavements.

Groundwater

As stated, groundwater was not encountered during our exploration. However, the site is located in a karst setting where spring flow has the potential to occur, particularly during the wetter months of the year. Therefore, the contractor should be prepared to perform dewatering actions during construction. The dewatering of shallow excavations may be accomplished with conventional pumps. However, it may be necessary to utilize a "French drain" system, or equivalent control measure, to accommodate spring flow or other subsurface water and to direct water away from the construction areas (see detail).



Slope Stability

Temporary excavations should be inclined in accordance with OSHA safety standards for Type A materials (0.75horizontal:1vertical). The contractor shall be responsible in all cases for maintain site safety and safe excavations. Permanent slopes constructed with soil fill or excavated in residual soils should demonstrate stability when inclined no steeper than 3H:1V. We recommend that permanent slopes be promptly seeded and sodded in order to reduce the potential for erosion losses to occur.

Slabs on Grade

An appropriately reinforced concrete slab-on-grade is expected to perform satisfactorily for the proposed structures when cast on a properly prepared subgrade. We recommend that slab thickness and reinforcement be based on a modulus of subgrade reaction of 125 pci. A minimum four-inch thickness of free-draining, aggregate base and vapor barrier should be included in the design. Slabs should be structurally separated from walls and columns and an appropriate number of control joints should be incorporated into the slab in order to accommodate any differential settlement that may occur.

Retaining Walls And Below Grade Walls

In order to reduce lateral earth pressure exerted against these walls, we recommend that a free-draining, granular fill, such as ASTM D 448 size number 57, be placed immediately adjacent to the walls to the minimum dimensions shown in Figure 1. The stone should be placed in uniform lifts no greater than twelve inches in un-compacted thickness and be thoroughly compacted with a light vibratory plate compactor. The granular backfill should extend to the entire height of the wall, except that two feet of relatively impervious soil should cap the surface of the stone. The surface should be graded to provide positive drainage away from the

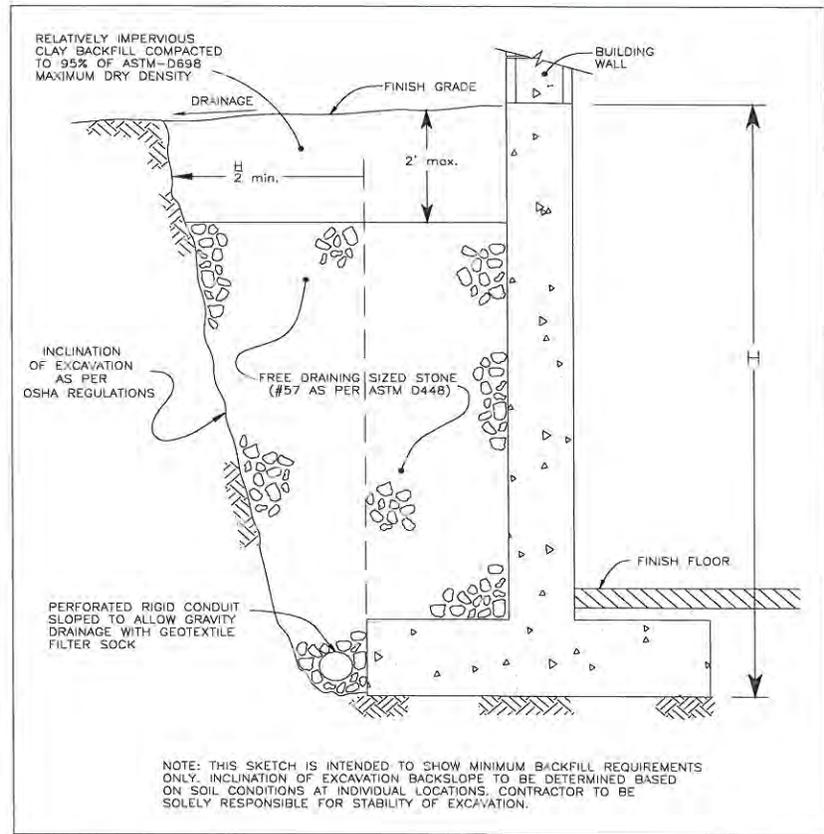


Figure 1-Typical backfill recommendations for retaining walls

structures to minimize infiltration of surface water, or the wall design should incorporate other methods to rapidly divert water from behind the wall. Retaining walls are generally able to move slightly, which relieves some of the lateral load and enables the use of the active earth pressure coefficient. Below-grade walls associated with proposed structures are usually restrained from moving by the floor slabs, these walls should be designed for an at-rest earth pressure condition. In either case, external loads applied to the backfill should be included in the design. Tiered or stepped retaining wall configurations must be analyzed for overall stability in addition to individual wall analyses. In all cases, a factor of safety of at least two should be incorporated into the design.

Coefficient of active earth pressure, k_a , (Horizontal Backfill)	0.30
Coefficient of at-rest earth pressure, k_o , (Horizontal Backfill)	0.45
Coefficient of passive earth pressure, k_p , (Horizontal Backfill)	3.33
Stone unit weight (above the water table)	100 pcf
Stone unit weight submerged	37 pcf

In addition, we estimate the coefficient of friction acting between the site overburden and any concrete surfaces to be 0.40.

Pavement Design

Site preparation within proposed vehicle storage areas and POV parking and drive areas should be conducted in accordance with the recommendations stated above. We assess the support capabilities

of the properly prepared pavement subgrades to be approximately equivalent to the laboratory CBR value of 4.5%. Based on this value, our assumption of the traffic frequencies, a 20-year design life, and the minimum requirements established by the USACOE, we offer the following asphalt pavement design for your consideration:

Flexible Pavement
 (Automobile and light truck traffic)

<u>Material</u>	<u>Thickness</u>
Asphalt Surface Course*	1 ½ inches
Asphalt Base Course*	2 inches
Mineral Aggregate Base Course compacted to at least 95% of its maximum modified Proctor dry density (ASTM D1557) * **	8 inches
Total Pavement Thickness	<u>11 ½ inches</u>

*All materials and procedures used in pavement construction should conform to the State of Kentucky Standard Specification for Road and Bridge Construction 2004 Edition sections 400 and 806.

**The mineral aggregate base should conform to specifications stated in the State of Kentucky Standard Specification for Road and Bridge Construction 2004 Edition sections 302 and 805.06.

It should be noted that the pavement sections provided are based on anticipated traffic frequencies expected following construction. The design does not apply to construction equipment and/or traffic which may utilize the paved areas during construction. The owner should be aware that extensive construction traffic can be destructive to paved roadways not designed for that purpose.

Rigid Pavements

Pavement areas which will be subjected to repeated passes of heavy aircraft should utilize a Portland cement concrete (PCC) pavement. The concrete pavement design is based on U.S. Army manual UF 3-260-02 and the Portland Cement Association "Thickness Design for Concrete Highway and Street Pavements" and the following design parameters:

Pavement Service Life	20 years
Pavement Flexural Strength, minimum	650 psi
Pavement Compressive Strength, minimum	4,500 psi
Roadbed Soil Resilient Modulus	6,600 psi minimum
Reliability	85%

Table 5: PCC Pavement Design Thicknesses

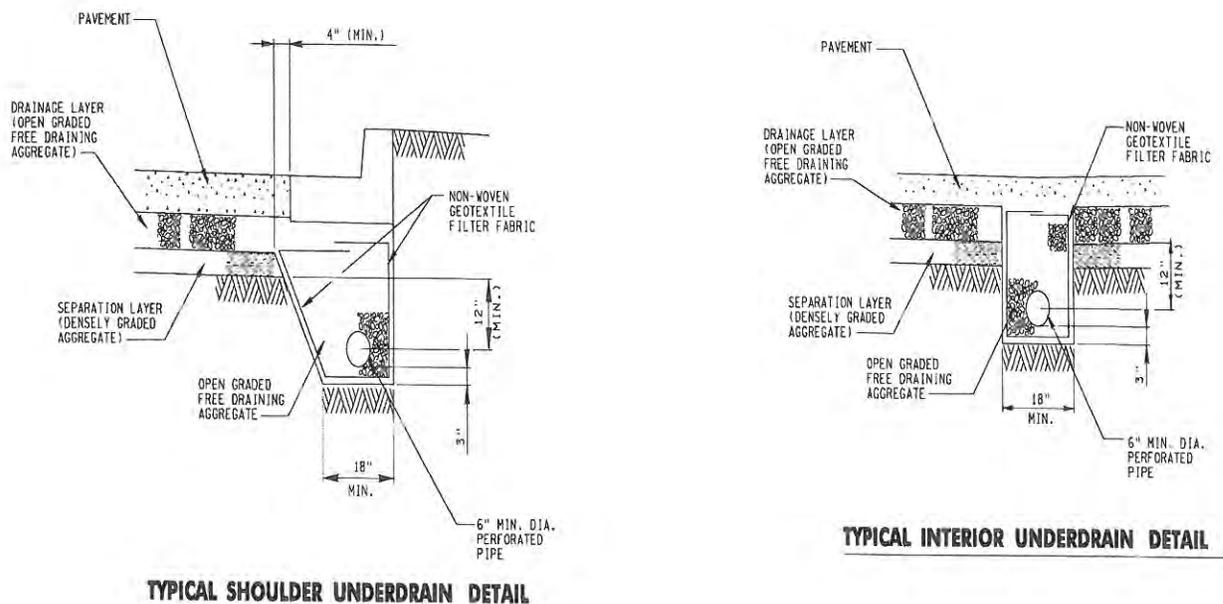
Pavement Area	*Plain Concrete Thickness
Light and heavy duty parking and drive areas	6 inches
MH-47 Ramp Area	6.5 inches
C-17 Ramp and Taxi-Way	15 inches

*Reinforced concrete pavement sections are available if requested. However, it has been our experience that plain concrete pavements are typically more cost effective.

Rigid pavements should be underlain by a minimum of 8 inches of free draining aggregate base (such as ASTM D 448 Size #57). The slump and air content at the point of concrete placement should range from 4 to 6 inches and 2 to 4 percent, respectively. Concrete pavement sections should feature an appropriate number of control joints. Pavements which do not have a tied concrete shoulder should be thickened by 25 percent to account for the edge loading conditions. Construction joints should be doweled to provide load transfer across joints. It will be vital that the distributed steel be positioned accurately within the pavement cross section.

In addition, based on the subsurface conditions present within the proposed paved areas (cohesive clay soils classified as CL or CH based on the USCS), an underdrain system will be required. We recommend that the under-drain system be configured as shown below in Figure 1. We recommend that the dense graded aggregate layer be placed in a maximum thickness of 6 inches and subsequently compacted to a minimum of 95% of the modified Proctor (ASTM D 1557). Geotextile fabric will not be required as part of the design. The under-drains should be extended to day-light or to drainage structures.

Figure 1-Under-drain configuration (courtesy of USACOE)



Proper perimeter drainage for pavements is very important and should be provided so that infiltration of surface water from unpaved areas surrounding the pavement is minimized. If curbs are needed in certain areas, they should extend through the base and at least 3 inches into the final subgrade. This will help reduce migration of subsurface water into the pavement base course from adjacent areas. A crack sealant compatible to both asphalt and concrete should be provided at all concrete-asphalt interfaces.

The pavement section has been designed using generally recognized structural coefficients for the pavement materials. These structural coefficients reflect the relative strength of the pavement materials and their contribution to the structural integrity of the pavement. If the pavement does not drain properly, it is likely that ponded water will infiltrate the pavement materials resulting in a weakening of the materials. As a result, the structural coefficients of the pavement materials will be reduced and the life and performance of the pavement will be shortened. The Asphalt Institute recommends a minimum of 2 percent slope for asphalt pavements and ½ percent for concrete pavements. The importance of proper drainage cannot be overemphasized and should be thoroughly considered by the project team.

Pavement Joints and Reinforcement

The following is recommended for all concrete pavement sections in this report:

Contraction Joint Spacing:	15 feet each way
Contraction Joint Depth:	At least ¼ of slab thickness.
Contraction Joint Width:	⅛" to ¼"
Construction Joint Location:	Install at planned contraction joint
Construction Joint Depth:	Full depth of pavement thickness.
Construction Joint Width:	⅛" to ¼"
Isolation Joint Spacing:	As required to isolate pavement from structures, etc.
Isolation Joint Depth:	Full depth of pavement thickness.
Isolation Joint Width:	¾" to 1"

Note: All joints should be sealed. Over time, unsealed joints can allow for water to migrate into the subsurface leading to pavement distress.

All construction and contraction joints have dowels. Dowel recommendations vary with pavement thickness as presented below.

Pavement Thickness:	6.5 inches
Dowels:	¾ inch diameter
Dowel Spacing:	12 inches on center
Dowel Length:	12 inches long
Dowel Embedment:	6 inches

Pavement Thickness:	10 inches
Dowels:	1 inch diameter
Dowel Spacing:	12 inches on center
Dowel Length:	18 inches long
Dowel Embedment:	10 inches

Pavement Thickness: 15 inches
 Dowels: 1 1/2 inch diameter
 Dowel Spacing: 15 inches on center
 Dowel Length: 20 inches long
 Dowel Embedment: 10 inches

Flexible Apron Design For Ramp Shoulder
C-17 Ramp Area

<u>Material</u>	<u>Thickness</u>
Asphalt Surface Course*	4 inches
Asphalt Base Course*	6 inches
Mineral Aggregate Base Course compacted to at least 95% of its maximum modified Proctor dry density (ASTM D1557) * **	22 inches
Total Pavement Thickness	<u>32 inches</u>

Flexible Apron Design Alternative
MH-47 Ramp Area

<u>Material</u>	<u>Thickness</u>
Asphalt Surface Course*	2 inches
Asphalt Base Course*	3 inches
Mineral Aggregate Base Course compacted to at least 95% of its maximum modified Proctor dry density (ASTM D1557) * **	10 inches
Total Pavement Thickness	<u>15 inches</u>

Flexible Apron Design Alternative
C-17 Ramp and Taxi-way Area

<u>Material</u>	<u>Thickness</u>
Asphalt Surface Course*	5 inches
Asphalt Base Course*	10 inches
Mineral Aggregate Base Course compacted to at least 95% of its maximum modified Proctor dry density (ASTM D1557) * **	35 inches
Total Pavement Thickness	<u>50 inches</u>

All materials and procedures used in pavement construction should conform to the State of Kentucky Standard Specification for Road and Bridge Construction 2004 Edition sections 400 and 806.

**The mineral aggregate base should conform to specifications stated in the State of Kentucky Standard Specification for Road and Bridge Construction 2004 Edition sections 302 and 805.06.

General Pavement Construction Considerations

Immediately prior to installation of the mineral aggregate base course, the soil subgrade should be proof-rolled with heavy, pneumatic-tired equipment, such as a loaded dump truck, in order to confirm the stability of the subgrade. Unstable areas should be repaired in the manner described for placement of engineered fill. To prevent the mineral aggregate base course from becoming saturated and thereby reducing the support capabilities of the subgrade, we recommend that the underlying soil subgrade be graded to provide positive drainage away from the pavement. During construction of the aggregate base, in-place density tests and thickness checks should be performed in order to evaluate compliance with project specifications. If a significant delay occurs between installation of the aggregate base and installation of the pavement elements, the surface of the aggregate base should again be proof-rolled prior to paving in order to verify that no loss in stability has occurred.

LIMITATIONS

The foregoing recommendations were developed based on observations, analysis of samples, and test data obtained from a limited number of borings and with the assumption that the materials exposed fairly represent conditions existing across the site. It is possible that different conditions could exist between the explored locations, and such unknown conditions could have an impact on design and construction. Additionally, subsurface conditions can change with the passage of time. Because it is not possible to know every detail of the conditions hidden beneath the surface, our comments and recommendations are presented as opinions and judgments, as opposed to statements of fact. Should any conditions or variance with this report be encountered during construction, this office should be notified immediately so that further studies can be made and supplemental recommendations can be provided. The purpose of this report is to provide information and recommendations for use by the building designers. While the subsurface information may be helpful to contractors, the study is not intended to provide all information that a contractor may need to evaluate construction costs and material quantities. The data and recommendations are specific to the site and project described herein.

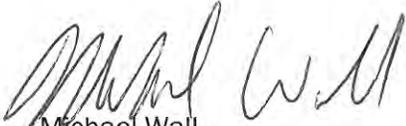
MONITORING AND TESTING

It is essential that all aspects of site preparation and foundation construction be monitored by knowledgeable personnel responsible to the geotechnical engineer and the Owner. As the geotechnical engineer of record for this project, we will plan to provide the on-site monitoring and testing services to confirm that the construction complies with our recommendations and project specifications. Our forces will be available to provide these important services, as well as other generally specified quality control testing that you may require. In the interim, we are available at your convenience to discuss with you the details of this project and our recommendations.

CLOSURE

TTL, Inc. appreciates this opportunity to be of service to you. If you have any questions or require additional information, please call.

Sincerely,
TTL, INC.



Michael Wall
Geotechnical Staff Professional



Cc: Mr. Jason Starner, P.E.
BWS&C, Inc.

Important Information about Your Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you — should apply the report for any purpose or project except the one originally contemplated.*

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,

- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual

subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that

have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely on Your ASFE-Member Geotechnical Engineer for Additional Assistance

Membership in ASFE/THE BEST PEOPLE ON EARTH exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.



8811 Colesville Road/Suite G106, Silver Spring, MD 20910

Telephone: 301/565-2733 Facsimile: 301/589-2017

e-mail: info@asfe.org www.asfe.org

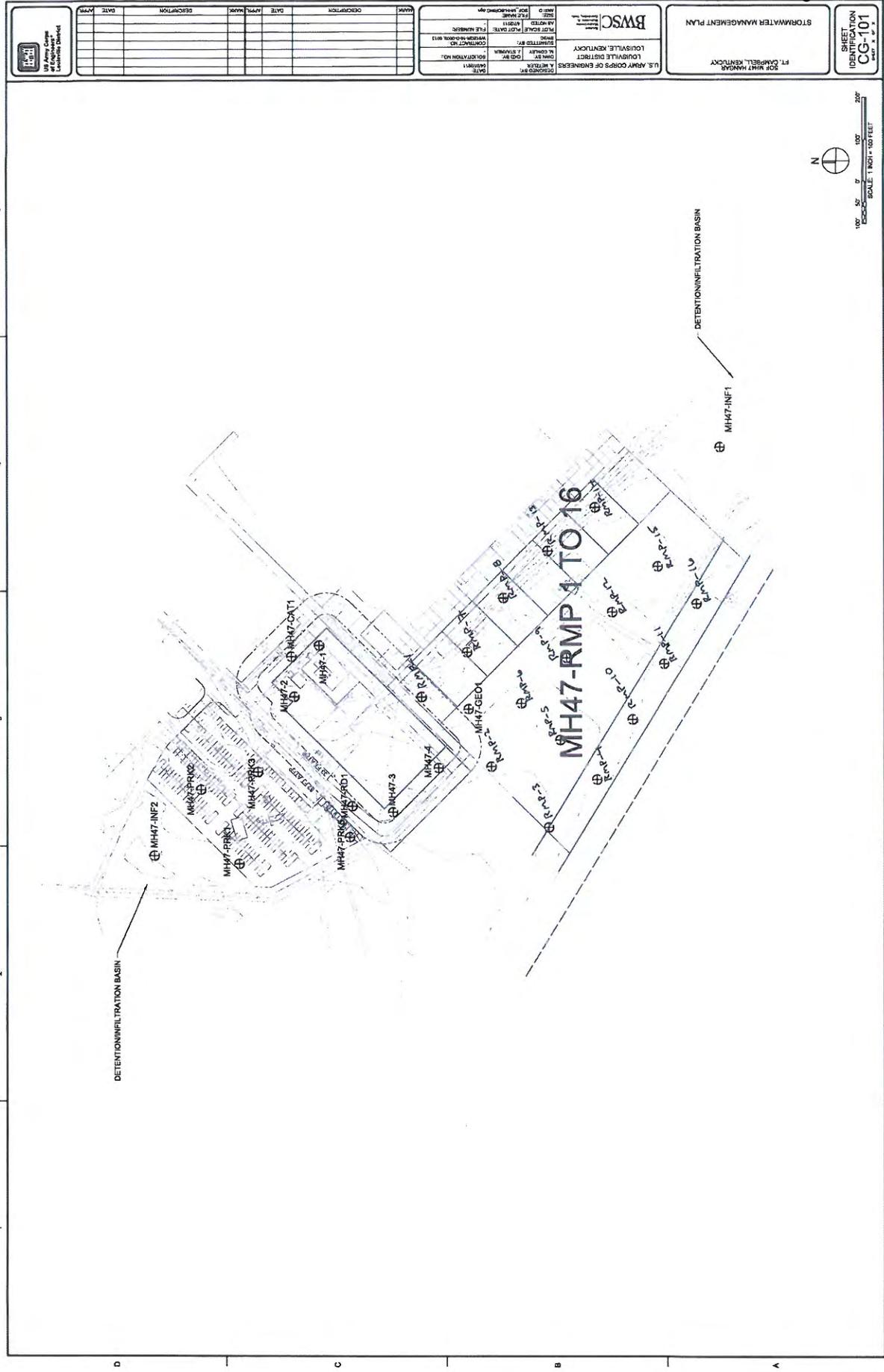
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*Geotechnical Exploration
Proposed MH-47 Hangar Addition
Fort Campbell, Kentucky
TTL Proposal No. 100811080*

APPENDIX 1

**PLANS, PROFILES, AND
BORING LOGS**



SAFETY PAYS

SUPPORT VALUE ENGINEERING . IT PAYS

DESCRIPTIVE TERMINOLOGY INCLUDED ON BORING LOGS

MOISTURE CONDITIONS

	<u>Fine-Grained Soils</u>	<u>Coarse-Grained Soils</u>
<i>Dry</i>	Seems dry, but contains some moisture	Contains no noticeable moisture
<i>Moist</i>	Moisture below the plastic limit	Contains a noticeable amount of moisture, but no appreciable free water
<i>Very Moist</i>	Moisture above the plastic limit, but below the liquid limit	
<i>Wet</i>	Moisture may approach the liquid limit	Contains free water, but voids are not water-filled
<i>Saturated</i>	Moisture is frequently at or above the liquid limit	Soil voids are water-filled or nearly so

STANDARD PENETRATION RESISTANCE (N)¹

<u>Sands (Cohesionless Soils)</u>		<u>Silts and Clays (Cohesive Soils)</u>	
<u># of Blows, N</u>	<u>Relative Density</u>	<u># of Blows, N</u>	<u>Relative Consistency</u>
0 - 4	Very Loose	0 - 1	Very Soft
5 - 10	Loose	2 - 4	Soft
11 - 30	Firm (Medium)	5 - 8	Firm (Medium)
31 - 50	Dense	9 - 15	Stiff
Over 50	Very Dense	16 - 30	Very Stiff
		31 - 50	Hard
		Over 50	Very Hard

¹ Measured with 2 inch OD, 1 3/8 inch ID sampler driven 1 foot by 140 lb hammer falling 30 inches. See Standard Methods for Penetration Test and Split-Barrel Sampling of Soils, ASTM D 1586.

RELATIVE PROPORTIONS

<u>Term</u>	<u>Range</u>
Trace	Less than 10%
Little	10% - 20%
Some	20% - 30%
With	30% - 40%
And	40% - 50%

STANDARD ABBREVIATIONS

"WOH" = Weight Of Hammer
 "WOR" = Weight Of Rod

LEGEND OF SYMBOLS

Soil (USCS Classification)		Rock	Other Materials	Samplers
	GW WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES			
	GP POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES			
	GM SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES			
	GC CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES			
	SW WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES			
	SP POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES			
	SM SILTY SANDS, SAND - SILT MIXTURES			
	SC CLAYEY SANDS, SAND - CLAY MIXTURES			
	ML INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY			
	CL INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS			
	OL ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY			
	MH INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS			
	CH INORGANIC CLAYS OF HIGH PLASTICITY			
	OH ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS			
	PT PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS			

Water Level Symbols	
	WATER LEVEL AT TIME OF DRILLING
	DELAYED WATER LEVEL
	CAVE-IN DEPTH



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FORT CAMPBELL MH 47 HANGAR

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Fort Campbell, Kentucky

Drilling Co.: <i>Tri-State Drilling</i>	TTL Project No.: <i>100811080</i>
Driller: <i>Fred Reynolds</i>	Date Drilled: <i>7/11/2011</i>
Logged by: <i>M. Wall</i>	Boring Depth: <i>15 feet</i>
Equipment: <i>CME 55</i>	Boring Elevation: <i>565 feet</i>
Hammer Type: <i>Automatic</i>	Coordinates: <i>Not Available</i>
Drilling Method: <i>Hollow Stem Auger w/SPT Sampling</i>	

Remarks:
 Borehole dry upon completion of drilling activities and 24 hours after completion of drilling activities.
 Boring offset to avoid equipment.

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DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS CLASSIFICATION	MATERIALS DESCRIPTION	MOISTURE (%)	PPV (tsf)	TYPE	SAMPLE DATA									
								N-COUNT			STANDARD PENETRATION TEST DATA (blows per foot)						
								1st 6"	2nd 6"	3rd 6"	10	20	30	40	50		
	565		CL	Topsoil and vegetation (5 inches) RESIDUUM: Clay, (CL), stiff, silty, dark reddish brown				3 - 6 - 7 N = 13									
5	560		CH	Clay, (CH), stiff, slightly silty, reddish brown				4 - 5 - 6 N = 11									
10	555							4 - 4 - 5 N = 9									
15	550							5 - 5 - 5 N = 10									
				Boring terminated at 15 feet.				3 - 4 - 5 N = 9									

- This boring log shall not be separated from the corresponding Instrument of Service; no third party may rely upon this boring log or the corresponding Instrument of Service absent a written TTL Secondary Client Agreement.



Drilling Co.: <i>Tri-State Drilling</i>	TTL Project No.: <i>100811080</i>	Remarks: Borehole dry upon completion of drilling activities and 24 hours after completion of drilling activities. Boring offset to avoid equipment.
Driller: <i>Fred Reynolds</i>	Date Drilled: <i>7/11/2011</i>	
Logged by: <i>M. Wall</i>	Boring Depth: <i>15 feet</i>	
Equipment: <i>CME 55</i>	Boring Elevation: <i>566 feet</i>	
Hammer Type: <i>Automatic</i>	Coordinates: <i>Not Available</i>	
Drilling Method: <i>Hollow Stem Auger w/SPT Sampling</i>		

SAMPLE DATA

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS CLASSIFICATION	MATERIALS DESCRIPTION	MOISTURE (%)	PPV (tsf)	TYPE	N-COUNT		STANDARD PENETRATION TEST DATA (blows per foot)								
								1st 6"	2nd 6"	3rd 6"	10	20	30	40	50			
								RQD % REC										
				Concrete (7 inches)														
	565		CL	RESIDUUM: Clay, (CL), stiff, silty, reddish brown, moist				3 - 4 - 6 N = 10										
			CH	Clay, (CH), stiff, slightly silty, reddish brown, with trace of gravel sized chert fragments				4 - 4 - 5 N = 9										
5								3 - 4 - 6 N = 10										
	560							5 - 5 - 6 N = 11										
								4 - 6 - 7 N = 13										
10																		
	555																	
15				Boring terminated at 15 feet.														
	550																	

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Fort Campbell, Kentucky

Drilling Co.: <i>Tri-State Drilling</i>	TTL Project No.: <i>100811080</i>
Driller: <i>Fred Reynolds</i>	Date Drilled: <i>7/11/2011</i>
Logged by: <i>M. Wall</i>	Boring Depth: <i>15 feet</i>
Equipment: <i>CME 55</i>	Boring Elevation: <i>563 feet</i>
Hammer Type: <i>Automatic</i>	Coordinates: <i>Not Available</i>
Drilling Method: <i>Hollow Stem Auger w/SPT Sampling</i>	

Remarks:
 Borehole dry upon completion of drilling activities and 24 hours after completion of drilling activities.

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DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS CLASSIFICATION	MATERIALS DESCRIPTION	MOISTURE (%)	PPV (tsf)	TYPE	SAMPLE DATA										
								N-COUNT			STANDARD PENETRATION TEST DATA (blows per foot)							
								1st 6"	2nd 6"	3rd 6"	10	20	30	40	50			
			CH	Topsoil and vegetation (5 inches) RESIDUUM: Clay, (CL), stiff to medium, silty, reddish brown, moist														
	560							7 - 5 - 6 N = 11										
5			CH	Clay, (CH), medium to very stiff, slightly silty, reddish brown, moist, with trace gravel sized chert fragments				3 - 4 - 4 N = 8										
	555							4 - 3 - 3 N = 6										
10								3 - 5 - 6 N = 11										
	550																	
15				Boring terminated at 15 feet.				5 - 8 - 8 N = 16										
	545																	

This boring log shall not be separated from the corresponding Instrument of Service; no third party may rely upon this boring log or the corresponding Instrument of Service absent a written TTL Secondary Client Agreement.



Drilling Co.: <i>Tri-State Drilling</i>	TTL Project No.: <i>100811080</i>
Driller: <i>Fred Reynolds</i>	Date Drilled: <i>7/7/2011</i>
Logged by: <i>M. Wall</i>	Boring Depth: <i>15 feet</i>
Equipment: <i>CME 55</i>	Boring Elevation: <i>564 feet</i>
Hammer Type: <i>Automatic</i>	Coordinates: <i>Not Available</i>
Drilling Method: <i>Hollow Stem Auger w/SPT Sampling</i>	

Remarks:
 Borehole dry upon completion of drilling activities and 24 hours after completion of drilling activities.

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DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS CLASSIFICATION	MATERIALS DESCRIPTION	MOISTURE (%)	PPV (tsf)	TYPE	N-COUNT		STANDARD PENETRATION TEST DATA (blows per foot)							
								1st 6"	2nd 6"	3rd 6"	10	20	30	40	50		
								RQD % REC									
			CL	Topsoil and vegetation (5 inches) RESIDUUM: Clay, (CL), medium, silty, reddish brown, moist				5 - 5 - 3 N = 8									
5			CH	Clay, (CH), medium to very stiff, slightly silty, reddish brown, with trace gravel sized chert fragments				3 - 4 - 4 N = 8									
10								4 - 6 - 8 N = 14									
15				Boring terminated at 15 feet.				7 - 8 - 9 N = 17									

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Drilling Co.: <i>Tri-State Drilling</i>	TTL Project No.: <i>100811080</i>
Driller: <i>Fred Reynolds</i>	Date Drilled: <i>7/7/2011</i>
Logged by: <i>M. Wall</i>	Boring Depth: <i>5 feet</i>
Equipment: <i>CME 55</i>	Boring Elevation: <i>560 feet</i>
Hammer Type: <i>Automatic</i>	Coordinates: <i>Not Available</i>
Drilling Method: <i>Hollow Stem Auger w/SPT Sampling</i>	

Remarks:
 Borehole dry upon completion of drilling activities and 24 hours after completion of drilling activities.

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS CLASSIFICATION	MATERIALS DESCRIPTION	MOISTURE (%)	PPV (tsf)	TYPE	SAMPLE DATA							
								N-COUNT			STANDARD PENETRATION TEST DATA (blows per foot)				
								1st 6"	2nd 6"	3rd 6"	10	20	30	40	50
	560		CL	Topsoil and vegetation (6 inches) RESIDUUM: Clay, (CL), medium, silty, reddish brown to brown, moist				4 - 4 - 4 N = 8							
5	555			Boring terminated at 5 feet.				3 - 3 - 4 N = 7							
10	550														
15	545														

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Drilling Co.: <i>Tri-State Drilling</i>	TTL Project No.: <i>100811080</i>
Driller: <i>Fred Reynolds</i>	Date Drilled: <i>7/7/2011</i>
Logged by: <i>M. Wall</i>	Boring Depth: <i>5 feet</i>
Equipment: <i>CME 55</i>	Boring Elevation: <i>562 feet</i>
Hammer Type: <i>Automatic</i>	Coordinates: <i>Not Available</i>
Drilling Method: <i>Hollow Stem Auger w/SPT Sampling</i>	

Remarks:
 Borehole dry upon completion of drilling activities and 24 hours after completion of drilling activities.

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS CLASSIFICATION	MATERIALS DESCRIPTION	MOISTURE (%)	PPV (tsf)	TYPE	SAMPLE DATA										
								N-COUNT			STANDARD PENETRATION TEST DATA (blows per foot)							
								1st 6"	2nd 6"	3rd 6"	10	20	30	40	50			
			CL	Topsoil and vegetation (4 inches) RESIDUUM: Clay, (CL), stiff, silty, reddish brown														
5	560			Boring terminated at 5 feet.				4 - 6 - 5 N = 11										
	555							4 - 4 - 5 N = 9										
10																		
	550																	
15																		
	545																	

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Drilling Co.: <i>Tri-State Drilling</i>	TTL Project No.: <i>100811080</i>	Remarks: Borehole dry upon completion of drilling activities and 24 hours after completion of drilling activities.
Driller: <i>Fred Reynolds</i>	Date Drilled: <i>7/7/2011</i>	
Logged by: <i>M. Wall</i>	Boring Depth: <i>5 feet</i>	
Equipment: <i>CME 55</i>	Boring Elevation: <i>564 feet</i>	
Hammer Type: <i>Automatic</i>	Coordinates: <i>Not Available</i>	
Drilling Method: <i>Hollow Stem Auger w/SPT Sampling</i>		

SAMPLE DATA

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DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS CLASSIFICATION	MATERIALS DESCRIPTION	MOISTURE (%)	PPV (tsf)	TYPE	N-COUNT			STANDARD PENETRATION TEST DATA (blows per foot)						
								1st 6"	2nd 6"	3rd 6"	10	20	30	40	50		
								RQD	% REC								
				Topsoil and vegetation (4 inches) FILL: clay, (CL), silty, brown, with some gravel sized limestone fragments													
	560		CL	RESIDUUM: Clay, (CL), stiff, silty, reddish brown				4 - 5 - 6 N = 11									
5				Boring terminated at 5 feet.				5 - 5 - 5 N = 10									
	555																
10																	
	550																
15																	
	545																

* This boring log shall not be separated from the corresponding instrument of Service; no third party may rely upon this boring log or the corresponding instrument of Service absent a written TTL Secondary Client Agreement.



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Page 1 of 1

Drilling Co.: <i>Tri-State Drilling</i>	TTL Project No.: <i>100811080</i>
Driller: <i>Fred Reynolds</i>	Date Drilled: <i>7/7/2011</i>
Logged by: <i>M. Wall</i>	Boring Depth: <i>5 feet</i>
Equipment: <i>CME 55</i>	Boring Elevation: <i>562 feet</i>
Hammer Type: <i>Automatic</i>	Coordinates: <i>Not Available</i>
Drilling Method: <i>Hollow Stem Auger w/SPT Sampling</i>	

Remarks:
 Borehole dry upon completion of drilling activities and 24 hours after completion of drilling activities.

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS CLASSIFICATION	MATERIALS DESCRIPTION	MOISTURE (%)	PPV (tsf)	TYPE	SAMPLE DATA									
								N-COUNT			STANDARD PENETRATION TEST DATA (blows per foot)						
								1st 6"	2nd 6"	3rd 6"	10	20	30	40	50		
			CH	Topsoil and vegetation (5 inches) RESIDUUM: Clay, (CH), stiff, slightly silty, reddish brown				4 - 4 - 5 N = 9									
5				Boring terminated at 5 feet.				3 - 5 - 7 N = 12									
	560																
	555																
10																	
	550																
15																	
	545																

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Drilling Co.: <i>Tri-State Drilling</i>	TTL Project No.: <i>100811080</i>
Driller: <i>Fred Reynolds</i>	Date Drilled: <i>7/11/2011</i>
Logged by: <i>M. Wall</i>	Boring Depth: <i>10 feet</i>
Equipment: <i>CME 55</i>	Boring Elevation: <i>565 feet</i>
Hammer Type: <i>Automatic</i>	Coordinates: <i>Not Available</i>
Drilling Method: <i>Hollow Stem Auger w/SPT Sampling</i>	

Remarks:
 Borehole dry upon completion of drilling activities and 24 hours after completion of drilling activities.

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DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS CLASSIFICATION	MATERIALS DESCRIPTION	MOISTURE (%)	PPV (tsf)	TYPE	SAMPLE DATA										
								N-COUNT			STANDARD PENETRATION TEST DATA (blows per foot)							
								1st 6"	2nd 6"	3rd 6"	10	20	30	40	50			
	565		CL	Topsoil and vegetation (6 inches) RESIDUUM: Clay, (CL), medium, silty, reddish brown to dark reddish brown														
								2 - 4 - 4 N = 8										
5	560		CH	Clay, (CH), medium, slightly silty, reddish brown, moist, with some gravel sized chert fragments				5 - 7 - 7 N = 14										
								2 - 3 - 4 N = 7										
10	555			Boring terminated at 10 feet.				2 - 3 - 5 N = 8										
15	550																	

* This boring log shall not be separated from the corresponding Instrument of Service; no third party may rely upon this boring log or the corresponding Instrument of Service absent a written TTL Secondary Client Agreement.



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Drilling Co.: <i>Tri-State Drilling</i>	TTL Project No.: <i>100811080</i>	Remarks: Borehole dry upon completion of drilling activities and 24 hours after completion of drilling activities.
Driller: <i>Fred Reynolds</i>	Date Drilled: <i>7/11/2011</i>	
Logged by: <i>M. Wall</i>	Boring Depth: <i>10 feet</i>	
Equipment: <i>CME 55</i>	Boring Elevation: <i>563 feet</i>	
Hammer Type: <i>Automatic</i>	Coordinates: <i>Not Available</i>	
Drilling Method: <i>Hollow Stem Auger w/SPT Sampling</i>		

SAMPLE DATA

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS CLASSIFICATION	MATERIALS DESCRIPTION	MOISTURE (%)	PPV (tsf)	TYPE	STANDARD PENETRATION TEST DATA (blows per foot)													
								N-COUNT			RQD										
								1st 6"	2nd 6"	3rd 6"	% REC										
				Topsoil and vegetation (5 inches) RESIDUUM: Clay, (CL), soft to stiff, dark reddish brown, moist																	
	560		CL					3 - 2 - 2 N = 4													
5								3 - 5 - 5 N = 10													
	555								3 - 3 - 5 N = 8												
10									4 - 4 - 5 N = 9												
				Boring terminated at 10 feet.																	
	550																				
15																					
	545																				

\\192.168.45.10\NASHVILLE\SERVER\PROJECTS\2011 PROJECTS\FT CAMPBELL\FT. KNOX BORING SAMPLES.GPJ 8/16/11 Report:2010 GEOTECH W/SPT (LSW SPECIAL)

This boring log shall not be separated from the corresponding Instrument of Service; no third party may rely upon this boring log or the corresponding Instrument of Service absent a written TTL Secondary Client Agreement.



BARGE WAGGONER SUMNER & CANNON, INC.
FORT CAMPBELL MH 47 HANGAR

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SOIL BORING RMP-5

geotechnical - analytical - materials - environmental

Fort Campbell, Kentucky

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Drilling Co.: <i>Tri-State Drilling</i>	TTL Project No.: <i>100811080</i>	Remarks: Borehole dry upon completion of drilling activities and 24 hours after completion of drilling activities.
Driller: <i>Fred Reynolds</i>	Date Drilled: <i>7/8/2011</i>	
Logged by: <i>M. Wall</i>	Boring Depth: <i>10 feet</i>	
Equipment: <i>CME 55</i>	Boring Elevation: <i>564 feet</i>	
Hammer Type: <i>Automatic</i>	Coordinates: <i>Not Available</i>	
Drilling Method: <i>Hollow Stem Auger w/SPT Sampling</i>		

I:\192.168.45.10\NASHVILLE\SERVER\PROJECTS\2011 PROJECTS\FT CAMPBELL\FT. KNOX BORING SAMPLES.GPJ 8/16/11 Report:2010 GEOTECH W/SPT (LSW SPECIAL)

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS CLASSIFICATION	MATERIALS DESCRIPTION	MOISTURE (%)	PPV (tsf)	TYPE	SAMPLE DATA										
								N-COUNT			STANDARD PENETRATION TEST DATA (blows per foot)							
								1st 6"	2nd 6"	3rd 6"	10	20	30	40	50			
				Topsoil and vegetation (7 inches)														
			CL	RESIDUUM: Clay, (CL), stiff, silty, dark reddish brown				5 - 5 - 6 N = 11										
	560							5 - 5 - 6 N = 11										
5			CH	Clay, (CH), stiff, slightly silty, reddish brown, with trace of gravel sized chert fragments				2 - 6 - 7 N = 13										
	555							4 - 4 - 7 N = 11										
10				Boring terminated at 10 feet.														
	550																	
15																		
	545																	

This boring log shall not be separated from the corresponding Instrument of Service; no third party may rely upon this boring log or the corresponding Instrument of Service absent a written TTL Secondary Client Agreement.



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BARGE WAGGONER SUMNER & CANNON, INC.
FORT CAMPBELL MH 47 HANGAR

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LOG OF BORING RMP-6

Fort Campbell, Kentucky

Page 1 of 1

Drilling Co.: <i>Tri-State Drilling</i>	TTL Project No.: <i>100811080</i>
Driller: <i>Fred Reynolds</i>	Date Drilled: <i>7/8/2011</i>
Logged by: <i>M. Wall</i>	Boring Depth: <i>10 feet</i>
Equipment: <i>CME 55</i>	Boring Elevation: <i>564 feet</i>
Hammer Type: <i>Automatic</i>	Coordinates: <i>Not Available</i>
Drilling Method: <i>Hollow Stem Auger w/SPT Sampling</i>	

Remarks:
 Borehole dry upon completion of drilling activities and 24 hours after completion of drilling activities.
 Boring likely drilled within limits of previous pond area.

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DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS CLASSIFICATION	MATERIALS DESCRIPTION	MOISTURE (%)	PPV (tsf)	TYPE	N-COUNT		STANDARD PENETRATION TEST DATA (blows per foot)								
								1st 6"	2nd 6"	3rd 6"	10	20	30	40	50			
								RQD % REC										
				Topsoil and vegetation (7 inches)														
				FILL: clay, silty, dark reddish brown to grayish brown, moist														
	560							3 - 3 - 4 N = 7										
5																		
			CL	Clay, (CL), very silty, grayish brown, wet (probable original ground surface)														
			CL	RESIDUUM: Clay, (CL), silty, very stiff, reddish brown, with some gravel sized chert fragments														
	555							1 - 2 - 1 N = 3										
10																		
				Boring terminated at 10 feet.														
	550																	
15																		
	545																	

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BARGE WAGGONER SUMNER & CANNON, INC.
FORT CAMPBELL MH 47 HANGAR

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LOG OF BORING RMP-7

Fort Campbell, Kentucky

Page 1 of 1

Drilling Co.: <i>Tri-State Drilling</i>	TTL Project No.: <i>100811080</i>
Driller: <i>Fred Reynolds</i>	Date Drilled: <i>7/8/2011</i>
Logged by: <i>M. Wall</i>	Boring Depth: <i>10 feet</i>
Equipment: <i>CME 55</i>	Boring Elevation: <i>565 feet</i>
Hammer Type: <i>Automatic</i>	Coordinates: <i>Not Available</i>
Drilling Method: <i>Hollow Stem Auger w/SPT Sampling</i>	

Remarks:
 Borehole dry upon completion of drilling activities and 24 hours after completion of drilling activities.

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DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS CLASSIFICATION	MATERIALS DESCRIPTION	MOISTURE (%)	PPV (tsf)	TYPE	SAMPLE DATA											
								N-COUNT			STANDARD PENETRATION TEST DATA (blows per foot)								
								1st 6"	2nd 6"	3rd 6"									
	565			Topsoil and vegetation (4 inches) FILL: clay, (CL), silty, reddish brown, moist, with trace of gravel sized limestone fragments															
5	560							5 - 5 - 5 N = 10											
			CL	RESIDUUM: Clay, (CL), stiff, silty, reddish brown				4 - 4 - 4 N = 8											
10	555							2 - 2 - 3 N = 5											
				Boring terminated at 10 feet.				3 - 4 - 6 N = 10											

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BARGE WAGGONER SUMNER & CANNON, INC.
FORT CAMPBELL MH 47 HANGAR

Fort Campbell, Kentucky

Drilling Co.: <i>Tri-State Drilling</i>	TTL Project No.: <i>100811080</i>
Driller: <i>Fred Reynolds</i>	Date Drilled: <i>7/11/2011</i>
Logged by: <i>M. Wall</i>	Boring Depth: <i>10 feet</i>
Equipment: <i>CME 55</i>	Boring Elevation: <i>564 feet</i>
Hammer Type: <i>Automatic</i>	Coordinates: <i>Not Available</i>
Drilling Method: <i>Hollow Stem Auger w/SPT Sampling</i>	

Remarks:
 Borehole dry upon completion of drilling activities and 24 hours after completion of drilling activities.

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS CLASSIFICATION	MATERIALS DESCRIPTION	MOISTURE (%)	PPV (tsf)	TYPE	SAMPLE DATA									
								N-COUNT			STANDARD PENETRATION TEST DATA (blows per foot)						
								1st 6"	2nd 6"	3rd 6"	10	20	30	40	50		
			CL	Topsoil and vegetation (5 inches) RESIDUUM: Clay, (CL), stiff to medium, silty, reddish brown to brown, moist				3 - 5 - 4 N = 9									
	560																
5			CH	Clay, (CH), medium, slightly silty, reddish brown, moist, with trace gravel sized chert fragments				3 - 3 - 4 N = 7									
	555							2 - 4 - 4 N = 8									
10				Boring terminated at 10 feet.				3 - 4 - 4 N = 8									
	550																
15																	
	545																

I:\192.168.45.10\NASHVILLE\SERVER\PROJECTS\2011 PROJECTS\FT CAMPBELL\FT. KNOX BORING SAMPLES.GPJ 8/16/11 Report:2010 GEOTECH W/SPT (LSW SPECIAL)

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BARGE WAGGONER SUMNER & CANNON, INC.
FORT CAMPBELL MH 47 HANGAR

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NO. OF BORING
RMP-9

geotechnical - analytical - materials - environmental

Fort Campbell, Kentucky

Page 1 of 1

Drilling Co.: <i>Tri-State Drilling</i>	TTL Project No.: <i>100811080</i>
Driller: <i>Fred Reynolds</i>	Date Drilled: <i>7/11/2011</i>
Logged by: <i>M. Wall</i>	Boring Depth: <i>10 feet</i>
Equipment: <i>CME 55</i>	Boring Elevation: <i>564 feet</i>
Hammer Type: <i>Automatic</i>	Coordinates: <i>Not Available</i>
Drilling Method: <i>Hollow Stem Auger w/SPT Sampling</i>	

Remarks:
 Borehole dry upon completion of drilling activities and 24 hours after completion of drilling activities.

I:\92.168.45.10\NASHVILLE\SERVER\PROJECTS\2011 PROJECTS\FT CAMPBELL\FT. KNOX BORING SAMPLES.GPJ 8/16/11 Report:2010 GEOTECH W/SPT (LSW SPECIAL)

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS CLASSIFICATION	MATERIALS DESCRIPTION	MOISTURE (%)	PPV (tsf)	TYPE	SAMPLE DATA										
								N-COUNT			STANDARD PENETRATION TEST DATA (blows per foot)							
								1st 6"	2nd 6"	3rd 6"	10	20	30	40	50			
				Topsoil and vegetation (4 inches) FILL: clay, silty, grayish brown to brown														
	560		CH	RESIDUUM: Clay, (CH), medium, slightly silty, reddish brown, moist				4 - 5 - 7 N = 12										
5								2 - 3 - 2 N = 5										
	555							2 - 3 - 4 N = 7										
10				Boring terminated at 10 feet.				2 - 3 - 5 N = 8										
	550																	
15																		
	545																	

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BARGE WAGGONER SUMNER & CANNON, INC.
FORT CAMPBELL MH 47 HANGAR

Fort Campbell, Kentucky

Drilling Co.: <i>Tri-State Drilling</i>	TTL Project No.: <i>100811080</i>
Driller: <i>Fred Reynolds</i>	Date Drilled: <i>7/11/2011</i>
Logged by: <i>M. Wall</i>	Boring Depth: <i>10 feet</i>
Equipment: <i>CME 55</i>	Boring Elevation: <i>565 feet</i>
Hammer Type: <i>Automatic</i>	Coordinates: <i>Not Available</i>
Drilling Method: <i>Hollow Stem Auger w/SPT Sampling</i>	

Remarks:
 Borehole dry upon completion of drilling activities and 24 hours after completion of drilling activities.

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS CLASSIFICATION	MATERIALS DESCRIPTION	MOISTURE (%)	PPV (tsf)	TYPE	SAMPLE DATA										
								N-COUNT			STANDARD PENETRATION TEST DATA (blows per foot)							
								1st 6"	2nd 6"	3rd 6"	10	20	30	40	50			
	565		CH	Topsoil and vegetation (5 inches) RESIDUUM: Clay, (CH), stiff to very stiff, slightly silty, reddish brown, with trace to some gravel sized chert fragments														
	560							2 - 6 - 6 N = 12										
5								3 - 4 - 6 N = 10										
	555							4 - 8 - 13 N = 21										
10				Boring terminated at 10 feet.				4 - 8 - 10 N = 18										
	550																	

I:\192.168.45.10\NASHVILLE\SERVER\PROJECTS\2011\PROJECTS\FT CAMPBELL\FT. KNOX BORING SAMPLES.GPJ 8/16/11 Report:2010 GEOTECH W/SPT (LSW SPECIAL)

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BARGE WAGGONER SUMNER & CANNON, INC.
FORT CAMPBELL MH 47 HANGAR

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LOG OF BORING
RMP-11

geotechnical - analytical - materials - environmental

Fort Campbell, Kentucky

Page 1 of 1

Drilling Co.: <i>Tri-State Drilling</i>	TTL Project No.: <i>100811080</i>
Driller: <i>Fred Reynolds</i>	Date Drilled: <i>7/11/2011</i>
Logged by: <i>M. Wall</i>	Boring Depth: <i>10 feet</i>
Equipment: <i>CME 55</i>	Boring Elevation: <i>565 feet</i>
Hammer Type: <i>Automatic</i>	Coordinates: <i>Not Available</i>
Drilling Method: <i>Hollow Stem Auger w/SPT Sampling</i>	

Remarks:
 Borehole dry upon completion of drilling activities and 24 hours after completion of drilling activities.

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS CLASSIFICATION	MATERIALS DESCRIPTION	MOISTURE (%)	PPV (tsf)	TYPE	SAMPLE DATA										
								N-COUNT			STANDARD PENETRATION TEST DATA (blows per foot)							
								1st 6"	2nd 6"	3rd 6"	10	20	30	40	50			
	565		CL	Topsoil and vegetation (4 inches) RESIDUUM: Clay, (CL), medium, silty, dark reddish brown, moist														
			CH	Clay, (CH), stiff, slightly silty, reddish brown to yellowish brown				2 - 3 - 3 N = 6										
5	560							2 - 5 - 7 N = 12										
								4 - 6 - 8 N = 14										
10	555			Boring terminated at 10 feet.				3 - 5 - 6 N = 11										
15	550																	

\\192.168.45.10\NASHVILLE\SERVER\PROJECTS\2011 PROJECTS\FT CAMPBELL\FT. KNOX BORING SAMPLES.GPJ 8/16/11 Report:2010 GEOTECH W/SPT (LSW SPECIAL)

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BARGE WAGGONER SUMNER & CANNON, INC.
FORT CAMPBELL MH 47 HANGAR

Fort Campbell, Kentucky

Drilling Co.: <i>Tri-State Drilling</i>	TTL Project No.: <i>100811080</i>
Driller: <i>Fred Reynolds</i>	Date Drilled: <i>7/11/2011</i>
Logged by: <i>M. Wall</i>	Boring Depth: <i>10 feet</i>
Equipment: <i>CME 55</i>	Boring Elevation: <i>565 feet</i>
Hammer Type: <i>Automatic</i>	Coordinates: <i>Not Available</i>
Drilling Method: <i>Hollow Stem Auger w/SPT Sampling</i>	

Remarks:
 Borehole dry upon completion of drilling activities and 24 hours after completion of drilling activities.

\\192.168.45.10\NASHVILLE\SERVER\PROJECTS\2011 PROJECTS\FT CAMPBELL\FT. KNOX BORING SAMPLES.GPJ 8/16/11 Report:2010 GEOTECH W/SPT (LSW SPECIAL)

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS CLASSIFICATION	MATERIALS DESCRIPTION	MOISTURE (%)	PPV (tsf)	TYPE	SAMPLE DATA									
								N-COUNT			STANDARD PENETRATION TEST DATA (blows per foot)						
								1st 6"	2nd 6"	3rd 6"	10	20	30	40	50		
	565		CL	Topsoil and vegetation (5 inches) RESIDUUM: Clay, (CL), medium, silty, reddish brown, moist				3 - 3 - 4 N = 7									
5	560		CH	Clay, (CH), stiff, slightly silty, reddish brown, with trace of gravel sized chert fragments				2 - 3 - 5 N = 8									
								3 - 6 - 8 N = 14									
10	555			Boring terminated at 10 feet.				2 - 5 - 6 N = 11									
15	550																

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BARGE WAGGONER SUMNER & CANNON, INC.
FORT CAMPBELL MH 47 HANGAR

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LOG OF BORING
RMP-14

geotechnical • analytical • materials • environmental

Fort Campbell, Kentucky

Page 1 of 1

Drilling Co.: <i>Tri-State Drilling</i>	TTL Project No.: <i>100811080</i>
Driller: <i>Fred Reynolds</i>	Date Drilled: <i>7/11/2011</i>
Logged by: <i>M. Wall</i>	Boring Depth: <i>10 feet</i>
Equipment: <i>CME 55</i>	Boring Elevation: <i>562 feet</i>
Hammer Type: <i>Automatic</i>	Coordinates: <i>Not Available</i>
Drilling Method: <i>Hollow Stem Auger w/SPT Sampling</i>	

Remarks:
 Borehole dry upon completion of drilling activities and 24 hours after completion of drilling activities.

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS CLASSIFICATION	MATERIALS DESCRIPTION	MOISTURE (%)	PPV (tsf)	TYPE	SAMPLE DATA										
								N-COUNT			STANDARD PENETRATION TEST DATA (blows per foot)							
								1st 6"	2nd 6"	3rd 6"	10	20	30	40	50			
				Topsoil and vegetation (7 inches)														
			CH	RESIDUUM: Clay, (CH), stiff, slightly silty, reddish brown, moist														
	560							5 - 6 - 7 N = 13										
5								4 - 8 - 6 N = 14										
	555							3 - 5 - 8 N = 13										
10				Boring terminated at 10 feet.				4 - 5 - 6 N = 11										
	550																	
15																		
	545																	

I:\192.168.45.10\NASHVILLE\SERVER\PROJECTS\2011 PROJECTS\FT CAMPBELL\FT. KNOX BORING SAMPLES.GPJ 8/16/11 Report:2010 GEOTECH W/SPT (LSW SPECIAL)

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 geotechnical • analytical • materials • environmental	BARGE WAGGONER SUMNER & CANNON, INC. FORT CAMPBELL MH 47 HANGAR	Page 36 of 40 LOG OF BORING RMP-15
Fort Campbell, Kentucky		Page 1 of 1

Drilling Co.: <i>Tri-State Drilling</i>	TTL Project No.: <i>100811080</i>	Remarks: Borehole dry upon completion of drilling activities and 24 hours after completion of drilling activities.
Driller: <i>Fred Reynolds</i>	Date Drilled: <i>7/11/2011</i>	
Logged by: <i>M. Wall</i>	Boring Depth: <i>10 feet</i>	
Equipment: <i>CME 55</i>	Boring Elevation: <i>564 feet</i>	
Hammer Type: <i>Automatic</i>	Coordinates: <i>Not Available</i>	
Drilling Method: <i>Hollow Stem Auger w/SPT Sampling</i>		

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS CLASSIFICATION	MATERIALS DESCRIPTION	MOISTURE (%)	PPV (tsf)	TYPE	SAMPLE DATA										
								N-COUNT			STANDARD PENETRATION TEST DATA (blows per foot)							
								1st 6"	2nd 6"	3rd 6"	10	20	30	40	50			
		↓ ↓ ↓		Topsoil and vegetation (4 inches)														
			CL	RESIDUUM: Clay, (CL), stiff, silty, dark reddish brown			X	3 - 4 - 5 N = 9	●									
	560		CH	Clay, (CH), stiff, slightly silty, reddish brown, with trace of gravel sized chert fragments			X	2 - 4 - 6 N = 10	●									
5							X	3 - 6 - 7 N = 13	●									
	555						X	4 - 5 - 6 N = 11	●									
10				Boring terminated at 10 feet.														
	550																	
15																		
	545																	

\\192.168.45.10\NASHVILLE\SERVER\PROJECTS\2011 PROJECTS\FORT CAMPBELL\FT. KNOX BORING SAMPLES.GPJ 8/16/11 Report:2010 GEOTECH W/SPT (LSW SPECIAL)

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BARGE WAGGONER SUMNER & CANNON, INC.
FORT CAMPBELL MH 47 HANGAR

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LOG OF BORING
RMP-16

Fort Campbell, Kentucky

Page 1 of 1

Drilling Co.: <i>Tri-State Drilling</i>	TTL Project No.: <i>100811080</i>	Remarks: Borehole dry upon completion of drilling activities and 24 hours after completion of drilling activities.
Driller: <i>Fred Reynolds</i>	Date Drilled: <i>7/11/2011</i>	
Logged by: <i>M. Wall</i>	Boring Depth: <i>10 feet</i>	
Equipment: <i>CME 55</i>	Boring Elevation: <i>565 feet</i>	
Hammer Type: <i>Automatic</i>	Coordinates: <i>Not Available</i>	
Drilling Method: <i>Hollow Stem Auger w/SPT Sampling</i>		

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS CLASSIFICATION	MATERIALS DESCRIPTION	MOISTURE (%)	PPV (tsf)	TYPE	SAMPLE DATA											
								N-COUNT			STANDARD PENETRATION TEST DATA (blows per foot)								
								1st 6"	2nd 6"	3rd 6"	10	20	30	40	50				
	565			Topsoil and vegetation (7 inches)															
			CH	RESIDUUM: Clay, (CH), stiff, slightly silty, dark reddish brown				3 - 4 - 6 N = 10											
5	560							3 - 5 - 6 N = 11											
								2 - 4 - 6 N = 10											
10	555			Boring terminated at 10 feet.				2 - 4 - 5 N = 9											
15	550																		

\\192.168.45.10\NASHVILLE\SERVER\PROJECTS\2011 PROJECTS\FT CAMPBELL\FT. KNOX BORING SAMPLES.GPJ 8/16/11 Report:2010 GEOTECH W/SPT (LSW SPECIAL)

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*Geotechnical Exploration
Proposed MH-47 Hangar Addition
Fort Campbell, Kentucky
TTL Proposal No. 100811080*

APPENDIX 2

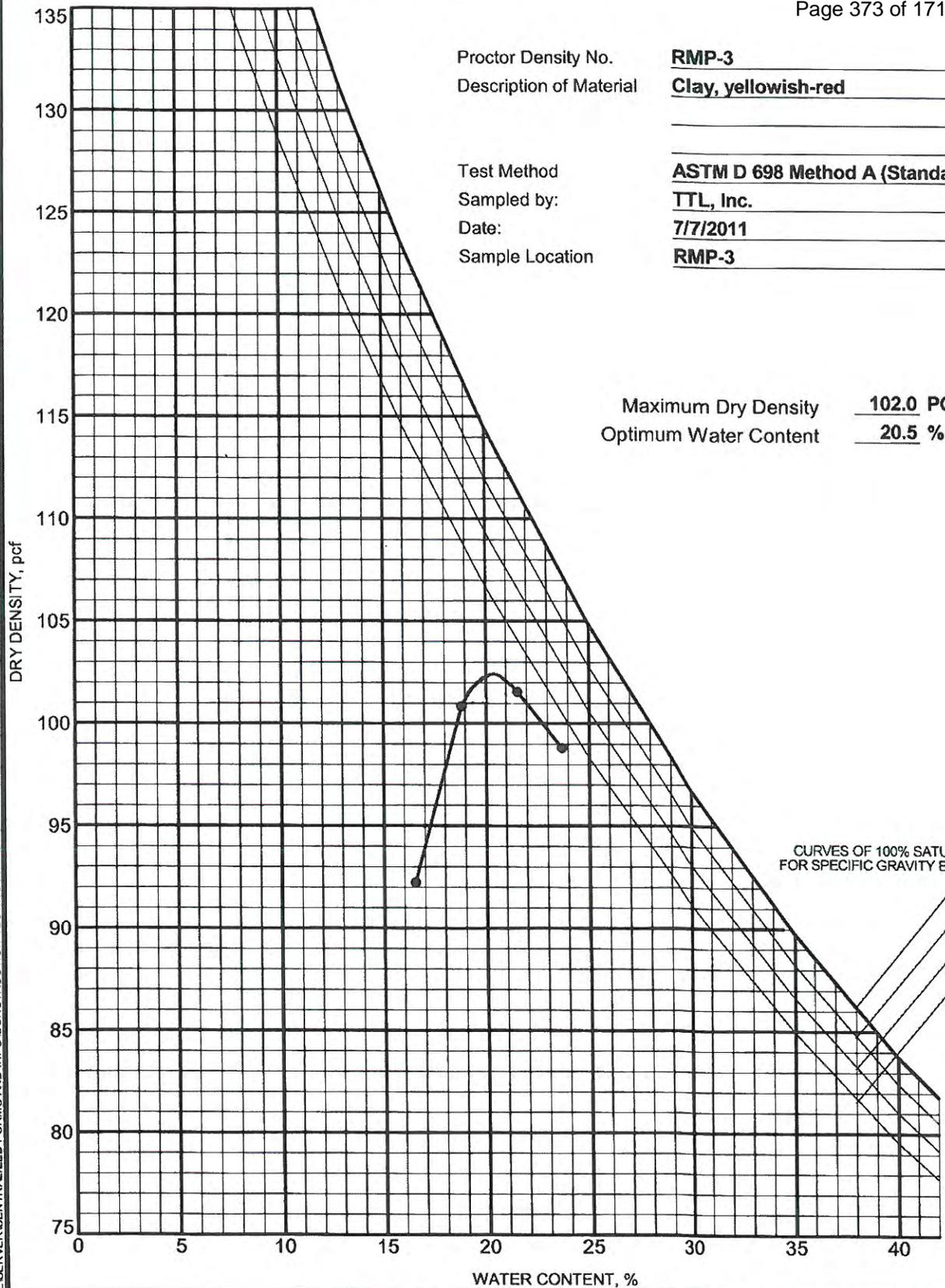
**LABORATORY
TEST DATA**

Boring	Depth	Date Sampled	Classification	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Dry Density (pcf)	Saturation (%)	Void Ratio
MH-3	1 - 2.5	7/7/2011	CH	24	56	18	38					
MH-4	1 - 2.5	7/7/2011		22								
MH-4	4 - 6	7/7/2011		23						98.9		
MH-4	6 - 7.5	7/7/2011		25								
MH-4	8.5 - 10	7/7/2011		29								
MH-4	13.5 - 15	7/7/2011		35								
MHPK-2	1 - 2.5	7/7/2011		20								
MHPK-2	3.5 - 5	7/7/2011		21								
RMP-10	6 - 7.5	7/7/2011	CH	35	65	29	36		88			
RMP-12	1 - 2.5	7/7/2011		20								
RMP-12	3.5 - 5	7/7/2011		22								
RMP-12	6 - 7.5	7/7/2011		28								
RMP-12	8.5 - 10	7/7/2011		37								
RMP-14	3.5 - 5	7/7/2011	CH	24	55	19	36					
RMP-2	3.5 - 5	7/7/2011	CL	24	43	22	21					
RMP-3	1 - 2.5	7/7/2011		21								
RMP-3	3.5 - 5	7/7/2011		23								
RMP-3	6 - 7.5	7/7/2011		26								
RMP-3	8.5 - 10	7/7/2011		28								

9/8/11 Report:SOIL SUMMARY - MANUAL \\192.168.45.10\NASHVILLE\SERVER\CENTRALIZED FORMS AND INFO\CONSTRUCTION TESTING\AMY'S FOLDER\FORT CAMPBELL.GPJ

 geotechnical • analytical • materials • environmental	<h3>Summary of Laboratory Results</h3>
	Client: Barge Waggoner Sumner & Cannon, Inc. Project: Fort Campbell SOF MH47 Hanger Location: Fort Campbell, Tennessee Project Number: 100811080

I:\TTL\2\3\NASHVILLE\SERVER\CENTRALIZED FORMS AND INFO\CONSTRUCTION TESTING\WV\MS FOLDER\FORT CAMPBELL-BULK SAMPLE.GPJ 7/28/11 Report.PD-2011 NOSIG (AUTO)



Proctor Density No. RMP-3
 Description of Material Clay, yellowish-red
 Test Method ASTM D 698 Method A (Standard)
 Sampled by: TTL, Inc.
 Date: 7/7/2011
 Sample Location RMP-3

Maximum Dry Density 102.0 PCF
 Optimum Water Content 20.5 %

CURVES OF 100% SATURATION
 FOR SPECIFIC GRAVITY EQUAL TO:
 2.90
 2.80
 2.70
 2.60



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PROCTOR MOISTURE-DENSITY RELATIONSHIP

Client: Barge Waggoner Sumner & Cannon, Inc.
 Project: Fort Campbell SOF MH47 Hanger
 Location: Fort Campbell, Tennessee
 Project Number: 100811080

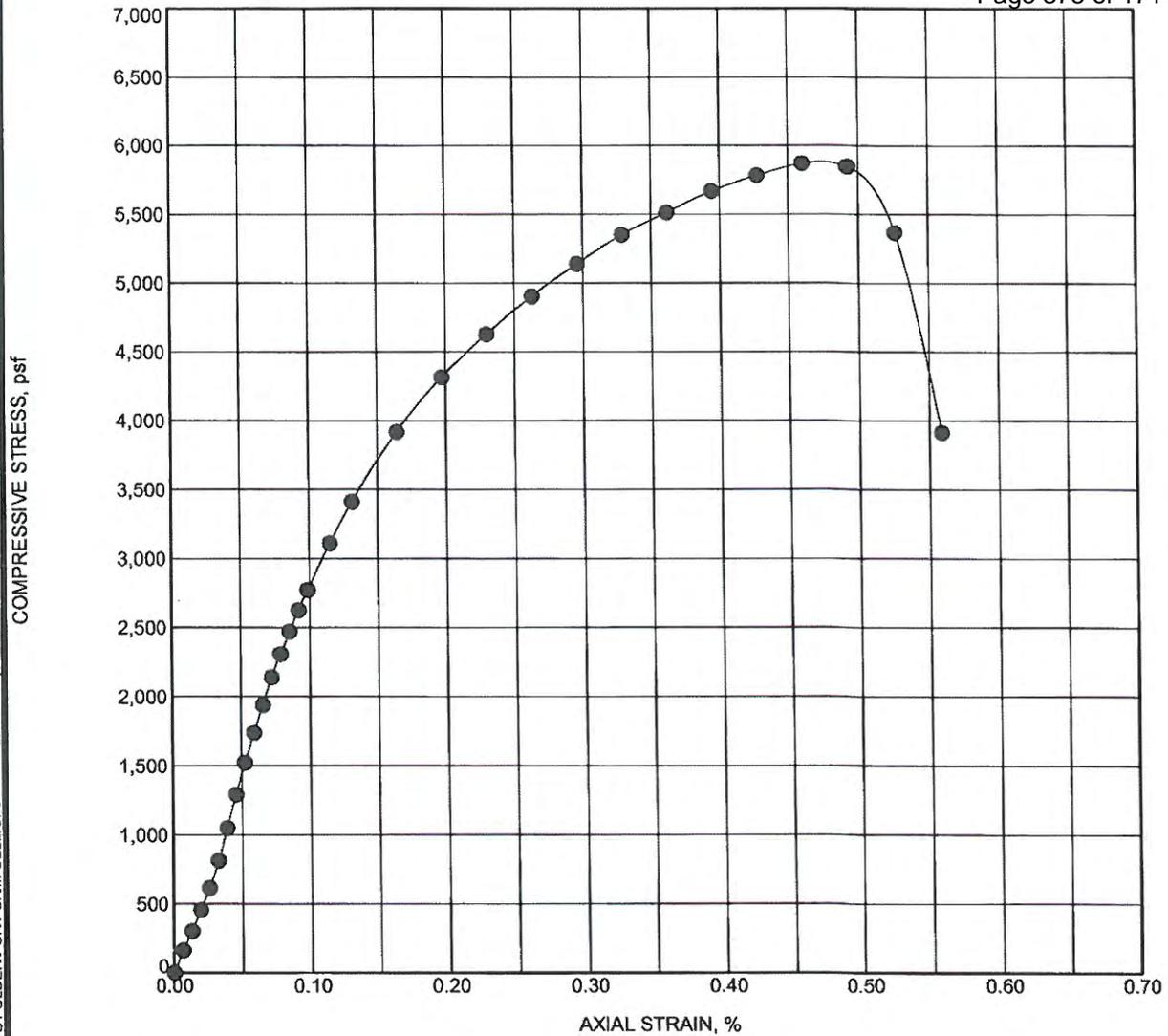
Project Name: Fort Campbell AdditionsProject No. 100811080Location: Fort Campbell, TennesseeDate 7/7/2011

Boring	Depth (feet)	Natural Moisture Content (%)	Date Sampled	USCS Classification		R cm
RWH-3	1.0 - 2.5	19.5	7/7/2011	Clay, silty, yellowish-red	CL	6767.7
MH-3	1.0 - 2.5	24.0	7/7/2011	Clay, dark red	CH	6661.2

TTL

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\\TTL2\K3\ASH\ASHVILLE\SERVER\CENTRALIZED FORMS AND INFO\CONSTRUCTION TESTING\AMYS FOLDER\FORT CAMPBELL.GPJ 7/28/11 Report\UNCONF COMP MANUAL



Boring ID		Sample Depth		Date Sampled	Date Tested		
MH-4		4 - 6 ft of 15 ft boring		7/7/2011	7/7/2011		
Unconfined Strength (psf)	Undrained Shear Strength (psf)	Failure Strain (%)	Strain Rate (in./min.)	Test Method			
5870.1	2935.0	0.5	0.040	ASTM D 2166			
USCS Classification		Liquid Limit	Plastic Limit	Plastic Index	Specific Gravity	Type	
Clay, reddish-brown ()		---	---	---		Undisturbed	
Water Content %	Wet Density (pcf)	Dry Density (pcf)	Saturation %	Void Ratio	Specimen Diameter (in.)	Specimen Height (in.)	Height/Diameter Ratio
23.3	122.0	98.9			2.830	5.990	2.12

 geotechnical • analytical • materials • environmental	UNCONFINED COMPRESSION TEST	
	Client: Barge Waggoner Sumner & Cannon, Inc. Project: Fort Campbell SOF MH47 Hanger Location: Fort Campbell, Tennessee Project Number: 100811080	

*Geotechnical Exploration
Proposed MH-47 Hangar Addition
Fort Campbell, Kentucky
TTL Project No. 100811080*

APPENDIX 3

**PAVEMENT DESIGN
CALCULATIONS**



Project: _____

Subject: PCC MH-47

I	II	III	IV	V	V/III
AIRCRAFT	WEIGHT (LB)	PASSES (20M)	PRELIMINARY THICKNESS	ALLOWABLE PASSES AT 13"	
MH-476	26,000	146,000	7"	10 x 10 ⁶	68.50
C-17	450,000	36,500	13"	36,500	1.0
				Σ	36,568.50 PASSES w/ C-17

UFC 3-260-02
30 June 2001

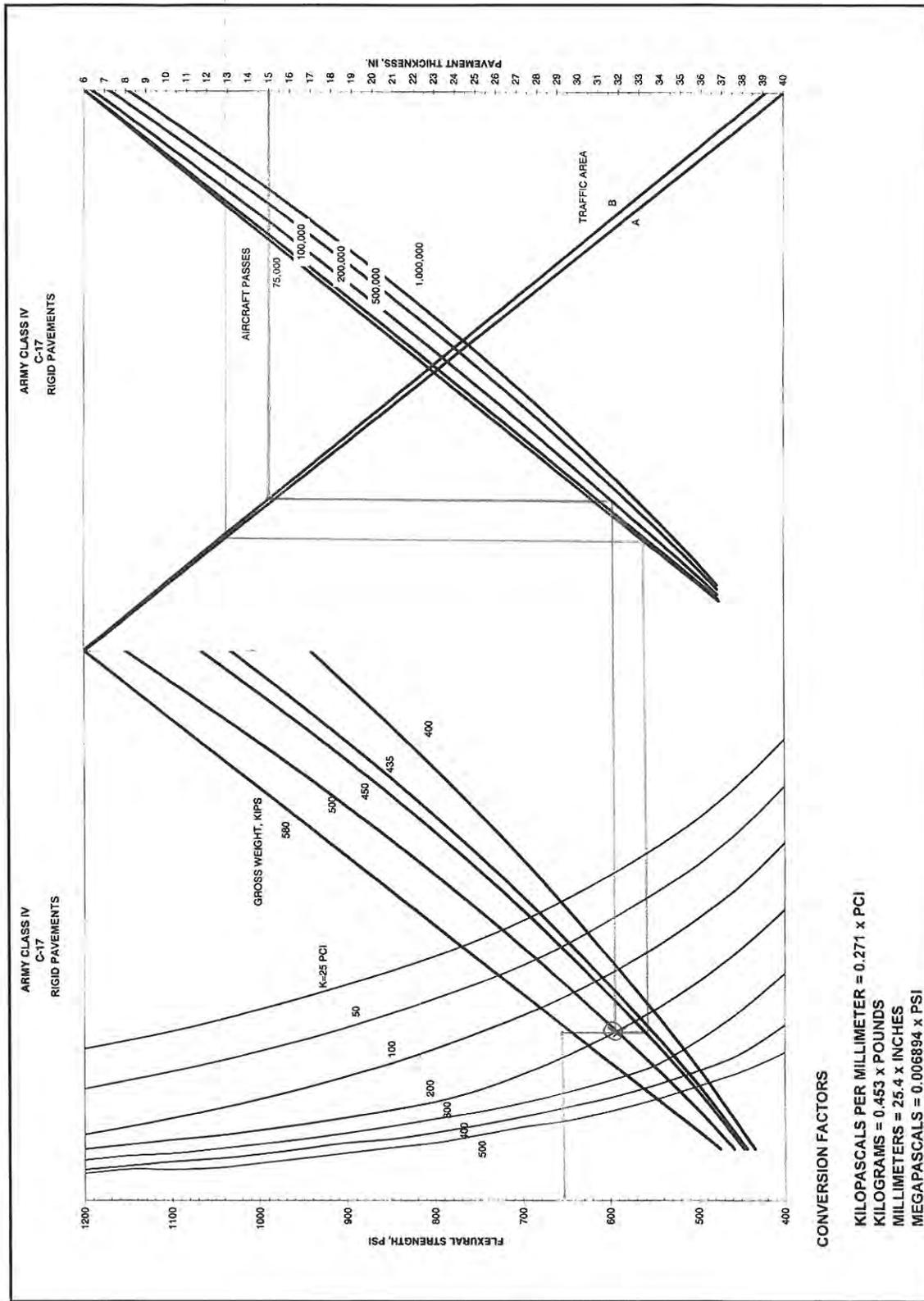


Figure 12-5. Plain concrete design curves for army Class IV airfields (C-17 aircraft) with runway > 2,745 meters (9,000 feet)

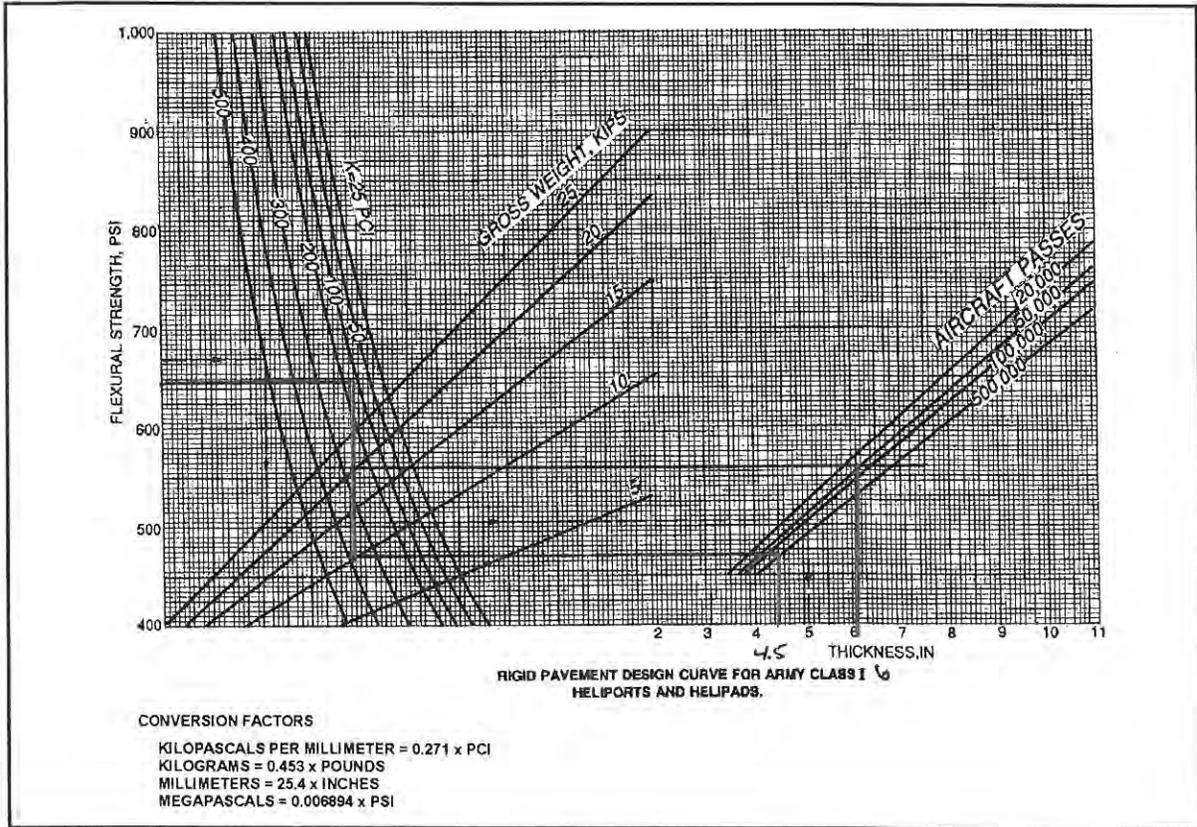


Figure 12-1. Plain concrete design curves for Army Helipads, Class I



GEOTECHNICAL

Subsurface Investigations
Sinkhole Evaluation
Distress Studies
Engineering Geology
Seismic Studies

ANALYTICAL

Certified Analytical Laboratory
Biotoxicity Services
NPDES Permitting and Monitoring
Source Water Assessment Plans
Sampling and Field Services

MATERIALS

Soil
Concrete
Steel
Aggregate
Pavement

ENVIRONMENTAL

Phase I & II Studies
Regulatory Permitting
Wetland Evaluations
Asbestos/Radon/Mold
Hydrogeology

P.O. Box 292950 Nashville, TN 37229

* 5010 Linbar Drive Nashville, TN 37211

* Phone 615.331.7770

* Fax 615.331.7771

APPENDIX B
List of Drawings

Not Used

APPENDIX C
Utility Connections

Utility Procedures

PARAGRAPH

- F-1 [Introduction](#)
- F-2 [Record Drawings](#)
- F-3 [Metering](#)
- F-4 [Distribution Lines](#)
- F-5 [Existing Lines to be Removed](#)
- F-6 [New Service Lines](#)
- F-7 [Plans and Specifications](#)
- F-8 [Utility Cost Estimate](#)
- F-9 [Utility Company Contracts](#)

[Return to Table of Contents](#)

[Return to Section 02510](#)

[Return to Sanitary Sewers](#)

[Return to Section 02556](#)



The natural gas distribution system, the water distribution system for domestic and fire, and the sewer systems at Fort Campbell are now privately owned and operated by utility companies.

This is an outline of the recommended procedures for dealing with the utility aspects of facility design projects. Variation from this procedure is expected, depending upon the project. However, revised procedures should be agreed upon during the early design stages of a project. Unless noted otherwise in the design scope of work, the utility companies will install new service lines to buildings.

The utility companies are active players in the planning, design, and construction process of each building project.

Utility company contacts are provided below.

F-2 RECORD DRAWINGS:

The utility companies maintain as-built record utility drawings for the installation. To obtain utility drawings, refer to UTILITY COMPANY CONTACTS below.

F-3 METERING:

Metering of gas, steam, heating hot water, electricity, fuel oil, etc. is required by UFC 3-400-01 Energy Conservation.

Metering of water is required for all buildings where potable water demand is estimated to exceed 100,000 gallons per year.

Connection of the meters to the Energy Monitoring and Control System (EMCS) is required.

The gas utility company will install a regulator, an emergency gas connection, a seismic shutoff valve, and a meter with a pulse initiator for EMCS. [A typical gas service meter assembly at the building is attached for information.](#) Coordinate the location of this assembly with the utility company and show the location on the drawings and indicate that the installation is by the gas utility company.

Where required, a building domestic water meter will be provided inside the building mechanical room by the water company. Coordinate the location of this meter with the utility company and show the location on the drawings and indicate that the installation is by the water utility company.

The fire sprinkler water will not be metered.

F-4 DISTRIBUTION LINES:

The utility company will determine whether changes to the utility distribution systems will be required. The cost, schedule, and execution of the upgrade to the distribution system will be handled by Fort Campbell and the utility company as a contract action separate from the building project.

F-5 EXISTING LINES TO BE REMOVED:

Unused lines will be removed by the utility company.

F-6 NEW SERVICE LINES:

The building designer determines the required capacity of each service line and the preferred location of the building service entrance.

The building designer determines the required gas pressure into the building (typically 14 inches water column).

The building designer obtains the installation utility record drawings (maps) from the utility company.

The building designer coordinates with the utility companies to determine and share the following information concerning the service lines:

- Flow
- Estimated consumption
- Line size
- Routing
- Tie-in points to the main distribution system
- Location of the utility service entrance to the building
- Location of the gas regulator / meter / emergency connection / seismic shutoff valve assembly
- Location of valves including the post indicator valve for the fire sprinkler system
- Location of the water meter
- The type of backflow preventer on the incoming domestic water service lines, usually a reduced pressure type
- The type of backflow preventer on the incoming fire sprinkler line, usually a double check type. However if there are additives such as antifreeze or foam in the system or if there is a second non-potable water source connected to the sprinkler system, a reduced pressure type is required.
- Location of existing utility lines to be removed

F-7 PLANS AND SPECIFICATIONS:

On the design drawings, the building designer shows:

- The routing of the new utility service lines, noted to be installed by others
- The location of building meters and regulator assemblies, noted to be installed by others
- The location of fire hydrants, noted to be installed by others
- The location of water line valves in the service lines, noted to be installed by others
- The location of post indicator valves, noted to be installed by others
- The location of utility lines to be removed, noted to be removed by others
- The main gas pressure
- The required building gas pressure
- The available static and residual water pressure and associated flow

Utility installation details are not shown.

Fire department connections are included in the contract as part of the sprinkler work.

The backflow preventers for domestic water and for fire sprinkler service are to be located inside the building and will be included in the building construction contract.

The building designer sends the design drawings to the utility companies. This should be done during concept design and during final design.

The utility company reviews the drawings and coordinates any required changes with the building designer.

The building designer includes a provision in the specifications that the building construction contractor must coordinate with the utility companies on the timing and sequence of work for the installation of the utilities. The utility contacts for utility work during construction below are to be included in the design documents.

The design documents must indicate that the utility company applies for all permits from the appropriate state authorities.

F-8 UTILITY COST ESTIMATE:

The building designer has no involvement in the gas and water utility cost estimate.

F-9 UTILITY COMPANY CONTACTS:

NATURAL GAS:

To obtain record drawings, to discuss gas service line capacity, size, routing, and tie-in points to the main distribution system, and for coordination of gas utility work during construction or for inspection of contractor installed lines:

Randall Lewis
Clarksville Gas and Water Co.
Phone: 931-542-9600
Fax: 931-542-9601

WATER AND SEWER:

To obtain water and sewer record drawings, to discuss water and sewer service line capacity, size, routing, and tie-in points to the main distribution system, and for coordination of water and sewer utility work during construction or for inspection of contractor installed lines:

Chris Semler
CH2M Hill Co.
Phone: 931-431-2015
Fax: 931-431-0952



APPENDIX D
Results of Fire Flow Tests

Appendix D

Fire Flow Test Data

Centralized fire pumps and water storage tanks serve the hangars in the area of this facility. This provides the data on the existing fire pumps and water storage system. The existing fire pumps are located in building 6623. The existing fire line will be extended to the new hangar as part of this contract.

Fire Pumps

Fire Pump (typical of 3)

Fairbanks Morse

6" Pump Model 1824BF

S/N K4H1-027100-Q

1500 GPM @ 125 PSI, 1750 RPM

Cummins Diesel Engine

Family 403

Model 6BTA5.9-F1

Generator: (1 unit)

Cummins Diesel Engine

Model 4BT8.9-G4

S/N 45924343

Water Storage: 500,000 gallons

APPENDIX E
Environmental Information

RECORD OF ENVIRONMENTAL CONSIDERATION

To: DPW - Environmental Division
Building 2182, 13 ½ Street
Fort Campbell, KY 42223

From: DPW – Master Plans Division
Building 852, 16th Street
Fort Campbell, KY 42223

Project Title: Construct SOF MH-47 Hangar (PN 76374)

Brief Description: Construct a MH-47 aviation maintenance hangar (approximately 105,000 SF) to include maintenance bays, shops, company administration and readiness, platoon offices, aviation operations, locker room and storage areas. Work also includes construction of an MH-47 parking ramp, C-17 unloading ramp (approximately 780,000 SY total), relocation of the existing TACAN, information systems, fire protection/alarm systems, and Energy Monitoring and Control Systems (EMCS) connection. Sustainable Design and Development (SDD) and Energy Policy Act of 2005 (EPA05) features will be provided. Supporting facilities include site development, utilities and connections, lighting, paving, parking, walks, curbs and gutters, storm drainage, information systems, landscaping and signage. Heating and air conditioning will be provided by self contained systems. Measures in accordance with the Department of Defense (DoD) Minimum Antiterrorism for Buildings standards will be provided. Air Conditioning (Estimated 200 Tons).

Anticipated date and/or duration of the proposed action: FY 2012

Reason for using record of environmental consideration: The proposed action is adequately covered in an EA entitled "Standard Practices for Construction Projects in the Cantonment Area", dated 3 May 2004. The EA may be reviewed at DPW, Environmental Division, Building 2182, 13½ Street, Fort Campbell, Kentucky. However, the mitigation/minimization measures, as developed while using the attached REC checklist, must be implemented while this project is being accomplished.

Any change to the footprint of this project may result in a re-evaluation of its environmental impacts.

This document **DOES NOT** relieve the proponent of compliance with applicable Federal, State and Local laws and regulations. *Compliance with the following federal, state, and local laws and regulations is required before the project can be implemented:*

- 1. Clean Air Act - The contractor must coordinate with the Air Program for GCR Analysis before beginning any activity. GCR checklist must be submitted.**
- 2. Clean Water Act - A Storm Water Pollution Prevention Plan is required. Storm water and sediment must not leave the site; storm water quality/quantity must not exceed preconstruction levels. Storm water BMPs must be in place prior to construction and maintained until disturbed areas stabilize.**
- 3. Solid Waste - Coordinate with SW/R Program for approval of Construction and Demolition Waste Management Plan (WMP). Minimum 50% waste diversion is required. Actual waste diversion must be reported to the Solid Waste Program upon project completion.**
- 4. Hazardous Materials - The Contractor must submit the FTCKY HAZMAT INVENTORY FORM and corresponding material safety data sheets (MSDS) prior to beginning action. The contractor shall submit an annual report on the use of HM and generation of HW on post.**
- 5. Solid Waste Management Unit – The location of this project is within a solid waste management unit group (SWMUG). Proponent must provide the Fort Campbell Environmental Division Restoration Program with project drawings and details so we can notify and ask for permission from the proper authorities.**
- 6. Storage Tanks - Two aboveground storage tanks (AST) and one underground storage tank (UST) are within the footprint of this project. Coordinate with Russell Godsave for removal, 270.798.9637.**

This REC is valid for up to 2 years from date of Installation Environmental Coordinator's signature.

Sally Castleman, Chief, Master Plans Division *Sally P Castleman* 29 Oct 10
Project Proponent Date

Rondal G. Ballard, Chief, Environmental Division *Rondal G Ballard* 11/02/10
Installation Environmental Coordinator Date

Project Title: Construct SOF MH-47 Hangar (PN 76374)

Project Coordination Sheet

Program	Further Coordination Required		Requirements
	YES	NO	
Air Pollution Program 798-9603	X		<p>The contractor must coordinate with the Air Program for GCR Analysis before beginning any activity. GCR checklist must be submitted.</p> <p>Refer to Section r, 4f(2) of this document.</p>
Stormwater Program 798-9784	X		<p>All projects that disturb soil will require a Storm Water Pollution Prevention Plan (SWPPP). SWPPPs must be developed by the proponent/contractor and submitted to the Storm Water Program. Proponents are obligated to determine permit requirements with the assistance of the Fort Campbell Environmental Division, Storm Water Program. Coordinate with the Storm Water Program prior to beginning action.</p> <p>BMPs must control pollutants and sediment runoff as well as the increased volume of storm water discharged from the construction site to protect streams, drainage systems, sinkholes, and Class V injection wells. Storm water BMPs must be in place prior to construction and maintained until disturbed areas stabilize. Temporary BMPs must be removed upon stabilization.</p> <p>Refer to Section r, 4e(6) of this document.</p>
Solid Waste 798-9773	X		<p>Coordinate with SW/R Program for approval of Construction and Demolition Waste Management Plan (WMP). Minimum 50% waste diversion is required. All military construction, renovation, and demolition project contracts shall include requirements for 50% minimum diversion of C&D waste, by WEIGHT, from landfill disposal. Contract specifications must also require submission of the contractor's C&D Waste Management Plan prior to the start of land disturbance operations. Actual waste diversion must be reported to the Solid Waste Program upon project completion.</p> <p>Refer to Section r, 4j(1) of this document.</p>
SWMU 798-9768	X		<p>This project is within a solid waste management unit group (SWMUG). The Environmental Protection Agency (EPA) Hazardous Waste Permit (KY5210020140) prohibits unauthorized action within the permitted facility. This project cannot begin until we receive approval from the KY state regulatory agency. Please provide the Fort Campbell Environmental Division Restoration Program with project drawings and details so we can notify and ask for permission from the proper authorities. Any action that may impact the integrity of the SWMU will require coordination with the Fort Campbell Environmental Division Restoration Program (270) 798-9768.</p>

Storage Tanks 798-9637	X		<p>Two aboveground storage tanks (AST) and one underground storage tank (UST) are within the footprint of this project. One AST and one UST is adjacent to Building 7262; the other AST is inside Building 7293. Please coordinate with Russell Godsave for removal, 270.798.9637.</p> <p>Contractor must follow all procedures related to the installation or removal of all storage tanks, and all procedures relating to spill cleanup outlined in the Fort Campbell Technical Design Guide.</p> <p>Refer to Section r, 4o(1) of this document.</p>
Spill Response Program 798-9641		X	
Hazardous Material 798-9771	X		<p>The contractor must complete and submit the FTCKY HAZMAT INVENTORY FORM and corresponding material safety data sheets (MSDS) prior to beginning action. Form shall include type and quantity of hazardous materials (HM) to be brought on post. Contact Laura Macpherson, 270.798.9771, for coordination of hazmat deliveries and MSDS submittals prior to beginning action. The contractor shall submit an annual report on the use of HM and generation of HW on post.</p> <p>Refer to Section r, 4m(1) of this document.</p>
Hazardous Waste 798-9786		X	
Wetlands 798-9854		X	
Noise 798-9854		X	
Ag. Lease 798-9856		X	
Forestry 798-2616		X	
Lead/Asbestos 798-9604		X	
Wildlife/Endangered Species 798-9855		X	
Cultural Resources 798-7437		X	
NEPA Program 798-9854		X	

RECORD OF ENVIRONMENTAL CONSIDERATION (REC) CHECKLIST

1. TO: DPW - Environmental Division
Building 2182, 13 ½ Street
Fort Campbell, KY 42223

2. FROM: DPW - Master Plans Division
Building 852, 16th Street
Fort Campbell, KY 42223

3. PROJECT IDENTIFICATION

a. Project Number:

b. Project Title: Construct SOF MH-47 Hangar (PN 76374)

c. Project Description: Construct a MH-47 aviation maintenance hangar (approximately 105,000 SF) to include maintenance bays, shops, company administration and readiness, platoon offices, aviation operations, locker room and storage areas. Work also includes construction of an MH-47 parking ramp, C-17 unloading ramp (approximately 780,000 SY total), relocation of the existing TACAN, information systems, fire protection/alarm systems, and Energy Monitoring and Control Systems (EMCS) connection. Sustainable Design and Development (SDD) and Energy Policy Act of 2005 (EPA05) features will be provided. Supporting facilities include site development, utilities and connections, lighting, paving, parking, walks, curbs and gutters, storm drainage, information systems, landscaping and signage. Heating and air conditioning will be provided by self contained systems. Measures in accordance with the Department of Defense (DoD) Minimum Antiterrorism for Buildings standards will be provided. Air Conditioning (Estimated 200 Tons).

d. Anticipated start date and duration of project: FY 2012

4. ENVIRONMENTAL CHECKLIST
a. NEPA

- (1) Does this action involve controversy or uncertainty over the nature or extent of environmental impact? **NO**
- (2) Is this action the subject of extraordinary circumstance which require an EA or EIS? **NO**

b. Forestry

- (1) Will it result in the removal of Hardwood trees or any tree over 6" in diameter? **NO**

c. Wildlife/Threatened and Endangered Species

- (1) May this action affect a state and/or federally listed species? **NO**
- (2) May it adversely modify a federally listed species' critical habitat? **NO**
- (3) Does this action affect any Migratory bird species of concern or their habitat? **NO**

d. Cultural Resources

- (1) Are cultural resource inventories required for the affected area? **NO**

(2) Will this action result in an effect on:

(a) A historic property listed or eligible for listing on the National Register of Historic Places? **NO**

(b) A property designated as a National Historic Landmark? **NO**

(3) Will the action affect the performance of ceremonial rites or access to sites important in traditional Native American religions? **NO**

(4) Will the action affect human remains or funerary objects from Native American graves? **NO**

(5) Will the action result in the removal of items of archaeological interest or excavations that will require an ARPA permit? **NO**

e. Water Resources

(1) Will this action take place in a floodplain or have an impact on a floodplain? **NO**

(2) Does the proposed action impact a blue line or intermittent stream bank or channel? **NO**

(3) Will this action take place in a wetland or result in a net loss of wetlands? **NO**

(4) Is this action affected by water standards promulgated under one or more of these water programs:
(a) discharge of oil or hazardous substances; (b) National Pollutant Discharge Elimination System; and
(c) State water Quality Standards? **YES**

(5) Is this action affected by the drinking water standards of: (a) EPA, or a state which has assumed primacy in enforcing drinking water standards, or (b) affects groundwater or sole source aquifers? **NO**

(6) Does this action have a potential impact on storm water quality and/or quantity? **YES**

f. Air Quality

(1) Is there a significant impact resulting from the review of relevant Clean Air Act related Federal, State, and local regulations concerning this action? **NO**

(2) Is there potential that the action will result in other than minimal or no individual or cumulative negative impact on ambient air quality? **YES**

g. Agriculture Outlease

(1) Will this action have an affect on a current or future Agricultural Lease field? **NO**

h. Noise

(1) Is this action affected by noise standards? **NO**

i. Pesticides

(1) Is this action affected by purchase, use, storage, or disposal of pesticides? **NO**

j. Solid Waste

- (1) Is this action affected by solid waste disposal standards under one or more of these waste programs:
 (a) procurement of recycled and recyclable products; (b) source separation of recyclable products;
 (c) solid waste storage; (d) solid waste transport; (e) solid waste disposal? **YES**

k. Restoration

- (1) Is the site on a RCRA Solid Waste Management Unit or Area of Concern (SWMU/AOC) or are there any SWMUs/AOCs on the site in consideration? **YES**

l. Lead Based Paint / Radon / Asbestos

- (1) Is this action affected by the Radon Gas and Indoor Air Quality Research Act of 1986? **NO**
- (2) Is this action affected by EPA Regulation on Asbestos? **NO**

m. Hazardous Materials

- (1) Does this action involve the use or disposal of hazardous materials? **YES**

n. Hazardous Waste

- (1) Does this action include the procurement of goods, services, or materials from a facility on the EPA's list of violating facilities? **NO**
- (2) Is this action affected by EPA regulations on hazardous waste: (a) identification; (b) generation; (c) treatment, storage or disposal facility; or (d) permits? **NO**
- (3) Is this action affected by DOT regulations on hazardous material transportation? **NO**

o. Storage Tanks

- (1) Does this action affect any known underground or above ground storage tank? **YES**

p. Real Estate

- (1) Does this action involve the lease or disposal of real property? **NO**
- (2) Will this action involve the selling or transfer of Real Property where any type of activity relating to hazardous substances has ever occurred? **NO**

q. Construction

- (1) Will it result in construction and/or a construction contract? **YES**
- (2) Does this action include direct federal development, the planning or construction of public works, physical facilities and installations or real property development (including the acquisition, use and disposal of real property) undertaken by or for the use of the Federal Government or any of its agencies; or the leasing of real property for federal use where the use of such property will be substantially altered? **NO**
- (3) Does this action include the maintenance or retrofit of an existing federal building or construction of or lease of a new federal building? **NO**

r. Minimization

If you answered **YES** to any of the above questions then explain below how the problem or concern will be minimized or mitigated.

ITEM NO.**MINIMIZED BY**

4e(4) All land disturbing activity will be conducted in accordance with the Fort Campbell Erosion and Sediment Control Policy as posted on the FTC Environmental web site. All contractors need to be aware of any Wetlands, Sinkholes or Class V Injection Well that may be associated with this project. Coordinate with Mr. Reynolds, Water Program, for review of the Storm Water Pollution Prevention Plan ensure coverage under a Storm Water Discharge General Permit. Storm water controls must be in place prior to beginning any construction action, maintained throughout the construction period, and removed following completion of the project once stabilization efforts meet installation guidelines.

4e(6) The project requires coordination with the Water Quality Program of the Fort Campbell Environmental Division prior to any land disturbance operations taking place. TN General Permit No. TNR-1—0000 Storm Water Discharges from Construction Activities as well as the Kentucky Division of Water KPDES Permit for Construction establishes requirements to ensure compliance of Fort Campbell's commitment to water quality sustainability and the future establishment of state mandated Total Maximum Daily Loads (TMDLs). A copy of the Fort Campbell Policy for Storm Water Erosion and Sediment Control at Construction Projects can be accessed through the Environmental Division's internet website, <http://www.campbell.army.mil/campbell/directorates/DPW/envdiv/Pages/default.aspx>.

Tennessee Department of Environment and Conservation, TDEC, rule 1200-4-3 states, "In unavailable conditions, new or increased discharges of a substance that would cause or contribute to a condition of impairment will not be allowed." Unavailable conditions are defined as, "where water quality is at, or fails to meet, the criterion for one or more parameters." Per the State of TN NPDES permit, "Discharges that would add loadings of a pollutant that is identified as causing or contributing to an impairment of a water body on the list of impaired waters or which would cause degradation to waters designated by TDEC as high quality waters are not authorized." The Storm water pollution prevention plan, SWPPP, must certify that erosion prevention and sediment controls used at the site are designed to control storm runoff generated by a 5-year, 24-hour storm event. Per the TDEC SWPPP general permit, measures need to be installed to control pollutants (to include sediment) and the increased volume of storm water discharges from the construction site. Steep-slope sites require "measures to be installed that will dissipate the volume and energy of the storm water runoff to pre-development levels." Best Management Practices (BMPs) must be in place prior to construction and operational until disturbed areas stabilize. Temporary BMPs must be removed upon stabilization.

BMPs to reduce the potential impact on storm water quality and/or quantity must be adhered to throughout the construction process. Construction design must include structures to reduce the quantity of runoff as well as improve the quality of runoff. Structures must be maintained throughout the life of the project. Bi-weekly inspections and inspections following ½ inch rainfall are required and must be documented. The Storm Water Program must approve of a storm water pollution prevention plan prior to beginning any action, (270) 798-9784.

4f(2) The project, as described, requires coordination with the Air Quality program prior to construction. Fort Campbell was re-designated as an ozone attainment "maintenance" area in 2005. Section 176(c)(1) of the Clean Air Act (CAA) mandates the General Conformity Rule (GCR) analysis be completed by Fort Campbell to establish that any construction activity will not impede the continuation of the attainment status and ensure the action does not impede Kentucky or Tennessee air pollution control efforts in ozone "attainment maintenance areas". The rule requires that an analysis and other procedures (if required as a result of the analysis) be completed prior to the commencement of any of the project activities. In order to make the determination, the contractor will need to acquire the General Conformity Rule Checklist from the Air Quality Program. The checklist concerns equipment types, hours of operation, number of personnel, etc. and is used to calculate estimated emissions. Please contact the Air Quality office at (270) 798-9598 for the checklist or with any questions.

4j(1) All military construction, renovation, and demolition project contracts shall include requirements for 50% minimum diversion of C&D waste, by **WEIGHT**, from landfill disposal. Also, contract specifications must include submission of the contractor's C&D Waste Management Plan, prior to the start of land disturbance operations. Actual waste diversion must be reported to the Solid Waste Program upon project completion.

Per EO 13423, Strengthening Federal Environmental, Energy and Transportation Management, it is the responsibility of the initiator to include Affirmative Procurement (e.g. environmentally preferable, recycled – content products) during the acquisition process of goods and services and maintain effective waste prevention and recycling programs.

A Waste Management Plan (WMP) as required by the Assistant Chief of Staff for Installation Management (ACSIM) policy, Subject: Sustainable Management of Waste in Military Construction, Renovation, and Demolition Activities, dated 11 July 2006, requires construction, and demolition debris management on federally funded projects. This plan shall describe and document each of the following diversion and non-diversion activities: Salvage, Reuse, Source Separation Construction and Demolition Debris Recycling, Co-mingled Construction and Demolition Debris Recycling, and Landfill Disposal. Diversion specifications require at least 50% of construction, renovation, and demolition materials, by **WEIGHT**, including wood, plumbing materials, electrical fixtures and materials, windows, doors, toilet partitions, HVAC equipment, scrap metals, etc. to be diverted from the landfill. See UFGS Section 01 74 19, CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for more detail. Actual waste diversion must be reported to the Fort Campbell Environmental Division, Solid Waste Program upon project completion.

Construction projects requiring soil borrow material or projects having excess soil should be coordinated through DPW Engineering Division, at 270-798-0925.

4k(1) This project is within a solid waste management unit group (SWMUG). The Environmental Protection Agency (EPA) Hazardous Waste Permit (KY5210020140) prohibits unauthorized action within the permitted facility. This project cannot begin until we receive approval from the KY state regulatory agency. Please provide the Fort Campbell Environmental Division Restoration Program with project drawings and details so we can notify and ask for permission from the proper authorities. Any action that may impact the integrity of the SWMU will require coordination with the Fort Campbell Environmental Division Restoration Program (270) 798-9768.

4m(1) The contractor must complete and submit the FTCKY HAZMAT INVENTORY FORM, to include type and quantity of hazardous materials (HM) to be brought to the post and corresponding material safety data sheets (MSDS), prior to beginning action. Contact Laura Macpherson, 270.798.9771, for coordination of hazmat deliveries and MSDS submittals prior to beginning action.

All HM requirements are found in the Fort Campbell Installation Technical Design Guide: See pp. 42-46, 65. As required by the Emergency Planning and Community Right-to-Know Act (EPCRA), the contractor will develop a site specific Environmental Protection Plan, in which "the Contractor will account for the quantity of HM brought to the post, the quantity used or expended during the job, and the leftover quantity which (1) may have additional useful life as HM and shall be removed by the Contractor, or (2) may be hazardous waste" (HW), which shall be removed per Fort Campbell requirements and disposed of offsite according to applicable regulations at the contractor's expense. The contractor shall submit an annual report on the use of HM and generation of HW on post to the Contracting Officer Representative and Environmental Division - Pollution Prevention Branch. Per 49 CFR 171-177, all HM transported to Fort Campbell must be properly containerized and labeled.

The Fort Campbell Technical Design Guide is available on the Fort Campbell Directorate of Public Works website: http://www.campbell.army.mil/campbell/directorates/DPW/Documents/Docs/FTC_Tech_Design_Guide.pdf

The following sections should be reviewed:

- pg. 42-46
- pg. 65 (FTCKY HAZMAT INVENTORY FORM)

4o(1) Aboveground and underground petroleum product storage tanks shall not be permitted at new construction projects without design review and approval by the Directorate of Public Works , Environmental Division Petroleum Storage Tank Program Manager, 270-798-9637. Removal of existing tanks must be coordinated through the Storage Tank Program. Design for used petroleum products holding and storage shall not include tanks. Only 55-gallon drum containers shall be used for hazardous spill containment. Containers must be placed on approved pavement materials properly designed for hazardous spill containment.

Underground Storage Tanks (USTs) shall not be installed without approval from the DPW Environmental Division. If permitted, USTs shall be double walled steel fiberglass coated with interstitial monitoring and automatic tank gauging. The monitoring system shall be compatible with the systems already in use and capable of being remotely monitored by the Environmental Division. No used oil USTs shall be installed. Above Ground Storage Tanks (ASTs) shall not be installed without approval from the DPW Environmental Division. If permitted, ASTs shall follow requirements outlined in the Ft. Campbell: Standard Design Requirements for Aboveground Fuel Tanks prior to submission for permit requests.

Contractor must follow all procedures related to the installation or removal of all storage tanks, and all procedures relating to spill cleanup outlined in the Fort Campbell Technical Design Guide. The Fort Campbell Technical Design Guide is available on the Directorate of Public Works website:

http://www.campbell.army.mil/campbell/directorates/DPW/Documents/Docs/FTC_Tech_Design_Guide.pdf

The following sections should be reviewed:

- Section 2.1.2 (pg 15)
- Section 2.1.3 (pg 16)
- Aboveground Storage Tanks (pg 25)
- Section 01530 (pg 41)
- Site Specific Spill Contingency Plan (pg 65)
- Section A-3.9 (pg 277)

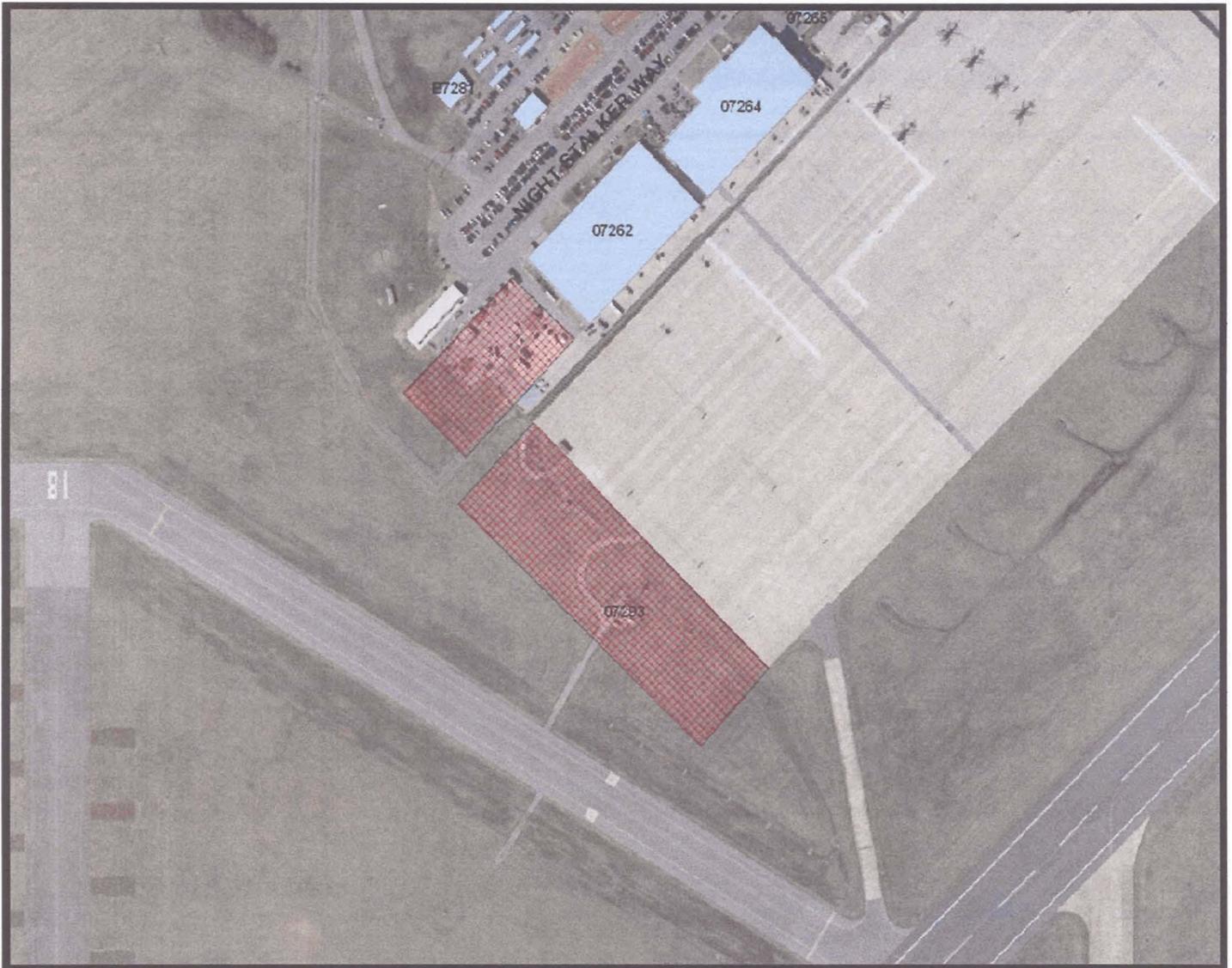
4q(1) Construction activity impacts will be mitigated by utilizing the following:

1. A Site-specific Storm Water Pollution Prevention Plan (SWPPP) as required by Fort Campbell's Policy for Storm Water Erosion and Sediment Control at Construction Projects and developed to include site description, description of storm water runoff controls, erosion prevention and sediment controls, storm water management, description of items needing control, approved local sediment and erosion control requirements, maintenance, inspections, and pollution prevention measures for non-storm water discharges. A SWPPP will be in place before soil disturbance or vegetation removal. Storm water best management practices (BMPs) will be in place and properly installed before soil disturbance or vegetation removal. Included in Fort Campbell's policy are Fort Campbell's Guidance for Low Impact Development and Permanent Storm Drainage Systems and Fort Campbell Construction Site Final Stabilization Specifications. (Technical References "Tennessee Erosion and Sediment Control Handbook" and the "Kentucky Erosion Prevention and Sediment Control Field Guide".)
2. Forestry must survey the area to ensure that no marketable trees will be removed.
3. Clearing and grubbing will be phased and held to a minimum necessary for grading and equipment operation.
4. Threatened and Endangered Species and Cultural sites will be avoided and areas marked prior to remediation to prevent damage and violations.
5. Grading activities will be avoided during periods of highly erosive rainfall or other wet periods.
6. All topsoil will be yarded to the side of the project area and will be re-distributed and seeded once final grade is obtained.

- 7. Equipment will be used that present the least amount of soil impact - disturbance as possible. Final grade, equipment shall be operated up and down the slope to prevent rills and other erosion on the face of the slope.
- 8. Conservation buffer strips will be established between construction sites and all streams or natural drainage ways.
- 9. Conservation buffer strips will also be maintained between the main training sites and sloped areas to maintain any sediment runoff on the actual site. Rip-rap (rock) checks will be placed within the grassed waterways. Road ditch lines will be improved and grassed with rock checks on as needed basis.
- 10. Vehicle ruts, rills, and gullies from erosion will be land smoothed and ground cover will be seeded.
- 11. Fertilizer and other soil enhancement products will be limited or avoided by using mulch as a soil application.
- 12. Gravel and other rock will be limited or avoided by constructing mulch roads and pads. The mulch will later be graded out and added into soil composition.
- 13. Gravel roads will follow the contour on the up slope or flat areas as much as possible. Drainage ditches and natural drains will be cleaned out and maintained to facilitate water drainage as much as possible and with as minimum impact as possible.
- 14. Some gravel will be used in drainage areas to build low water crossings to access/service areas. Geotextile will be placed under low water crossings.
- 15. Trees, shrubs and other vegetation will be maintained to erosion control and enhance tactical concealment of the objectives.
- 16. Combat trails (gravel, hardened roads) will be upgraded and maintained on an as needed basis to facilitate military maneuvers. Service roads will be built to a 11' width including ditch lines, and driving surface. Service road driving surface will be constructed above ground and from fill material from local borrow pit. Fill material shall be inspected and approved. Borrow pit(s) area shall be re-graded to allow drainage and re-seeded (see above directive # 4). Silt fence shall be placed around borrow pit(s) as needed to maintain erosion control – storm water compliance standards.
- 17. On banks of low water crossings and other severe slopes, surface erosion control mats will be staked into place to protect bare ground, and grass seeding will be used to reduce erosion problems. Silt fence will also be in place throughout the project duration. Check dams will be placed in waterways and in road ditches to prevent headcutting on an as needed basis.
- 18. Rip-rap will be placed on the banks of low water crossings and in waterways (lined ditches and rock checks) on an as needed basis. The back slopes of road ditches will be lined with rip-rap to protect the slopes (from vehicle damage) on an as needed basis.

PREPARED BY: Peggy Luthsmann DATE: 26 October 2010
 Peggy Luthsmann, NEPA Coordinator

REVIEWED BY: Gene Zirkle DATE: 10/26/2010
 Gene Zirkle, NEPA Program Manager



APPENDIX F
Conceptual Aesthetic Considerations



FORT CAMPBELL

INSTALLATION DESIGN GUIDE

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April 15, 2006

INSTALLATION DESIGN GUIDE

Fort Campbell, KY

US Army Corps of Engineers, Louisville District
P.O. Box 59
Louisville, KY 40201-0059

and

Fort Campbell, KY
Department of the Army
Headquarters, United States Army Garrison
Fort Campbell, KY 42223-5000

Michael Baker Jr., Inc.
100 Airside Drive
Moon Township, PA 15108

The Baker logo consists of the word "Baker" in a white, sans-serif font, centered within a solid blue rectangular background.

Klavon Design Associates, Inc.
915 Penn Avenue, Suite 1005
Pittsburgh, PA 15222



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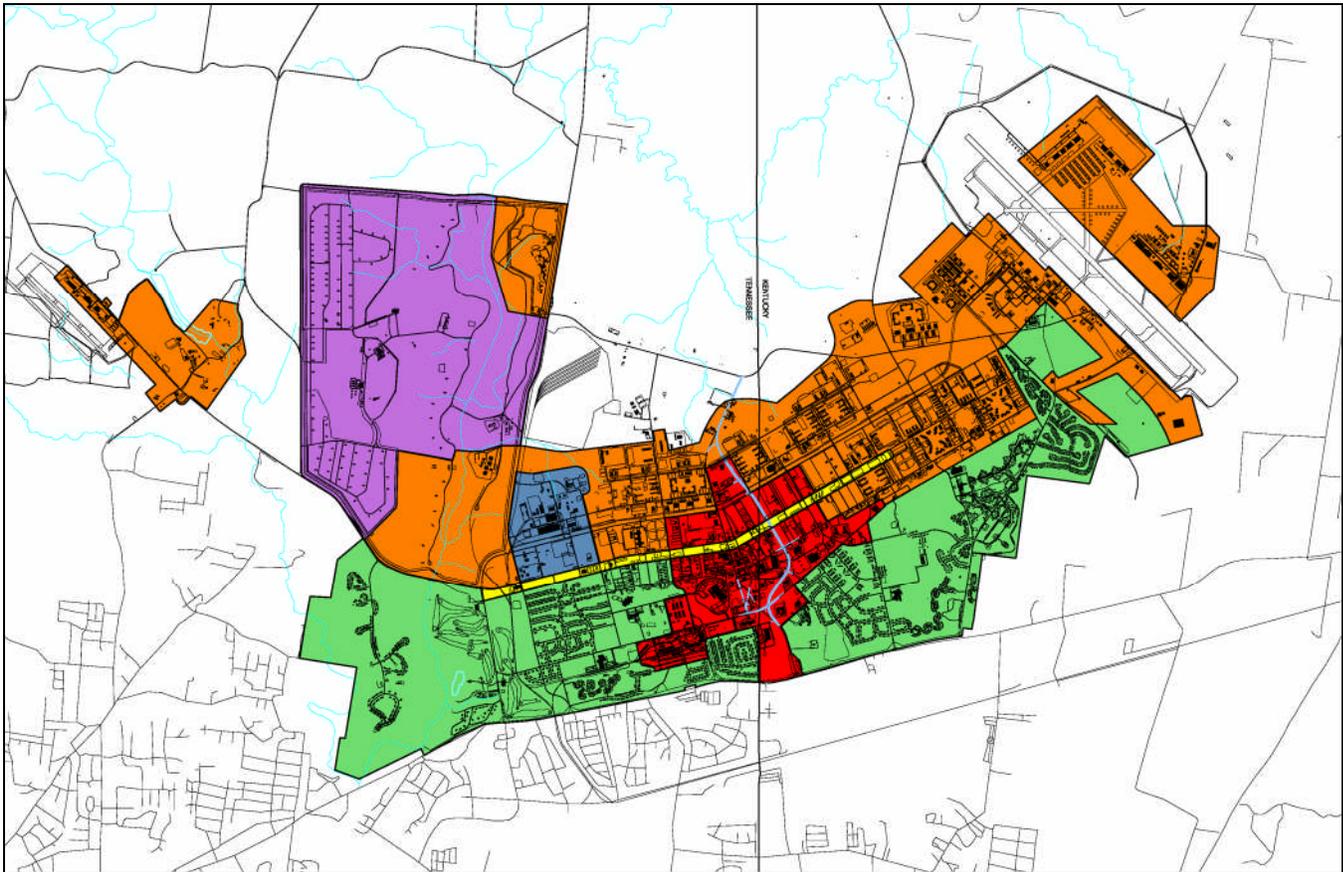


Figure 5-1 Fort Campbell Visual Themes Map

VISUAL THEMES

- TOWN CENTER**
- MEMORIAL BOULEVARD**
- COMMUNITY LIFE**
 - FAMILY HOUSING
 - COMMUNITY FACILITIES
 - PARKS / GREEN SPACE
- BRIGADE COMBAT TRAINING (BCT)**
 - MAINTENANCE / OPERATIONS
 - TROOP HOUSING
- CLARKSVILLE BASE**
- PROPOSED REALIGNMENT OF SCREAMING EAGLE BOULEVARD**



5.1 INTRODUCTION

Visual themes are determined after performing the two surveys mentioned in [paragraph 2.2](#). These surveys were conducted using existing installation maps, visual inspection, interviews, questionnaires, and photographs to record impressions of visual and spatial impacts. The data captured was used to define the visual themes of the installation. The map shown above (Figure 5-1) presents a graphical portrayal of the of the installation's visual themes.

5.2 VISUAL THEMES

Visual themes create a perception of unification within the installation. These themes create design consistency that provides orientation and a "sense of place".

Visual themes provide the same general use and visual characteristics. They include broad scale activities that occur on the installation. These activities typically include similar design and layout characteristics.

Assets and liabilities are determined according to the following criteria: installation visual goals and objectives ([Section 3, para 3.2](#)), design principles ([Section 3, para 3.3](#)) and visual elements ([Section 3, para 3.4](#)) in relationship to the six design components described in Sections 7 through 12 of this Army Installation Design Guide.

The visual analysis maps graphically illustrate the features and constraints that affect the visual character of the theme.

The following paragraphs present a functional analysis of each of the visual themes. This analysis includes a description of the visual character, a visual analysis map, assets, liabilities, and recommendations for each theme.

Recommendations are made to correct the liabilities or enhance the assets. These recommendations are used to generate projects that are listed in [Section 6](#), Improvement Projects.

It should be remembered that the current SPiRiT Standard of the base is currently gold, although the goal is for Platinum. All construction projects proposed as part of these recommendations should aim for the highest standard.

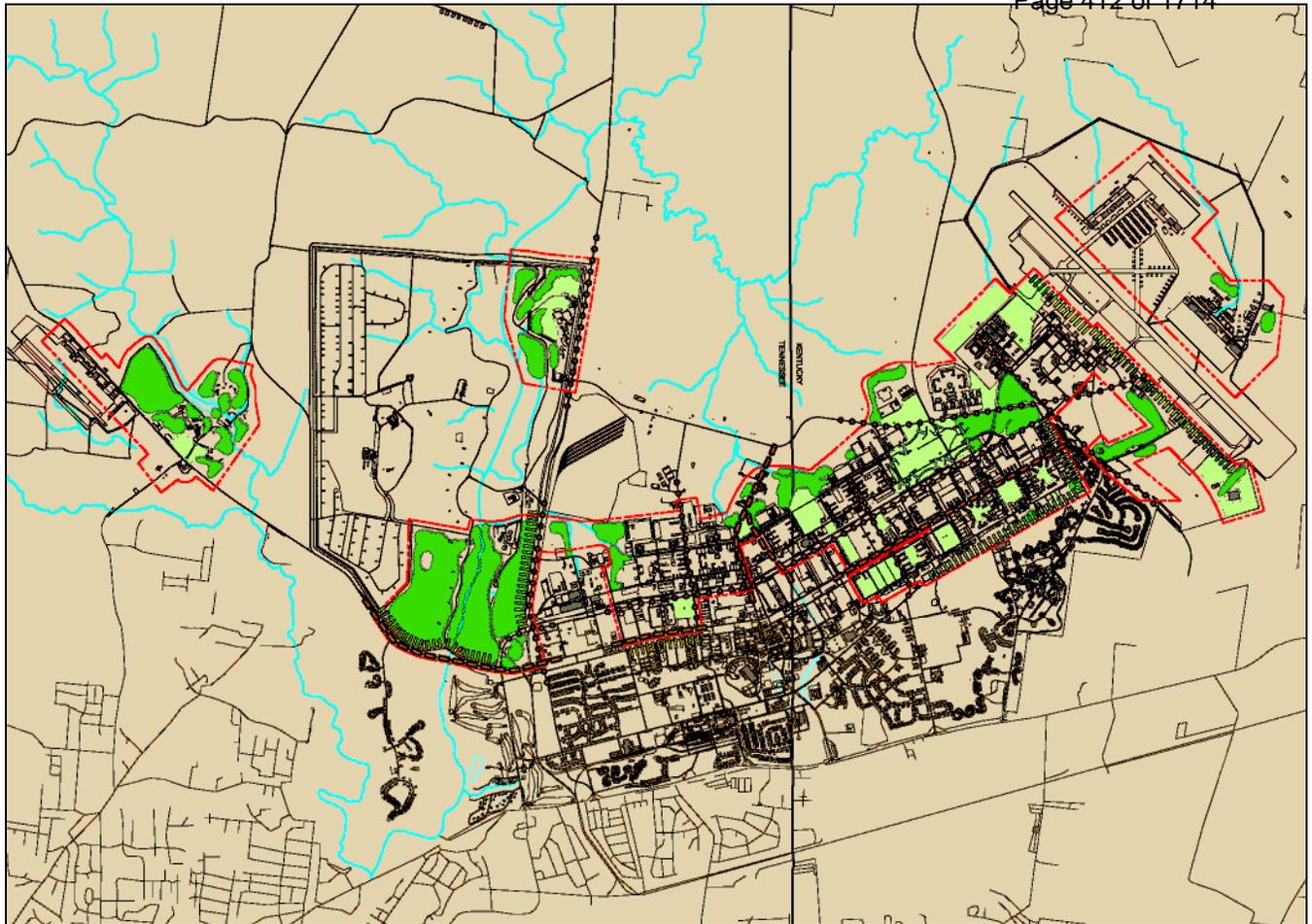


Figure 5-32 Brigade Combat Team Visual Theme Map

LEGEND

-  OPEN SPACE
-  SIGNIFICANT VEGETATION
-  PRIMARY ROAD
-  SECONDARY ROAD
-  PROPOSED REALIGNMENT OF SCREAMING EAGLE BOULEVARD
-  VISUAL THEME LIMITS
-  BUFFER



5.6 BRIGADE COMBAT TEAM VISUAL THEME

5.6.1 Visual Character

This visual theme includes two distinct visual zones: Operations/Maintenance and Troop Housing (Figure 5-31). There is a green space that runs along a north/south axis between Wickham Avenue and Desert Storm Avenue. This area contains a railway, which prohibits it from functioning as ‘open space’ for active use.

5.6.2 Visual Analysis Map

There are patches of open space within this theme, most of which are ball fields and unused spaces between buildings and parking lots. A small percentage of these spaces would fall within the Antiterrorism/Force Protection offsets from structures for security purposes.

The Parade Field is located in this theme, and is identified as open space.

5.6.3 Assets

Site Planning

Located on the western edge of the base, this theme area is partly buffered from the Community Life Theme area by the Town Center.

Larger block sizes allow for the scale of development needed to make Fort Campbell a power projection platform.

Buildings

The new troop housing buildings all use the same materials and same level of detailing.

Supporting facilities around the troop housing such as dining halls and brigade headquarters are close by and sited in a way that creates a campus setting.

LaPointe Medical facility has a nice entrance and screens the mechanical units and trash dumpsters well.

Two churches located along Indiana Avenue and 35th Streets respectively have an historic feel (Figure 5-33).

Circulation

There are four main routes through the theme area: Tennessee, Wickham, Desert Storm Avenues, and A Shau Valley Road. These four arteries provide for easy circulation for large-scale vehicles through the area.

Plant Material

There are numerous old trees scattered throughout the area.

The allée of trees along Wickham Avenue at the intersection of Glider Avenue is strong and should be considered a precedent for street plantings on the base (Figure 5-34).

Site Elements

The gate leading into the hammerhead buildings on Air Assault Street shows the character of the troops (Figure 5-35).

The Aviation Barracks Complex buildings create interior courtyards, which could be a great asset (Figure 5-36).

Force Protection

Buildings are adequately located away from roadways.

Plantings are minimal, and consist largely of trees and lawn.



Figure 5-33 35th Street Church



Figure 5-34 Allée of Trees Creates an Attractive Backdrop



Figure 5-35 Hammerhead Gate Shows Troop Character



Figure 5-36 Aviation Barracks Courtyard Has Potential



Figure 5-37 Inappropriate Stormwater Drainage



Figure 5-38 Hammerhead Barracks Detract From the Visual Aesthetic of the Base



Figure 5-39 Parking along A Shau Valley Road Creates a Dangerous Situation.



Figure 5-40 Shrubs Are Being Pruned Inappropriately at the Aviation Brigade Facilities

5.6.4 Liabilities

Site Planning

All parking is located along the street, on the front faces of buildings, instead of in the rear.

Inadequate storm water drainage swales occur all along A Shau Valley Road (Figure 5-37).

Buildings

The hammerhead barracks detract from the appeal of the post. They are poorly maintained and have no sense of entry (Figure 5-38).

Buildings along Indian Ave. have not been maintained.

Buildings lack appropriate landscaping.

Scale of troop housing is massive and uninviting.

Entrances to troop housing are not apparent.

Sheds in the theme are inappropriate storage solutions.

Circulation

Parking along A Shau Valley and Wickham Roads creates a dangerous situation as people pull out into traffic (Figure 5-39).

Plant Material

The health of all planted material should be evaluated for health status. Numerous trees along 38th Street and A Shau Valley Road appear to be in poor condition.

Troop housing areas have few trees.

Shrubs located in the Aviation Brigade facilities are severely pruned (Figure 5-40).

Site Elements

Trash dumpsters are poorly screened, are located in highly visible areas, are too close to roads, and occasionally create hazardous driving conditions (Figure 5-41).

Wheel stops add unnecessary visual clutter and are difficult to maintain.

Lighting is inconsistent throughout the theme area.

Force Protection

Dumpsters are not screened according to force protection standards (Figure 5-42).

5.6.5 Recommendations

Site Planning

Prototypical site plans should be created for buildings that provide outdoor seating areas for workers.

Buildings

Renovate hammerhead barracks to include a clearly defined entrance.

Develop new construction along Tennessee Avenue to build up density adjacent to Memorial Boulevard.

Use LaPointe Medical facility and buildings 7094, 7095 and 7096 as precedents for new construction in this area.

Maintain exteriors on all buildings.

Future troop housing units should be constructed at a scale that is different from maintenance and operations buildings.

Circulation

Create a network of walks through the entire troop housing area that will allow for movement between dorms, fitness enhancement, and pedestrian separation from vehicular traffic.

Plant Material

Site plans should be developed for all buildings. Troop housing areas should have more of a campus feeling, with large trees and lawn.

Site Elements

Lighting, benches, and trash receptacles should be consistent throughout the theme.

Dumpsters should be located more appropriately and adequately screened.

Force Protection

All dumpsters should be sited and screened according to force protection standards. Implement topographical techniques to secure dumpsters while allowing for a limited visual impact.



Figure 5-41 Dumpsters Create Hazardous Driving Conditions



Figure 5-42 Inappropriate Screening



8.1 INTRODUCTION

8.1.1 Installation Image

The design character of an installation's buildings is important in shaping the installation's overall image. This section will assess the design quality of the buildings according to the visual theme in which they are located. It will make recommendations on the renovations and maintenance of existing structures as well as the design of new ones. The preservation of historically and culturally significant structures adds to an installation's character and provides a sense of heritage.

The understanding of the architectural character of existing buildings is necessary in order to provide coherent visual themes for the future. All of which play an important part of an installation's assets and liabilities. The visual analysis of structures also includes concern for accessibility, use of materials, placement of entrances, integration of additions and renovations, the incorporation of plazas and courtyards, interior design and the appropriateness and quality of building maintenance.

8.2 BUILDING OBJECTIVES

8.2.1 Sustainability

Sustainable Sites

Minimize the impact of placing a building on a site, with emphasis on land use compatibility and biodiversity. Channel development to installation areas with existing infrastructure, rehabilitate damaged sites, and reduce impact from automobile use.

Water Efficiency

Minimize the use of potable water for landscape irrigation and within the building.

Energy and Atmosphere

Ensure that buildings work as intended. Establish energy efficiency and optimization for the base building and for systems and encourage use of renewable and distributed energy systems. Reduce ozone depletion and support early compliance with the Montreal Protocol.

Materials and Resources

Reduce waste from construction and building occupants and redirect recyclable material back to the manufacturing process. Extend the life cycle of existing building stock, in part by extending the life cycle of targeted building materials. Increase use of building products with recycled building material and of locally manufactured building products. Reduce depletion of finite raw materials and encourage environmentally sensitive forest management.

Indoor Environmental Quality

Promote indoor air quality (IAQ) and prevent exposure to Environmental Tobacco Smoke (ETS). Provide a high level of individual occupant control

of thermal, ventilation, and lighting systems. Provide a connection between indoor spaces and the outdoor environment through the introduction of sunlight and views into the occupied areas of the building. Provide appropriate acoustic conditions for user privacy and comfort.

Facility Delivery Process

Deliver a facility that optimizes tradeoffs among sustainability, first costs, life cycle costs and mission requirements. Assure that the delivery process insures efficient operation and maintenance of the facility.

Current Mission

Ensure that the delivery process establishes efficient operation and maintenance of the facility. Provide a high quality, functional, healthy, and safe work environment to promote soldier and workforce productivity and retention.

Future Missions

Require the understanding of: (1) The typical or likely lifespan of the function to be accommodated by the facility in order to recognize how soon the facility should be expected to adapt to a different use; and (2) The life spans of the building systems to understand when they will need to be updated during the lifespan of the facility and to design the facility in a manner that facilitates the updating of each system. Require design of the facility to maximize accommodation of future uses. The greater the future flexibility, the less likely it is that the facility will become a source for waste materials, or that it will require additional materials.

8.2.2 Building Design Objectives

The construction and location of new buildings and additions built onto existing buildings will be designed to strengthen the sustainability of the installation. Sustainable design can be used to reduce construction and/or maintenance costs, and to conserve energy requirements through proper construction and materials selection.

The following topics are good characteristics of sustainable design:

Site Adaptation

Adapt building designs and sitting to natural site and environmental conditions, such as sloped topography, predominant wind direction, solar exposure, position on hillsides, etc.

Land Preservation

Design buildings in clusters to preserve land and reduce construction and maintenance costs (Figure 8-1).

Coherent Architectural Styles

Develop a coherent architectural style that results in the blending of new and old structures. Figure 8-2 is an example of non-coherent architectural styles.

Emphasize Vertical Structures

Design buildings to include more floors in a vertical structure that results in a smaller footprint and more efficiently utilizes limited installation land areas (Figure 8-3).

Multi-activity Facilities

Combine multiple activities in one building to reduce the number of building required and more efficiently utilize limited installation land areas.



Figure 8-1 Buildings Designed In Clusters Preserved Land



Figure 8-2 Non-Coherent Architectural Styles



Figure 8-3 Vertical Structures Reduce Footprints



Figure 8-4 Maximize Natural Light



Figure 8-5 Good Example of Color and Materials Palette For Fort Campbell

Multi-Use Facilities

Design multiple use facilities with the capability to quickly change interior layouts to accommodate changing requirements.

Indigenous Materials

Use indigenous construction materials and practices that require less energy to produce and transport and may be recycled at the end of their usefulness.

Window Location

Locate windows to maximize natural light and outward views (Figure 8-4). Use false windows to obscure sensitive areas.

Building Re-use

Consider adaptive reuse of buildings once their initial use is no longer required.

8.2.3 Architectural Styles

The architectural style for new buildings on Fort Campbell should be consistent regardless of the visual theme. The color and materials palette will be the same for Town Center, Community Life, Historic, Brigade Combat Training, and Memorial Boulevard Themes (Figure 8-5).

8.3 STRUCTURAL CHARACTER

8.3.1 Architectural Character

The character of installation architecture varies according to the use of the structure and when it was built. The use and age variation can result in character incompatibilities. It is important for the designer to understand the architectural character of the installations buildings and also the character of the individual visual themes in order to develop and maintain a character that is compatible.

8.3.2 Design Relationships

In order for an installation to have an identity there must be a coherent relationship between buildings. These relationships are what create a “sense of order” and a “sense of place”. To maintain this identity the designer, when adding on to an existing building, cannot ignore the design features of that building. These features are what give these buildings their identity. When a new building is constructed the designer must understand the design features of the surrounding buildings in order for the new building to fit into the context of the existing fabric. The following design techniques will help in achieving an installation that has a coherent structural character.

Scale

Scale refers to the size of a building facade in relation to humans. Buildings that include predominant vertical facades, which dwarf the individual, are defined as monumental in scale. Building with more horizontal facades designed to relate more to the size of the human figure are defined as human scale. The scale of most buildings on installations should be more human than monumental. All new construction should be compatible in scale with adjacent buildings. Monumental architectural design is typically utilized for more ceremonial buildings, such as worship centers, headquarters complexes, and hotel facilities. These buildings make use of large, glazed areas at entrances and oversized fenestration elements to create a scale appropriate to the building's use. Scale and relief should be provided through roof form, fenestration, building articulation and landscape plantings.

Massing

Massing refers to the overall bulk or volume of a building or buildings. The size and proportion of the individual buildings in a grouping of buildings should be designed to be proportionally compatible with the adjacent structures (Figure 8-6).

Form

The form of a building is determined by its size, mass, shape and proportions. The use of similar building forms provides continuity to the installations architectural impact. The Result is a more aesthetically pleasing environment (Figure 8-7).

Color

The use of a color scheme that is consistent throughout the installation, where possible, results in a continuity of buildings and contributes to a sense of place.

Texture

The use of materials of similar texture in buildings helps to provide visual continuity for the installation.

Materials

The use of the same materials in the exterior finish and trim of buildings helps provide visual continuity (Figure 8-8).

Fenestration

Building fenestration includes features such as doors, windows, and building decoration details. These features should be similar in arrangement, design, size and proportion for architectural compatibility and visual consistency and continuity.



Figure 8-6 Appropriate Massing



Figure 8-7 Similar Building Forms Create a Visually Appealing Impact



Figure 8-8 Visual Continuity Through Exterior Finish and Trim



Figure 8-9 Building Entrance Should Be Recognizable



Figure 8-10 Building Orientation Should Be In a Prominent Location



Figure 8-11 Aesthetically Pleasing Service Area Screening

8.4 BUILDING ENTRANCES

8.4.1 Entrance Definition

A building entrance is a primary feature of any building design. The entrance should be defined and recognizable as the point of entry regardless of the size or importance of the building (Figure 8-9), but should not face adjacent uncontrolled roadways or parking areas to protect from blast and other direct attacks.

8.4.2 Entrance Detail

The details of an entrance should be designed to provide continuity with other entrances to the building and the entrances of adjacent buildings (Figure 8-10).

8.5 SERVICE AREAS

8.5.1 Service Area Screening

Service areas, such as loading docks and trash dumpsters, should be screened from the views of primary use areas such as entrances, courtyards, gathering areas, streets and parking lots (Figure 8-11). These spaces should be provided alternate means of surveillance to deter and detect inappropriate activities.

8.5.2 Location of Trash Areas and Dumpsters

Trash and garbage collection areas must be located a minimum of 25 meters (82 feet) from troop billeting, family housing areas (containing more than 12 units), and stand-alone retail facilities. They will be placed a minimum of 10 meters (33 feet) from all other inhabited structures ([UFC 4-010-01, Table B-1](#)). The surround should be maintained secured. If the surround design is not securable then the dumpsters should be maintained secured so that inappropriate items cannot be easily placed within. Screen walls should be in harmony with adjacent buildings.

8.6 BUILDING ACCESSIBILITY

8.6.1 Accessibility Standards

All structures or facilities, other than the exceptions mentioned below, must meet the [Americans with Disabilities Act Accessibility Guidelines \(ADAAG\)](#), and the [Uniform Federal Accessibility Standards \(UFAS\)](#) accessibility standards. The more stringent standards apply in the event of conflicting guidelines.

Any building or facility that is specifically restricted by occupancy classification to use only by able-bodied personnel during the expected useful life of the building or facility need not be accessible (military exclusion is provided by [UFAS 4.1.4 \[2\]](#)), but accessibility is recommended since the intended use of the facility may change with time.

In particular, the following facilities need not be designed to be accessible: unaccompanied personnel housing, closed messes, vehicle, and aircraft maintenance facilities.

8.6.2 Seismic Policy

The minimum performance objective for Army facilities is Substantial Life-Safety. To ensure compliance, seismic evaluations and mitigation of unacceptable seismic risks shall be performed. Higher levels of seismic protection for mission essential facilities will be considered in the evaluation.

Appendix H Exterior Materials Chart

Building Design Element		Permitted Material Type	Notes (Hyperlinked)
Walls	Base (primary) material	Masonry, Pre-cast	
	Secondary material	Brick, Metal (as approved)	
Roof	Sloped areas	Asphalt Shingles, Standing Seam Metal (as approved)	
	"Flat" areas	Membrane Roofing	
Fenestration	Doors	Metal, Wood	
	Storm Doors	Metal	
	Door & Window Frames	Aluminum, Vinyl	
	Storm window or sash	Aluminum	
	Window	Clear Glass	
Trim Items	Fascia	Aluminum	
	Soffit	Aluminum	
	Gutters and D.S.	Aluminum	
	Awnings and canopies	Glass, Metal	
	Stair or balcony railings, balusters, and related trim/accessories	Metal	
	Handrails	Metal	

Building Design Element		Permitted Material Type	Notes
Trim Items	Fire Escapes	Metal	
	Grilles and louvers	Metal, Aluminum	
	Coping	Aluminum	
	Roof ventilators	Aluminum to match roof color	
Related Site Structures	Courtyard enclosure walls, retaining walls, fences, dumpster enclosures	Masonry, Metal	
	Porch crawl space enclosure	Masonry, Metal, Wood	

Appendix I Exterior Color Charts

I.1 EXTERIOR COLOR CHARTS FOR INSTALLATION BUILDINGS

Colors schemes and building materials are critical design elements in relating adjacent buildings and creating a compatible visual environment within an installation. Related Army Standards are found in Chapter 3, Paragraph 3.5.5 Color, 3.5.5.2 Historic Buildings, 3.5.6 Texture, 3.5.7 Material, and 3.11 Renovations and Additions. This section identifies the Army standard palette of colors that will unify installations. A sufficient color palette range is provided to allow for variety. General direction on the use and application of materials and their colors follows:

Avoid cluttered, cosmetic application of a number of different colors on a facade. The exterior color scheme should consist of a wall color, trim color, and an accent color, all of which should work together with the choice of roofing to provide a harmonious appearance compatible with adjacent structures and environs.

their appropriateness to the building type, desired appearance, material to be painted, and prevailing architectural design and landscape character of the installation. Sustainability and ease of maintenance should also be considered.

Avoid garish colors. Strong or vibrant colors should be used with restraint and should be limited to accents or focal points such as entrance doors where appropriate.

I.2 PANTONE® COLORS

The six digit color designations found in the Exterior Color Charts are **PANTONE® TPX** series numbers taken from the **PANTONE® for architecture and interiors color guide**, which have been cross-referenced to the **PANTONE® process guide**. The colors in the **process guide** are intended for viewing on a color monitor and for printing on a four-color process printer (CMYK) using ISO 2846-1 inks. With proper calibration, colors viewed and printed should accurately represent the specified color.

Calibration for Dell FP E171 and I800FP Monitor is per manufacturer's recommendation.

Calibration for Hewlett Packard Color 4500 is per manufacturer's recommendation.

For calibration of equipment other than the above, contact Pantone at (201) 935-5500.

I.3 COLOR VALIDATION

Due to calibration and other technical problems, the color of paint to be used should be based on manufacturer's correspondence to the six-digit

PANTONE® TPX number and shall not be predicated on matching a computer-generated sample as seen in the Exterior Color Charts.

“White” when given without a number shall be construed as generic and is intended to cover those manufacturer’s paints and finished materials called “white”. Some slight variance may be discernible from one manufacturer to another.

I.4 COLOR NAMES

Names given for colors are not those assigned by **PANTONE®** but are rather the generic names used by the Army for general color identification only. Always use the six-digit **PANTONE® TPX** number instead of the generic name when specifying a color.

I.5 SUPPLEMENTAL COLOR BOARD

Included in this Appendix is a supplemental Color Board (Page L-4) containing squares with a simulation of each color used in the Exterior Color Charts. The electronic reproduction of this Color Board is, however, subject to some distortion and the color will probably be inaccurate to a greater or lesser degree depending on the printer used. A hard copy is available which contains accurate representations of all of the Army’s standard exterior colors. This hard copy is the **COLOR BOARD for the IDS APPENDIX L: HARD COPY VERSION** and may be requested by E-mail at: Baxter.Lawrence@mantech.com with a copy to Dannie.Fason@mantech.com.

If the E-mail is not acknowledged within three business days, call (703) 378-1030 to verify the request.

Provide the following information: quantity of color boards requested; name, title, and telephone number of person placing the order; mailing address; and the name of the installation.

I.6 FACTORY FINISHED MATERIALS

Colors given for surfaces that will be factory finished during manufacture are intended for guidance and are not intended to constitute a directive for a custom color or finish. Colors shall be selected from standard manufacturers colors with the exception of those manufactured products, which can be finished with a custom color at no additional cost and that would not result in diminishment of the standard material guarantee or serviceability.

I.7 SPECIALTY FINISHES

Site Elements, addressed in Chapter 6, are painted one of the colors used in the Color Charts and shown on the Color Board. Fire Hydrants (see Paragraph 6.6.6.5) which shall be Nutmeg Brown in color shall be finished in a standard manufacturer’s paint, suitable for this application, to which glass beads or other suitable reflective material has been added so as to create a light reflective finish meeting NFPA standards.

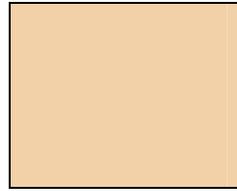
I.8 COLOR BOARD FOR THE ARMY INSTALLATION DESIGN STANDARDS

The color squares shown here are approximations of the **PANTONE® TPX** numbers indicated. They have been simulated using RGB values and are intended to be reproduced electronically. Color quality may vary with

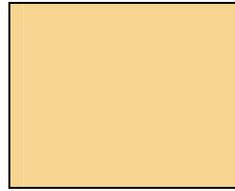
printer. **PANTONE® TPX** colors are a standard. In order to accurately reproduce the specified colors on these sheets and meet the required US Army standard, you must use the actual **PANTONE® TPX** swatch of the color indicated. A hard copy supplemental sheet with accurate color representations is available. See Paragraph L.5 for details.



11-0604 TPX
SHELL



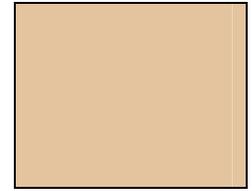
11-0907 TPX
ALMOND



12-0910 TPX
CUSTARD



12-4607 TPX
PASTEL SKY



13-1009 TPX
TAN



13-1013 TPX
ALLSPICE



13-1107 TPX
BEIGE



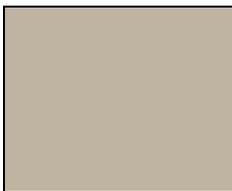
14-4506 TPX
BLUEGRAY



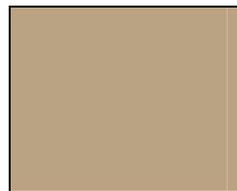
15-1306 TPX
TAUPE



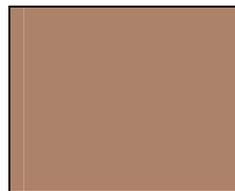
15-1309 TPX
NATURAL



15-5704 TPX
GRAY



16-1210 TPX
MOCHA



16-1221 TPX
BROWN



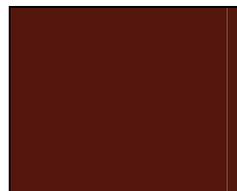
16-6216 TPX
METAL GREEN



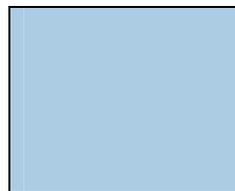
18-1027 TPX
DARK BROWN



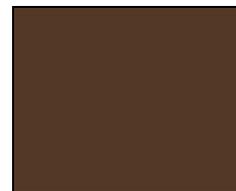
18-1444 TPX
SALSA



19-1540 TPX
MAROON



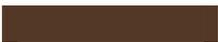
14-4318 TPX
SKY BLUE



18-1027 TPX
NUTMEG BROWN

LISTING OF ORIGINAL SOURCE FEDERAL OR COMMERCIAL MANUFACTURER'S DESIGNATION WITH NEW IDS NAME & EQUIVALENT PANTONE® DESIGNATIONS						
Source	Old Federal Color Name and/or Number	Other Name and/or Number	IDS Name (Generic)	IDS and PANTONE® TPX Number	Process Number	(C-M-Y-K)
Federal Paint Number	Tan 23578		TAN	13-1009 TPX	24-7C	0-10-25-10
Federal Paint Number	Tan 23717		CUSTARD	12-0910 TPX	22-8C	0-5-15-0
Federal Paint Number	Gray 26492		GRAY	15-5704 TPX	329-9C	0-0-3-30
Federal Paint Number	White 20372		TAUPE	15-1306 TPX	31-8C	5-10-20-20
Federal Paint Number	Metal Green 24373		METAL GREEN	16-6216 TPX	285-7C	25-0-30-25
Federal Paint Number	Brown 20313		BROWN	16-1221 TPX	76-8C	0-25-25-20
Federal Paint Number	Mocha 20372		MOCHA	16-1210 TPX	48-9C	10-15-25-15
Federal Paint Number	Gray 25526		BLUEGRAY	14-4506 TPX	213-9C	20-03-03-15
Federal Paint Number	Ochre 31643		ALLSPICE	13-1013 TPX	36-8C	0-15-25-0
Duron	Oyster White 921	(Oyster White) Almond 5910W	ALMOND	11-0907 TPX	32-9C	0-5-10-0
Duron	Alcazar Brown 8306N	Dark Brown 5225N	DARK BROWN	18-1027 TPX	318-1C	70-80-100-30
Duron	Shell White 917	White 5770W	SHELL	11-0604 TPX	No Match	0-3-3-0
Generic (no mfg. ref.)	Chocolate		DARK BROWN	18-1027 TPX	318-1C	70-80-100-30
ICI	Dusty Trail # 425		NATURAL	15-1309 TPX	44-7C	20-20-30-5
ICI	Sand Motif # 422		MOCHA	16-1210 TPX	48-9C	10-15-25-15
ICI	Bisque # 436		BEIGE	13-1107 TPX	43-9C	10-10-15-0
ICI	Salsa # 123		SALSA	18-1444 TPX	83-3C	30-75-75-0
ICI	Liberty Red # 159		MAROON	19-1540 TPX	69-2C	20-75-80-30
Generic (no mfg.ref.)	Pastel Sky		PASTEL SKY	12-4607 TPX	247-8C	20-0-5-3
			SKY BLUE	14-4318 TPX	229-7C	40-5-5-0
SHERMAN WILLIAMS		JAVA SW6090	NUTMEG BROWN	18-1222 TPX	322-9C	50-55-55-0

EXTERIOR COLOR CHART: CENTRAL ATLANTIC USA

Building Design Element		Required Color Standard	Color Sample (See Note 4)	Notes (Hyperlinked)
Walls	Base (primary) Material	Red Brick or limestone neutral gray tones		
	Secondary Material	Almond 11-0907 TPX or Custard 12-0910 TPX		
		Mocha 16-1210 TPX or Blue Gray 14-4506 TPX		
Roof	Sloped Areas	Metal Green 16-6216 TPX		
		Clay Terracotta		
		Fiberglass Shingle Gray/White		
	“Flat” Areas	White		
Fenestration	Doors	Wood: White 11-0604 TPX		
		Steel: Dark Brown 18-1027 TPX		
	Storm Doors	White		
	Door & Window Frames	Brown 16-1221 TPX		
	Storm Window or sash	White		
	Window	White		
Trim Items	Fascia	White		
	Soffit	White		
	Gutters and D.S.	Brown 16-1221 TPX		
	Awnings and Canopies	Tan 12-0910 TPX		
	Stair or Balcony Railings, Balusters and related Trim	Dark Brown 18-1027 TPX		
	Handrails	Dark Brown 18-1027 TPX		

Building Design Element		Required Color Standard	Color Sample (See Note 4)	Notes
Trim Items	Fire Escapes	Dark Brown 18-1027 TPX		
	Grilles and Louvers	Brown 16-1221 TPX		
	Coping	Brown 16-1221 TPX		
	Roof Ventilators	Blend to match roof		
Related Site Structures	Courtyard Enclosure Walls, Retaining Walls, Fences, Dumpster Enclosures	Red Brick or Dark Brown 18-1027 TPX		
	Porch Crawl Space Enclosure	White		

NOTES:	
Note 1	Color samples are electronic approximations of colors, which should not be construed as accurately representing the color standard. Paint shall match the PANTONE® number.

Finishes, Exterior and Interior

The following are Ft. Campbell's standard color schedule for **Exterior Finishes** and special items:

STANDING SEAM METAL ROOF AND FASCIA

Manufacturer: Varies

Color: Butler, Kyner 500, color "Terra Brown" or approved equal

METAL SIDING (When approved)

Manufacturer: Varies

Color: Butler, Kyner 500, color "Country Wheat" or approved equal

EXTERIOR DOORS, FRAMES, TRIM AND ANODIZED ALUMINUM WINDOWS

Manufacturer: Varies

Color: Match standing seam metal roof color

BRICK

Manufacturer: Palmetto Brick Company

Color: ".75 Greystone"

Manufacturer: Acme Brick

Color: "Ko-Ko Brown"

Manufacturer: Sioux City Brick

Color: Beige Grey Velour

ACCENT BRICK

Manufacturer: Acme Brick

Color: "Ko-Ko Plus Chocolate"

Manufacturer: Palmetto Brick Company

Color: "1.25 Greystone"

Manufacturer: Sioux City Brick

Color: Charcoal Grey Velour

SPLIT-FACE CONCRETE MASONRY UNITS

Manufacturer: Southland Supply style

Color: Goldenrod, 24H

MORTAR

Manufacturer: Quickrete

Color: Ochre 2

Manufacturer: Holcim Cement

Color: PCL S Buff

ROOF FIXTURES

Manufacturer: Varies

Color: Match standing seam metal roof

DOWNSPOUTS, GUTTERS, LOUVERS, FLASHING

Manufacturer: Varies

Color: Match standing seam metal roof

EXTERIOR SOFFITS AND CEILING

Manufacturer: Varies

Color: White (factory finish)

The following are Ft. Campbell's standard color schedule for Interior Finishes and special items:

Plastic Laminate, Vertical: **Wilsonart, "1500N-60, Grey"**
Wilsonart, "D432-60, Cashmere"

Plastic Laminate, Horizontal: **Wilsonart "4640-60, Dove Moraine"**
Wilsonart "4608-60, Caldera Beige"

Solid Surface Material: **Wilsonart "1521-MG, Light Beige Mirage"**
Wilsonart "D431-MG, Alabaster Mirage"

Vinyl Base: **Azrock, 4" Vinyl Base, "CB-66"**
Flexco, 4" Vinyl Base, "VCB-031 Zephyr"

VCT: **Azrock, 12"x12"x1/8" "V869, Tundra, Cortina Colors"**
Azrock, 12"x12"x1/8" "V787, Stratus"

Sheet Flooring: **Tarket, "18319"**

ACT: **USG "2110, 2'x2'x5/8" White, Radar"**

ACT Grid: **USG "Donn DX, 15/16", White"**

Window Blinds: **Valencia Deluxe, "0285, 1" Metal**
Valencia Deluxe, "0023, 1" Metal

Carpet: **Lees, 115 Mauve, Pebble Weave II**
Lees, 305 Cloisonne, Pebble Weave II
Lees, 204 Vienna Woods, Pebble Weave II

[Return to Finishes](#)
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APPENDIX G
GIS Data

Not Used

APPENDIX H
Exterior Signage

10800 [Toilet Accessories](#)**SECTION 10160**
Toilet Partitions**Ft. Campbell Requirements:**

Use of solid phenolic partitions is encouraged.

SECTION 10430
Exterior Signage**Ft. Campbell Requirements:**

Exterior signage is classified into three major categories:

- Identification Signage
- Directional and Street Signage
- Regulatory Signage

Identification signage shall be metal post and panel type and will be included in the construction contract. Graphics and lettering will not be included in the construction contract, but will be furnished and installed by the Fort Campbell Sign Shop.

Building Number Signs: *Colors:* White letters on standard brown background, single sided. Other data for the sign is as follows:

(1) *Colors.* White reflective letters and numbers on premium 2 mil vinyl mahogany brown background.

(2) *Dimensions.* 1ft-0in. H x 3ft-0in. W.

(3) *Number.* Upper case Helvetica medium, 8-inch capital letter height. Copy—centered. Average line length-5 characters (See Attachment 1 below).

(4) *Material.* .080 gage Aluminum.

Building number signs are required at four corners of each facility. Signs should be located on the sides of the building where rapid identification is possible (See Attachment 2 below). Signs are wall-mounted.

Unit Signs (Brigade, Battalion & Directorate): See Attachment 2 for material and dimensions for these signs. Graphics and lettering will not be included in the construction contract, but will be furnished and installed by the Fort Campbell Sign Shop. Other data for the sign is as follows:

- (1) *Colors:* Metal frame – dark bronzetone, Alupalite – Deep Mahogany Brown.
- (2) *Dimensions* – As shown on Attachment 2.
- (3) *Number* – No lettering required.
- (4) *Material* – Metal - 12 gage aluminum (anodized), sign – 30" X 72" X 1/4" Alupalite covered both sides with 2 mil premium vinyl.

Unit Signs (Company and Motorpool): See Attachment 3 for material and dimensions for these signs. Graphics and lettering will not be included in the construction contract, but will be furnished and installed by the Fort Campbell Sign Shop. Other data for the sign is as follows:

- (1) *Colors:* Metal frame – dark bronzetone, Aluminum sign – Deep Mahogany Brown.
- (2) *Dimensions* – As shown on Attachment 3.
- (3) *Number* – No letterings required.
- (4) *Material* – Metal frame- 14 gage 1 3/4" X 1 3/4" tube aluminum (anodized), angle – 3/4" X 3/4" X 1/8" aluminum (anodized), sign - 24" X 30", .80" aluminum covered both sides with 2 mil premium vinyl.

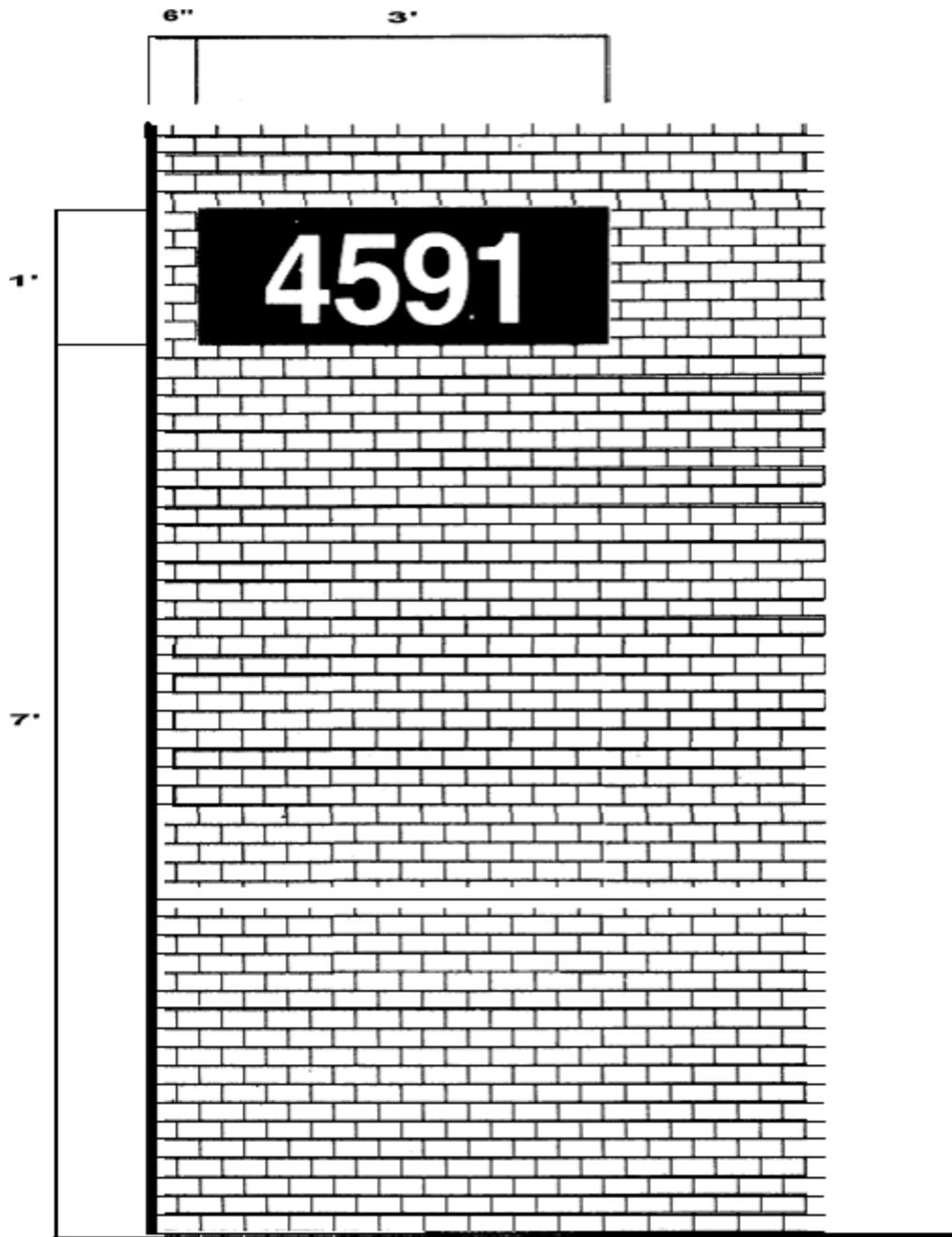
Street Signs: See Attachment 4 for details for these signs. Other data for the sign is as follows:

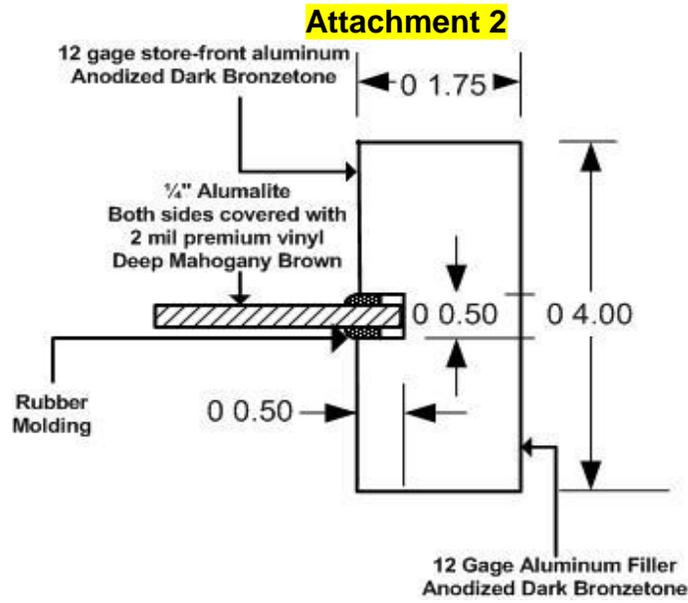
- (1) *Colors:* Sign – Engineer grade prismatic green vinyl background, Engineer grade prismatic 4" white letters.
- (2) *Dimensions* – As shown on Attachment 4.
- (3) *Letters* – 4" Upper case Helvetica medium, engineer grade prismatic white
- (4) *Material* - .80 Aluminum sign, 1 3/4" X 1 3/4" 12 gage galvanized steel post, 2" X 2" 12 gage galvanized steel post.

Regulatory Signage.

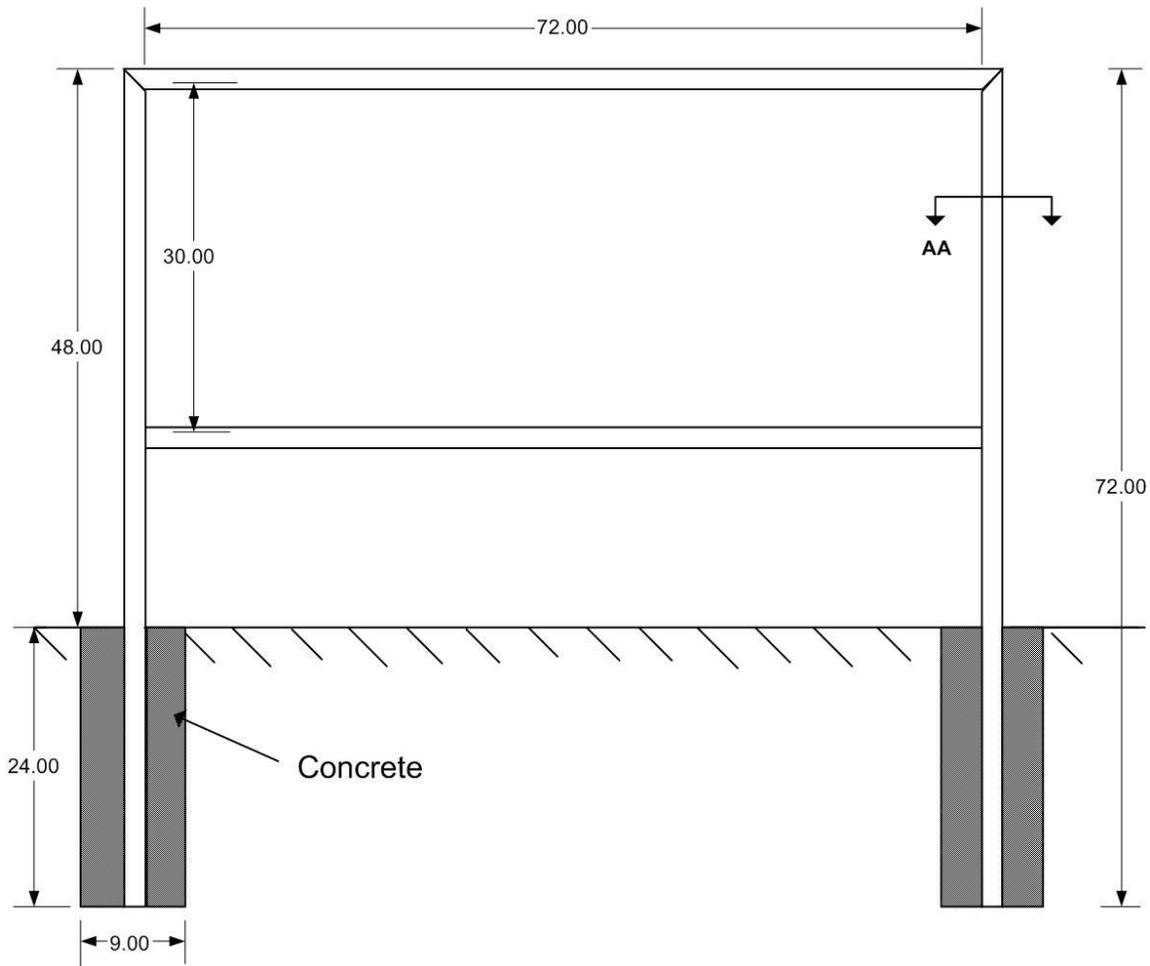
Highway Standards. Only those permanent-type signs that meet the specifications as set down in the Manual on Uniform Traffic Control Devices for Streets and Highways published by the United States Department of Transportation, Federal Highway Administration, will be erected on this installation. The height and lateral location of signs will conform to the specifications outlined in Manual on Uniform Traffic Control Devices for Streets and Highways, December 2009 ([Click here](#)).

ATTACHMENT 1

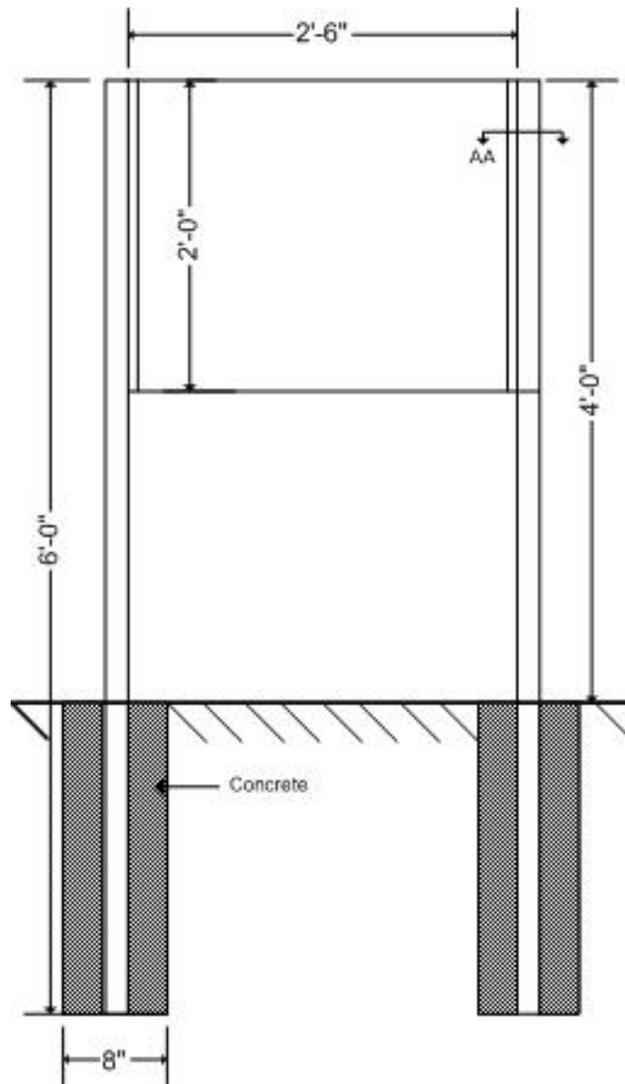
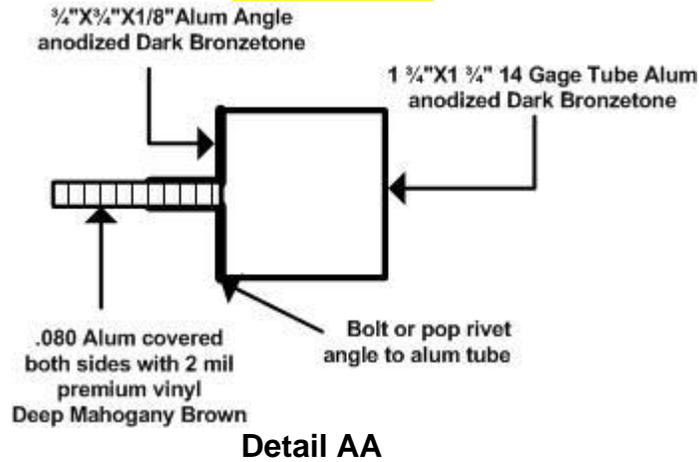




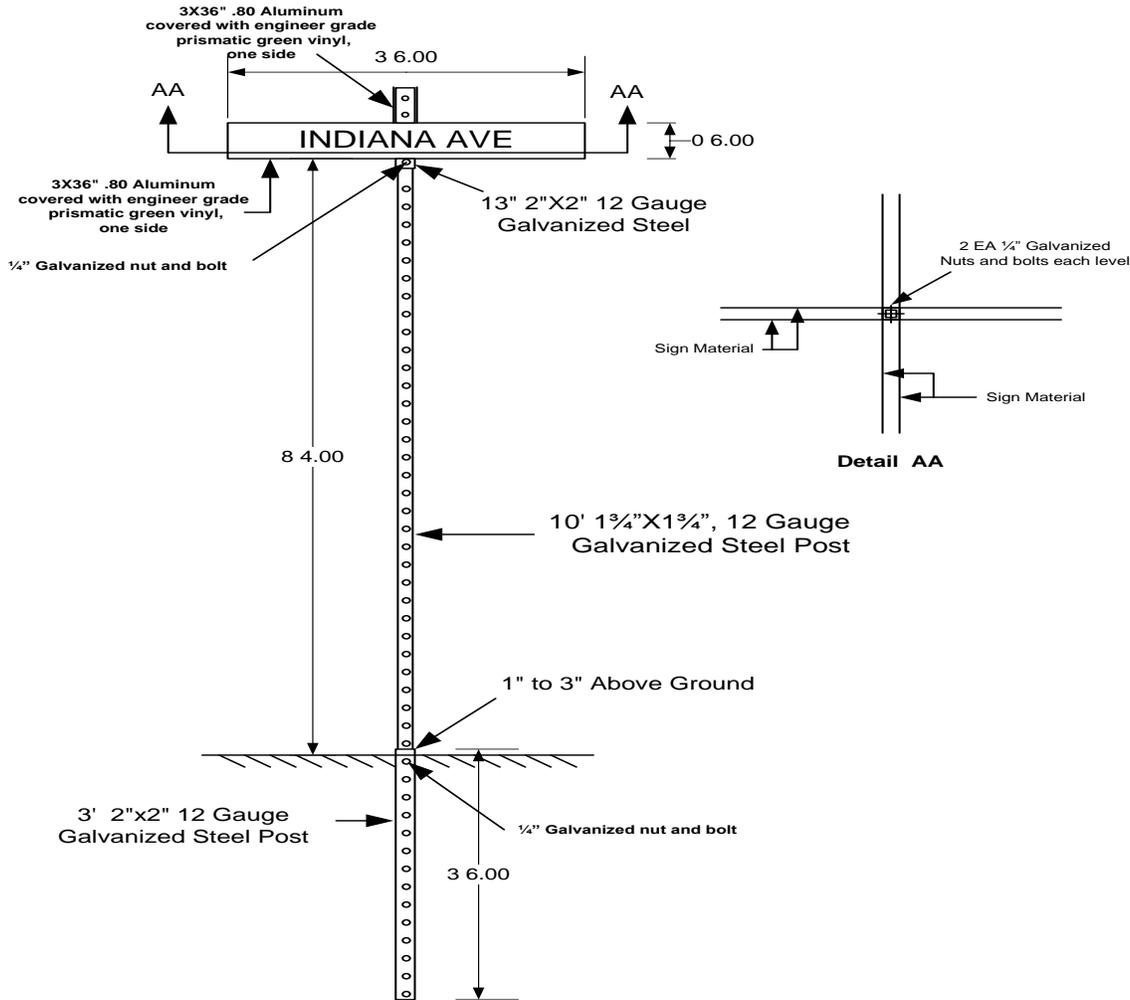
Detail AA



Attachment 3



Attachment 4



Projects that include new roads, shall also include street signage in the construction contract.

Instructions to Designers

1. Incorporate the above Fort Campbell requirements into the project specifications.

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APPENDIX I
Acceptable Plant List

Fort Campbell Landscape Plant List

Native Plant Material

(Native) Conifers/Evergreens:

Botanical Name	Common Name
(Native) Tall Trees – (trees over 50 ft. at maturity)	
<i>Pinus echinata</i>	Shortleaf Pine
<i>Tsuga canadensis</i>	Eastern Hemlock
<i>Taxodium distichum</i>	Bald Cypress
(Native) Medium Trees – (trees 25 to 50 ft. at maturity)	
<i>Pinus virginiana</i>	Virginia Pine
<i>Juniperus virginiana</i>	Eastern Red Cedar
(Native) Small Trees/Large Shrubs – (10 to 25 ft. at maturity)	
<i>Juniperus virginiana</i>	Eastern Red Cedar

[Return to Exterior Planting Section](#)

(Native) Deciduous:

Botanical Name	Common Name
(Native) Tall Trees– (trees over 50 ft. at maturity)	
<i>Liriodendron tulipifera</i>	Yellow or Tulip Poplar
<i>Sassafras albidum</i>	Sassafras
<i>Liquidambar styraciflua</i>	Sweetgum
<i>Ulmus thomasii</i>	Rock Elm
<i>Celtis occidentalis</i>	Hackberry
<i>Celtis laevigata</i>	Sugarberry
<i>Morus rubra</i>	Red Mulberry
<i>Juglans nigra</i>	Black Walnut
<i>Carya illinoensis</i>	Pecan
<i>Carya cordiformis</i>	Bitternut Hickory
<i>Carya tomentosa</i>	Mockernut Hickory
<i>Carya ovata</i>	Shagbark Hickory
<i>Carya glabra</i>	Pignut Hickory
<i>Fagus grandifolia</i>	American Beech

Botanical Name	Common Name
(Native) Tall Trees– (trees over 50 ft. at maturity) continued	
<i>Quercus alba</i>	White Oak
<i>Quercus stellata</i>	Post Oak

Botanical Name	Common Name
<i>Quercus bicolor</i>	Swamp White Oak
<i>Quercus michauxii</i>	Swamp Chestnut Oak
<i>Quercus prinus</i>	Chestnut Oak
<i>Quercus muehlenbergii</i>	Chinkapin Oak
<i>Quercus rubra</i>	Northern Red Oak
<i>Quercus palustris</i>	Pin Oak
<i>Quercus falcata</i>	Southern Red Oak
<i>Quercus velutina</i>	Black Oak
<i>Quercus shumardii</i>	Shumard Oak
<i>Quercus coccinia</i>	Scarlet Oak
<i>Quercus phellos</i>	Willow Oak
<i>Tilia americana</i>	American Basswood
<i>Populus deltoides</i>	Eastern Cottonwood
<i>Salix nigra</i>	Black Willow
<i>Diospyros virginiana</i>	Common Persimmon
<i>Prunus serotina</i>	Black Cherry
<i>Gleditsia tracanthos</i>	Honeylocust
<i>Gymnocladus dioica</i>	Kentucky Coffeetree
<i>Nyssa aquatica</i>	Water Tupelo
<i>Nyssa sylvatica</i>	Black Tupelo
<i>Aesculus octandra</i>	Yellow Buckeye
<i>Acer rubrum</i>	Red Maple
<i>Acer saccharinum</i>	Silver Maple
<i>Acer negundo</i>	Box Elder
<i>Fraxinus pennsylvanica</i>	Green Ash
<i>Fraxinus americana</i>	White Ash
(Native) Medium Trees – (trees 25 to 50 ft. at maturity)	
<i>Magnolia tripetala</i>	Umbrella Magnolia
<i>Magnolia macrophylla</i>	Bigleaf Magnolia
<i>Asimina triloba</i>	Pawpaw
<i>Ulmus alata</i>	Winged Elm
<i>Celtis occidentalis</i>	Hackberry
<i>Quercus stellata</i>	Post Oak
<i>Quercus marilandica</i>	Blackjack Oak
<i>Ostrya virginiana</i>	Eastern Hop Hornbeam
<i>Carpinus carolinia</i>	American Hornbeam
<i>Betula lenta</i>	Sweet Birch
<i>Betula nigra</i>	River Birch
<i>Salix nigra</i>	Black Willow
<i>Oxydendron arboreum</i>	Sourwood
<i>Diospyros virginiana</i>	Common Persimmon
<i>Halesia carolina</i>	Carolina Silverbell

Botanical Name	Common Name
(Native) Medium Trees – (trees 25 to 50 ft. at maturity) continued	
<i>Amelanchier arborea</i>	Downey Serviceberry
<i>Ilex opaca</i>	American Holly
<i>Rhamnus caroliniana</i>	Carolina Buckthorn
<i>Aesculus glabra</i>	Ohio Buckeye
<i>Acer negundo</i>	Box Elder
(Native) Small Trees/Large Shrubs – (10 to 25 ft. at maturity)	

Botanical Name	Common Name
<i>Hamamelis virginiana</i>	Witch Hazel
<i>Carpinus carolinia</i>	American Hornbeam
<i>Kalmia latifolia</i>	Mountain Laurel
<i>Prunus americana</i>	American Plum
<i>Crataegus spp.</i>	Hawthorn
<i>Cercis canadensis</i>	Eastern Redbud
<i>Cornus florida</i>	Flowering Dogwood
<i>Euonymus atropurpurens</i>	Eastern Wahoo
<i>Cephalanthus occidentalis</i>	Buttonbush
<i>Sambucus canadensis</i>	American Elder

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Introduced Species (Kentucky Extension Service List)

(Introduced) Evergreen:

Botanical Name	Common Name
(Introduced) Tall Trees– (trees over 50 ft. at maturity)	
<i>Abies nordmanniana</i>	Nordmann Fir
<i>Cedrus libani</i> var. <i>stenocoma</i>	Hardy Cedar of Lebanon
<i>Picea abies</i>	Norway Spruce
<i>Picea glauca</i> 'Densata'	Black Hills Spruce
<i>Picea omorika</i>	Serbian Spruce
<i>Picea orientalis</i>	Oriental Spruce
<i>Picea pungens</i>	Colorado Spruce
<i>Pinus densiflora</i>	Japanese Red Pine
<i>Pinus flexilis</i>	Limber Pine
<i>Pinus resinosa</i>	Red Pine
<i>Pseudotsuga menziesii</i>	Douglas Fir
<i>Thuja occidentalis</i>	American Arborvitae
(Introduced) Medium Trees – (trees 25 to 50 ft. at maturity)	
<i>Abies concolor</i>	White Fir
<i>Chamaecyparis obtusa</i>	Hinoki Cypress
<i>Chamaecyparis pisifera</i>	Thread Cypress
<i>Ilex attenuata</i> 'Fosteri'	Foster No. 2 Holly
<i>Juniperus chinensis</i>	Chinese Juniper
<i>Osmanthus americanus</i>	Devil Wood

Botanical Name	Common Name
(Introduced) Medium Trees – (trees 25 to 50 ft. at maturity) continued	
<i>Pinus bungeana</i>	Lacebark Pine
<i>Pinus cembra</i>	Swiss Stone Pine
<i>Pinus densiflora</i> 'Oculus-draconis'	Japanese Red Pine
<i>Pinus strobus</i> 'Fastigiata'	Columnar White Pine
<i>Pinus strobus</i> 'Pendula'	Weeping White Pine
<i>Pinus sylvestris</i>	Scotch Pine
<i>Platyclusus orientalis</i>	Oriental Arborvitae
<i>Taxus baccata</i>	English Yew
<i>Taxus cuspidata</i> 'Capitata'	Upright Japanese Yew

Botanical Name	Common Name
(Introduced) Small Trees/Large Shrubs – (10 to 25 ft. at maturity)	
<i>Abies koreana</i> 'Prostrate Beauty'	Prostrate Korean Fir
<i>Chamaecyparis obtusa</i> 'Torulosa'	Contorted Hinoki Cypress
<i>Ilex aquifolium</i>	English Holly
<i>Ilex crenata</i> 'Noble's Upright'	Noble's Upright Japanese Holly
<i>Ilex pedunculosa</i>	Longstock Holly
<i>Juniperus chinensis</i>	Chinese Juniper
<i>Juniperus scopulorum</i>	Rocky Mountain Juniper
<i>Picea glauca</i> 'Conica'	Dwarf Albert Spruce
<i>Pinus densiflora</i> 'Umbraculifera'	Tanyosho Pine
<i>Pinus mugo</i>	Mugho Pine
<i>Pinus strobus</i> 'Contorta'	Curly White Pine
<i>Pinus sylvestris</i> 'Wateri'	Waterer's Scotch Pine
<i>Rhododendron catawbiense</i>	Rhododendron
<i>Rhododendron azalea</i>	Azalea
<i>Rhododendron maximum</i>	Rosebay Rhododendron
<i>Sciadopitys verticillata</i>	Umbrella Pine
<i>Taxus cuspidata</i>	Japanese Yew
<i>Viburnum pragense</i>	Fragrant Viburnum
(Introduced) Medium Shrubs – (6 to 8 ft. at maturity)	
<i>Chamaecyparis obtusa</i> 'Sanderi'	Sanderi Hinoki False Cypress
<i>Chamaecyparis pisifera</i>	Sawara Cypress
<i>Ilex meserveae</i>	Blue Holly
<i>Juniperus chinensis</i> 'Sea Green'	Sea Green Chinese Juniper
<i>Mahonia aquifolium</i>	Oregon Holly Grape
<i>Pieris japonica</i>	Japanese Pieris
<i>Taxus cuspidata</i>	Japanese Yew
<i>Taxus media</i>	Spreading Yew
(Introduced) Small Shrubs – (4 to 5 ft. at maturity)	
<i>Buxus microphylla</i>	Boxwood
<i>Chamaecyparis pisifera</i>	Gold Thread Cypress
<i>Ilex glabra</i> 'Compacta'	Compact Inkberry
<i>Ilex opaca</i> 'Maryland Dwarf'	Maryland Dwarf American Holly
<i>Juniperus chinensis</i>	Chinese Juniper

Botanical Name	Common Name
(Introduced) Small Shrubs – (4 to 5 ft. at maturity) continued	
<i>Leucothoe fontanesiana</i>	Drooping Leucothoe
<i>Mahonia aquifolium</i>	Oregon Holly Grape
<i>Picea abies</i>	Norway Spruce
<i>Picea pungens</i>	Colorado Spruce
<i>Pinus mugo</i>	Mugho Pine
<i>Pinus strobus</i> 'Nana'	Dwarf White Pine
<i>Pinus sylvestris</i> 'Beuvronensis'	Dwarf Scotch Pine
<i>Rhododendron</i> 'Starry Night'	Starry Night Rhododendron
<i>Taxus baccata</i> 'Repandens'	Spreading English Yew
<i>Tsuga canadensis</i> 'Gentsch'	Gentsch White Canadian Hemlock
(Introduced) Low Shrubs – (2 to 3 ft. at maturity)	
<i>Abies balsamea</i> 'Nana'	Dwarf Balsam Fir

Botanical Name	Common Name
<i>Chamaecyparis obtusa</i> 'Pygmae Aurescens'	Dwarf Hinoki False Cypress
<i>Chamaecyparis pisifera</i>	Moss Cypress
<i>Juniperus horizontalis</i>	Compact Juniper
<i>Juniperus sabina</i>	Savin Juniper
<i>Juniperus squamata</i> 'Blue Star'	Blue Star Juniper
<i>Leucothoe fontanesiana</i>	Drooping Leucothoe
<i>Mahonia aquifolium</i> 'Compactum'	Compact Oregon Holly Grape
<i>Picea abies</i>	Dwarf Norway Spruce
<i>Pieris japonica</i> 'Pygmaea'	Pygmy Andromeda
<i>Pinus sylvestris</i> 'Riverside Gem'	Riverside Gem Scotch Pine
<i>Rhododendron obtusum</i>	Azalea (several varieties)

[Return to Exterior Planting Section](#)

**(Introduced)
Deciduous:**

Botanical Name	Common Name
(Introduced) Tall Trees-- (trees over 50 ft. at maturity)	
<i>Acer platanoides</i>	Norway Maple
<i>Alnus glutinosa</i>	European Alder
<i>Cercidiphyllum japonicum</i>	Katusra Tree
<i>Eucommia ulmoides</i>	Hardy Rubber Tree
<i>Fagus sylvatica</i>	European Beech
<i>Ginkgo biloba</i>	Ginkgo or Maidenhair Tree
<i>Larix kaempferi</i>	Japanese Larch
<i>Metasequoia glyptostroboides</i>	Dawn Redwood
<i>Platanus x acerfolia</i>	London Planetree
<i>Quercus acutissima</i>	Sawtooth Oak
<i>Quercus robur</i>	English Oak
<i>Tilia cordata</i>	European Linden

Botanical Name	Common Name
(Introduced) Tall Trees-- (trees over 50 ft. at maturity) continued	
<i>Tilia tomentosa</i>	Silver Linden
<i>Ulmus parvifolia</i>	Chinese Elm
<i>Ulmus x</i>	Hybrid Elms
<i>Zelkova serrata</i>	Japanese Zelkova
(Introduced) Medium Trees -- (trees 25 to 50 ft. at maturity)	
<i>Acer campestre</i>	Hedge Maple
<i>Acer griseum</i>	Paperbark Maple
<i>Aesculus x carnea</i>	Red Horsechestnut
<i>Aesculus pavia</i>	Red Buckeye
<i>Amelanchier grandiflora</i>	Apple Serviceberry
<i>Amelanchier laevis</i>	Alleghany Serviceberry
<i>Betula populifolia</i>	Gray Birch
<i>Betula maximowicziana</i>	Monarch Birch
<i>Carpinus betulus</i>	European Hornbeam
<i>Castanea mollissima</i>	Chinese Chestnut
<i>Corylus colurna</i>	Turkish Filbert

Botanical Name	Common Name
<i>Franklinia alatamaha</i>	Franklin Tree
<i>Ilex decidua</i>	Possum Haw
<i>Koeireuteria paniculata</i>	Golden Raintree
<i>Larix decidua</i> 'Pendula'	Weeping European Larch
<i>Maackia amurensis</i>	Amur Maackia
<i>Magnolia virginiana</i>	Sweet Bay Magnolia
<i>Phellodendron amurense</i>	Cork Tree
<i>Prunus sargentii</i>	Sargent Cherry
<i>Prunus serrulata</i> 'Kwanzan'	Kwanzan Japanese Cherry
<i>Pyrus fauriei</i>	Korean Pear
<i>Stewartia pseudocamellia</i>	Japanese Stewartia
<i>Syringa pekinensis</i>	Pekin Lilac
<i>Syringa reticulata</i>	Japanese Tree Lilac
<i>Prunus x yedoensis</i>	Yoshino Cherry
<i>Pyrus calleryana</i>	Callery Pear
(Introduced) Small Trees/Large Shrubs – (10 to 25 ft. at maturity)	
<i>Acer buergeranum</i>	Trident Maple
<i>Acer ginnala</i>	Amur Maple
<i>Acer japonicum</i>	Fullmoon Maple
<i>Acer maximowiczianum</i>	Nikko Maple
<i>Acer palmatum</i>	Japanese Maple
<i>Acer tegmentosum</i>	Manchu Striped Maple
<i>Aesculus parviflora</i>	Bottlebrush Buckeye
<i>Buddleia alternifolia</i>	Fountain buddiela
<i>Cercidiphyllum japonicum</i>	Weeping Katsura Tree
<i>Chionanthus retusus</i>	Chinese Fringe Tree
<i>Chionanthus virginicus</i>	Fringe Tree
<i>Cornus alternifolia</i>	Pagoda Dogwood

Botanical Name	Common Name
(Introduced) Small Trees/Large Shrubs – (10 to 25 ft. at maturity) continued	
<i>Cornus kousa</i>	Kousa Dogwood
<i>Cornus mas</i>	Cornelian Cherry Dogwood
<i>Cornus officinalis</i>	Japanese Cornel Dogwood
<i>Cornus racemosa</i>	Gray Dogwood
<i>Corylus avellana</i> 'Cortorta'	Curly European Filbert
<i>Corylus maxima</i> 'Purpurea'	Purple Giant Filbert
<i>Cotoneaster multiflorus</i>	Many-flowered Cotoneaster
<i>Crataegus crus-galli</i>	Cockspur Hawthorn
<i>Crataegus lavalleyi</i>	Lavalle Hawthorn
<i>Crataegus phaenopyrum</i>	Washington Hawthorn
<i>Crataegus viridis</i> 'Winter King'	Winter King Hawthorn
<i>Deutzia scabra</i> 'Pride of Rochester'	Pride of Rochester Deutzia
<i>Enkianthus campanulatus</i>	Redvein Enkianthus
<i>Euonymus alata</i>	Burning Bush
<i>Forsythia intermedia</i>	Border Forsythia
<i>Fothergilla major</i>	Large Fothergilla
<i>Ilex verticillata</i>	Winterberry
<i>Kolkwitzia amabilis</i>	Beauty Bush
<i>Ligustrum ibolium</i>	Ibolium Privet

Botanical Name	Common Name
<i>Ligustrum ovalifolium</i>	California Privet
<i>Ligustrum vicaryl</i>	Vicary Golden Privet
<i>Lindera benzoin</i>	Spicebush
<i>Lonicera morrowii</i>	Fragrant Honeysuckle
<i>Lonicera tatarica</i>	Tatarian Honeysuckle
<i>Magnolia x</i>	Hybrid Magnolia (several varieties)
<i>Magnolia loebneri</i> 'Merrill'	Dr. Merrill Magnolia
<i>Magnolia soulangiana</i>	Saucer Magnolia
<i>Magnolia stellata</i>	Star Magnolia
<i>Malus x spp.</i>	Crabapple
<i>Malus floribunda</i>	Flowering Crabapple
<i>Malus sieboldii</i> var. Zumi	Calocarpa Crabapple
<i>Philadelphus virginialis</i>	Mockorange
<i>Physocarpus opulifolius</i>	Eastern Ninebark
<i>Prunus x</i> 'Hally Jolivette'	Hally Jolivette Cherry
<i>Prunus subhirtella</i>	Higan Cherry
<i>Rhamnus fragula</i> 'Asplenifolia'	Cutleaf Buckthorn
<i>Syringa vulgaris</i>	Common Lilac
<i>Ulmus glabra</i> 'Camperdownii'	Camperdown Elm
<i>Viburnum burkwoodii</i>	Burkwood Viburnum
<i>Viburnum carlcephalum</i>	Fragrant Viburnum
<i>Viburnum dentatum</i>	Arrowwood Viburnum
<i>Viburnum dilatatum</i> 'Iroquois'	Iroquois Linden Viburnum
<i>Viburnum lantana</i>	Wayfaring Tree
<i>Viburnum lentago</i>	Nannyberry Viburnum
<i>Viburnum macrocephalum</i>	Chinese Snowball Viburnum
(Introduced) Small Trees/Large Shrubs – (10 to 25 ft. at maturity) continued	
<i>Viburnum opulus</i>	Cranberry Bush Viburnum
<i>Viburnum plicatum</i> var. <i>tomentosum</i> '	Doublefile Viburnum
<i>Viburnum prunifollum</i>	Blackhaw
<i>Viburnum rhytidophyloides</i>	Lantanaphyllum Viburnum
<i>Viburnum sargentii</i> 'Onondaga'	Onondaga Viburnum
<i>Viburnum sieboldii</i> 'Seneca'	Seneca Viburnum
<i>Viburnum setigerum</i>	Tea Viburnum
<i>Viburnum</i> 'Sesquehana'	Sesquehanna Viburnum
(Introduced) Medium Shrubs – (6 to 8 ft. at maturity)	
<i>Acanthopanax sieboldianus</i>	Five-leaved Aralia
<i>Acer palmatum</i>	Japanese Maple
<i>Aronia arbutifolia</i> 'Brilliantissima'	Brilliant Red Chokeberry
<i>Berberis mentorensis</i>	Mentor Barberry
<i>Berberis thunbergii</i>	Japanese Barberry
<i>Buddleia davidii</i>	Orange-eyed Butterfly Bush
<i>Clianthus florid us</i>	Carolina Allspice
<i>Cercis chinensis</i>	Chinese Redbud
<i>Chaenomeies speciosa</i>	Flowering Quince
<i>Clethra ainifloia</i>	Summer Sweet
<i>Cornus alba</i>	Tatarian Dogwood
<i>Cornus baileyi</i>	Bailey's Dogwood
<i>Cornus florida</i> 'Pygmaea'	Pygmy Dogwood
<i>Cornus sericea</i> 'Flaviramea'	Yellow-twig Dogwood

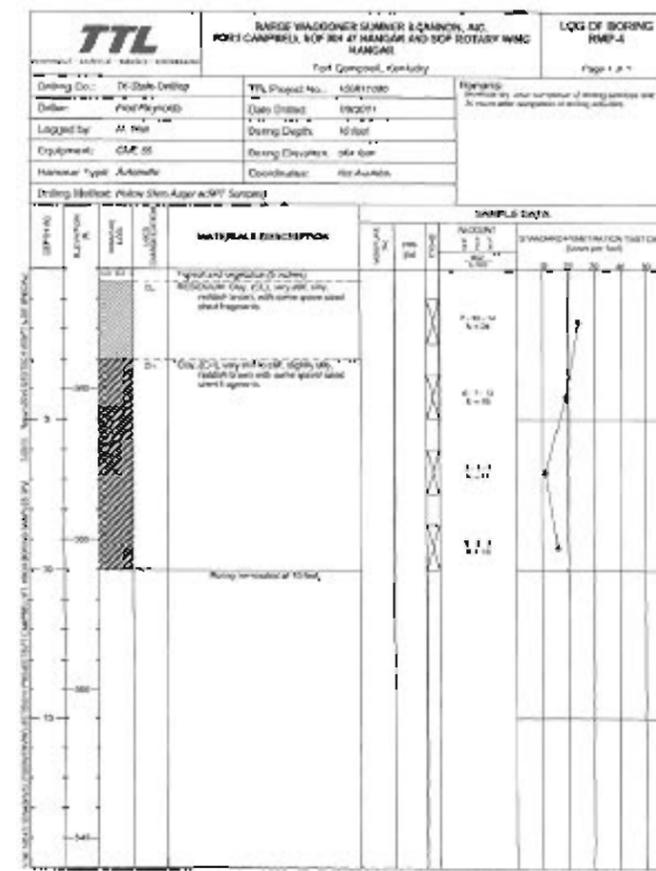
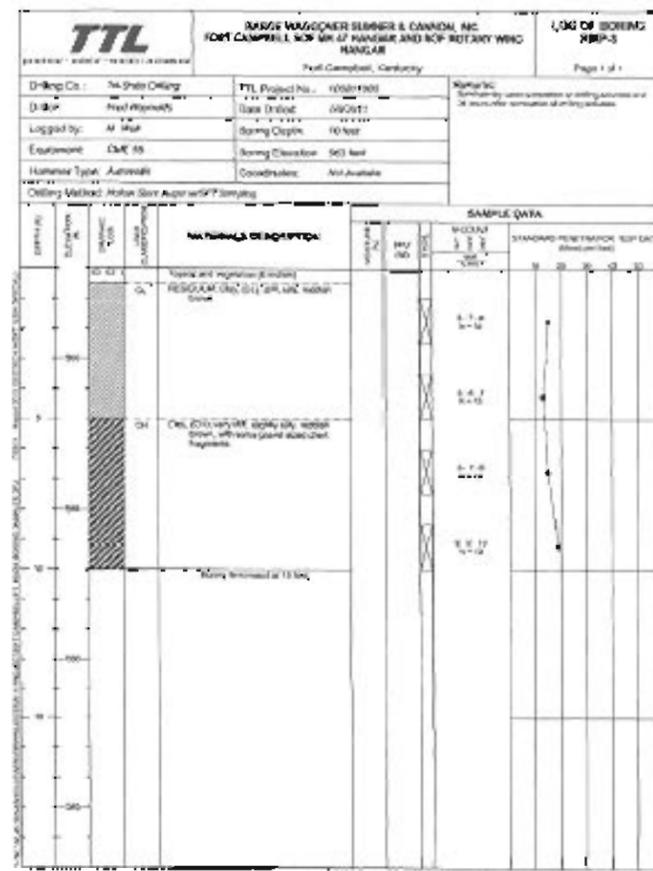
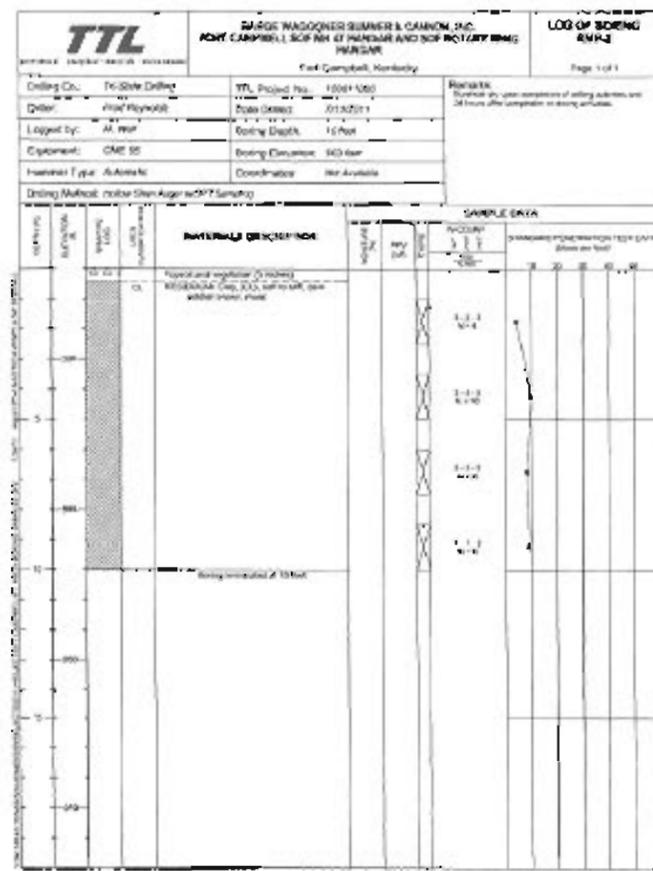
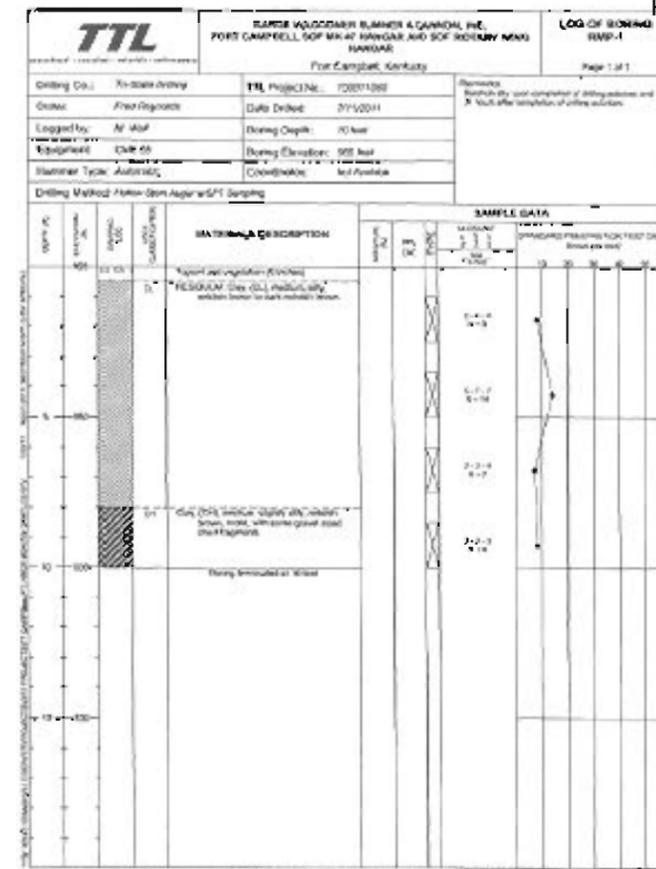
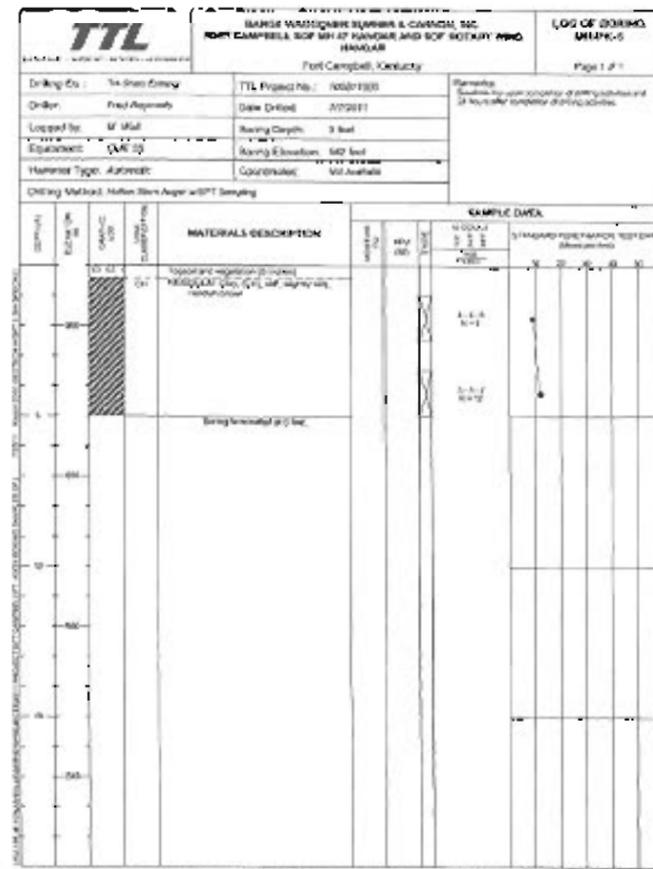
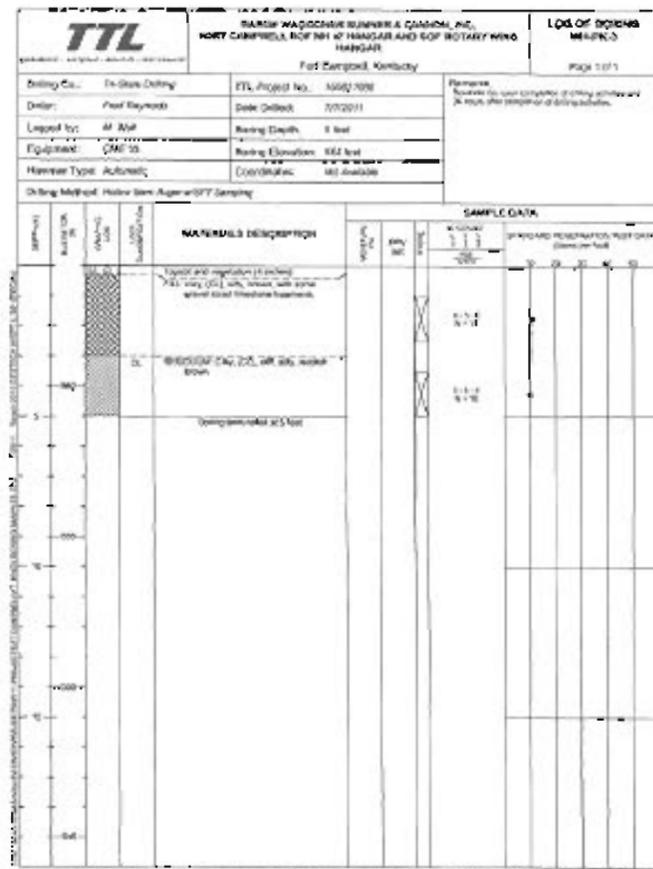
Botanical Name	Common Name
<i>Cotoneaster divaricata</i>	Spreading Cotoneaster
<i>Deutzia lemoinei</i>	Slender Deutzia
<i>Forsythia intermedia</i> 'Sunrise'	Border Forsythia
<i>Hamamelis vernalis</i>	Vernal Witchhazel
<i>Hibiscus syriacus</i>	Rose of Sharon
<i>Hydrangea quercifolia</i>	Oakleaf Hydrangea
<i>Ilex verticillata</i>	Winterberry
<i>Kerria japonica</i>	Japanese Kerria
<i>Ligustrum vulgare</i> 'Lodense'	Lodense Privet
<i>Lonicera xyldosteum</i> 'Claveyl'	Clavey's Honeysuckle
<i>Malus sargentii</i>	Sargent Crabapple
<i>Morus alba</i> 'Pendula'	Weeping Mulberry
<i>Myrica pensylvanica</i>	Northern Bayberry
<i>Prunus x cistena</i>	Purpleleaf Sand Cherry
<i>Pyracantha coccinea</i>	Scarlet Firethorn
<i>Rhus aromatica</i>	Fragrant Summac
<i>Ribes alpinum</i>	Alpine Currant
<i>Spiraea nipponica</i> 'Snowmound'	Snowmound Spirea
<i>Spiraea x vanhouttei</i>	Vanhoutte Spirea
<i>Viburnum acerfolium</i>	Mapleleaf Viburnum
<i>Viburnum carlesli</i>	Koreanspice
<i>Viburnum juddii</i>	Judd Viburnum
(Introduced) Medium Shrubs – (6 to 8 ft. at maturity) continued	
<i>Viburnum x 'Mohawk'</i>	Mohawk Viburnum
<i>Viburnum x pragense</i>	Prague Viburnum
<i>Weigela florida</i>	Weigela
(Introduced) Small Shrubs – (4 to 5 ft. at maturity)	
<i>Abelia grandiflora</i>	Glossy Abelia
<i>Berberis thunbergii</i> 'Aurea'	Golden Japanese Barberry
<i>Cotoneaster horizontalis</i>	Rockspray Cotoneaster
<i>Deutzia gracilis</i>	Slender Deutzia
<i>Divervilla sessilifolia</i>	Southern Bush Honeysuckle
<i>Hydrangea arborescens</i>	Hills-of-Snow
<i>Hypericum kalm</i>	Kalm St. Johnswort
<i>Ilex verticillata</i>	Winterberry
<i>Itea japonica</i> 'Beppu'	Beppu Sweetpire
<i>Malus sargentii</i> 'Tina'	Tina Crabapple
<i>Physocarpus opulifolius</i>	Eastern Ninebark
<i>Potentilla fruticosa</i>	Bush Cinquefoil
<i>Pyracantha coccinea</i>	Scarlet Firethorn
<i>Syringa meyeri</i> 'Palibin'	Meyer's Lilac
<i>Syringa patula</i> 'Miss Kim'	Littleleaf Lilac
<i>Viburnum opulus</i> 'Nana'	Dwarf Cranberrybush Viburnum
<i>Viburnum trilobum</i> 'Compactum'	Compact American Cranberry Bush
<i>Viburnum utile</i> 'Eskimo'	Eskimo Viburnum
(Introduced) Low Shrubs – (2 to 3 ft. at maturity)	
<i>Berberis thunbergii</i>	Japanese Barberry
<i>Caryopteris clandonensis</i> 'Blue	Blue Mist Bluebeard
<i>Cornus sericea</i> 'Kelseyi'	Kelsey's Dwarf Dogwood
<i>Cotoneaster apiculatus</i>	Cranberry Cotoneaster
<i>Cotoneaster dammeri</i>	Bearberry Cotoneaster
<i>Cotoneaster horizontalis</i> 'Perpusilla'	Perpusilla Rock Cotoneaster
<i>Cotoneaster microphylla</i>	Small Leaf Cotoneaster
<i>Forsythia viridissima</i> 'Bronxensis'	Bronx Forsythia

Botanical Name	Common Name
<i>Forsythia</i> 'Arnold's Dwarf'	Arnold's Dwarf Forsythia
<i>Fothergilla gardenii</i>	Dwarf Fothergilla
<i>Hypericum</i> 'Hidcote'	Hidcote St. Johnswort
<i>Jasminum nudiflorum</i>	Winter Jasmine
<i>Kalmia cuseata</i> 'White Wicky'	White Wicky Mountain Laurel
<i>Kerria japonica</i> 'Picta'	Variegated Japanese Kerria
<i>Physocarpus opulifolius</i> 'Nana'	Dwarf Eastern Ninebark
<i>Rhus aromatica</i> 'Gro-low'	Gro-low Fragrant Summac
<i>Ribes alpinum</i> 'Greenmound'	Greenmound Alpine Currant
<i>Rosa wichuriana</i>	Memorial Rose
<i>Spiraea x bumalda</i>	Bumald Spirea
<i>Spiraea japonica</i> 'Little Princess'	Little Princess Japanese Spirea
<i>Symphoricarpos albus</i>	Snowberry
<i>var. laevigatus</i>	

[Return to Exterior Planting Section](#)

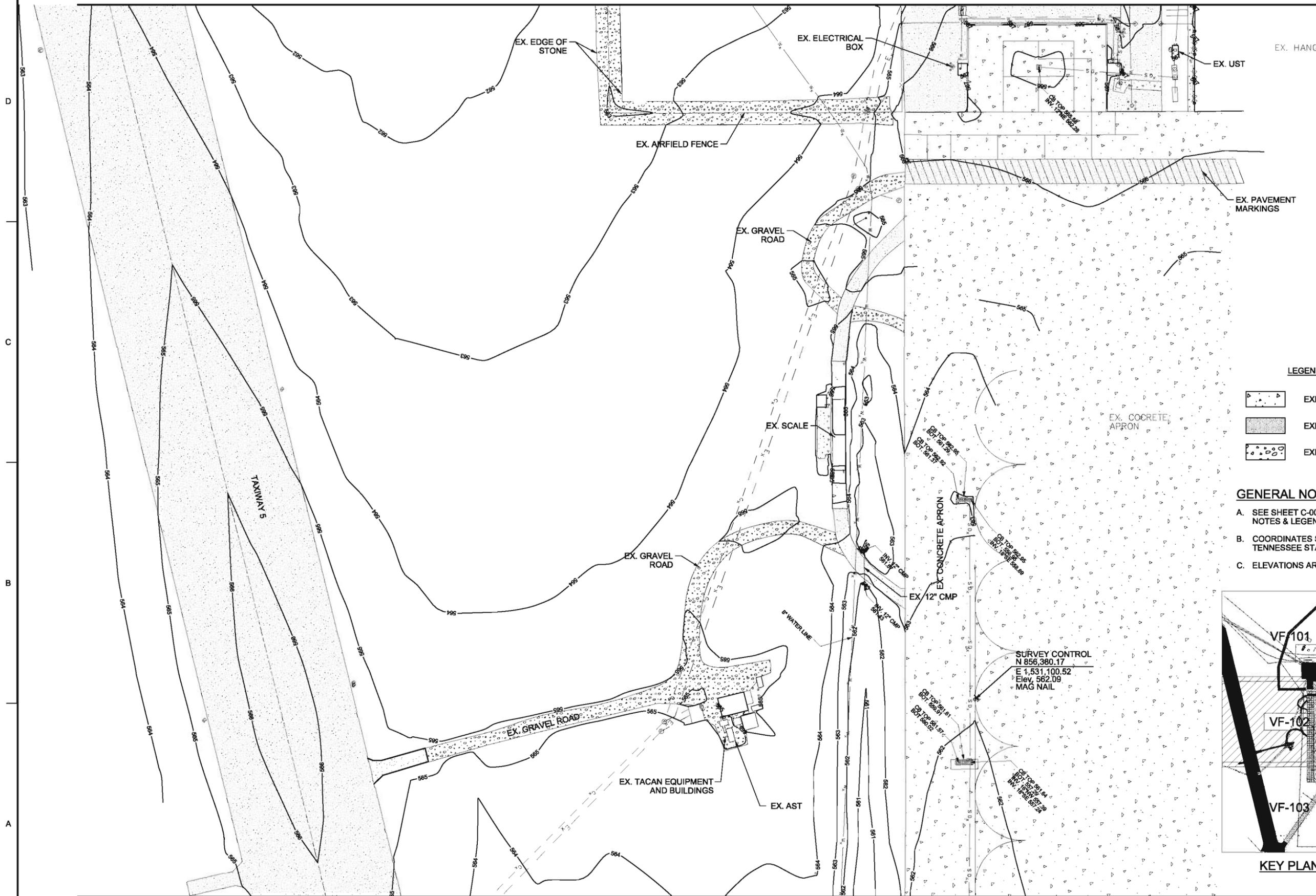
[Return to Table of Contents](#)

APPENDIX J
Drawings



U.S. ARMY CORPS OF ENGINEERS
 LOUISVILLE DISTRICT
 LOUISVILLE, KENTUCKY
 BWSCL
 FT. CAMPBELL, KENTUCKY
 RMP-2
 SOIL BORING LOGS

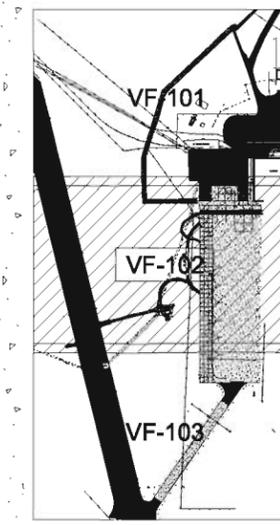
MATCHLINE - SEE SHEET VF-101



LEGEND

	EXISTING CONCRETE
	EXISTING ASPHALT
	EXISTING GRAVEL

- GENERAL NOTES:**
- A. SEE SHEET C-001 FOR GENERAL NOTES & LEGEND.
 - B. COORDINATES SHOWN HEREON ARE TENNESSEE STATE PLANE (NAD 83).
 - C. ELEVATIONS ARE NGVD 88 DATUM.



MATCHLINE - SEE SHEET VF-103



<p>US Army Corps of Engineers Louisville District</p>	
DESIGNED BY: M. CONLEY	DATE: 12/01/11
DRAWN BY: J. BARNER	SUBMITTAL NO.:
CHECKED BY: M. CONLEY	AS NOTED
APPROVED BY: M. CONLEY	FILE NAME: SOF_MH17_VF-102.dgn
PROJECT NO.:	FILE NUMBER:
CONTRACT NO.:	ANSI D:
<p>U.S. ARMY CORPS OF ENGINEERS LOUISVILLE DISTRICT LOUISVILLE, KENTUCKY</p>	
<p>SOF MH17 HANGAR FT. CAMPBELL, KENTUCKY PN 78374 P2 336965</p>	
<p>EXISTING SITE PLAN</p>	
<p>SHEET IDENTIFICATION VF-102 SHEET 14 OF 82</p>	

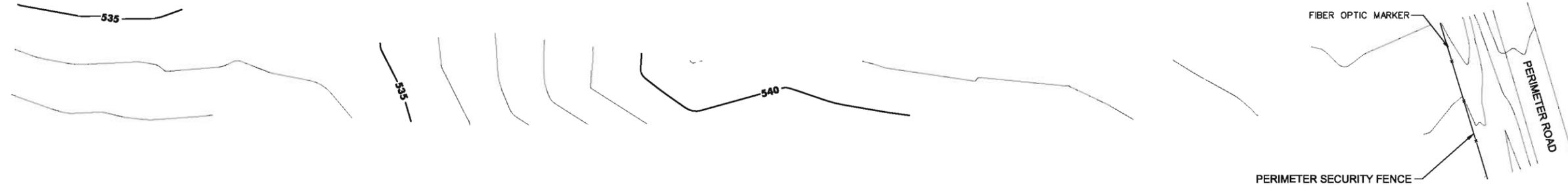
GENERAL NOTES:

- A. SEE SHEET C-001 FOR GENERAL NOTES & LEGEND.
- B. COORDINATES SHOWN HEREON ARE TENNESSEE STATE PLANE NAD 83.
- C. ELEVATIONS ARE NGVD 88 DATUM.

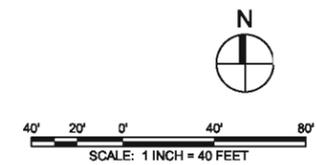


D

C



FOR SITE SURVEY CONTROL POINTS SEE SHEET VF-100

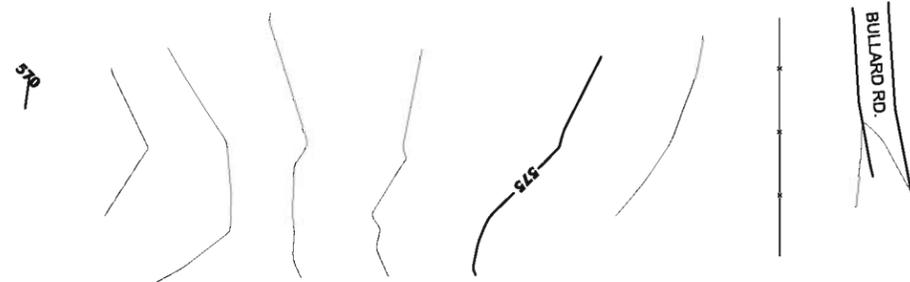


TACAN RELOCATION LOCATION

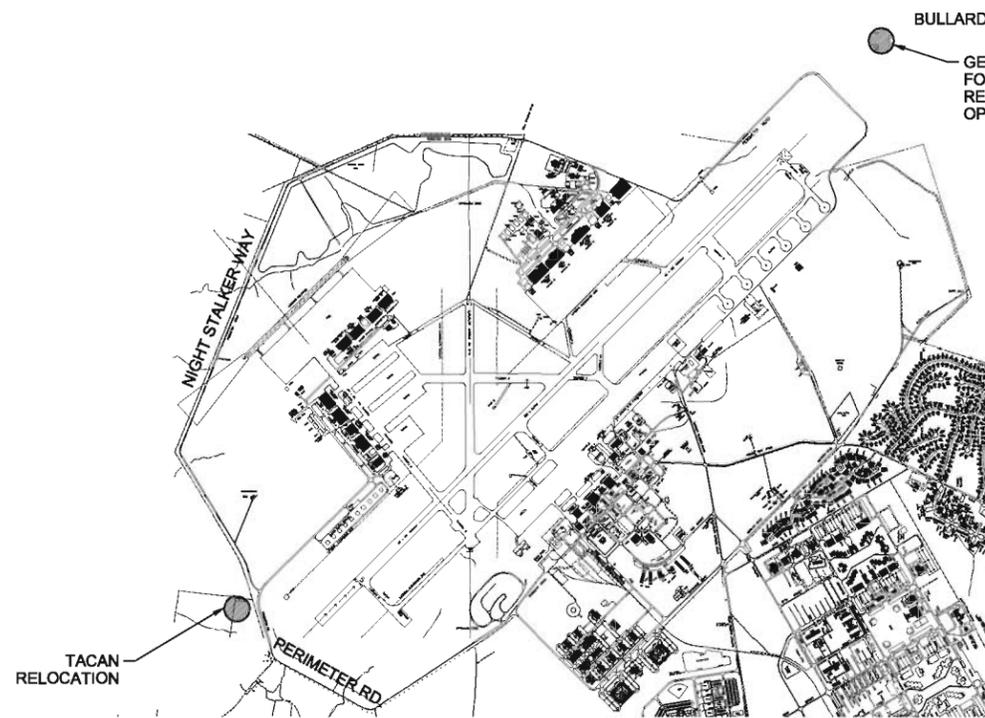
SCALE: 1" = 40'-0" 02

B

A



FOR SITE SURVEY CONTROL POINTS SEE SHEET VF-100



OPTION FOR TACAN RELOCATION

SCALE: 1" = 40'-0" 03

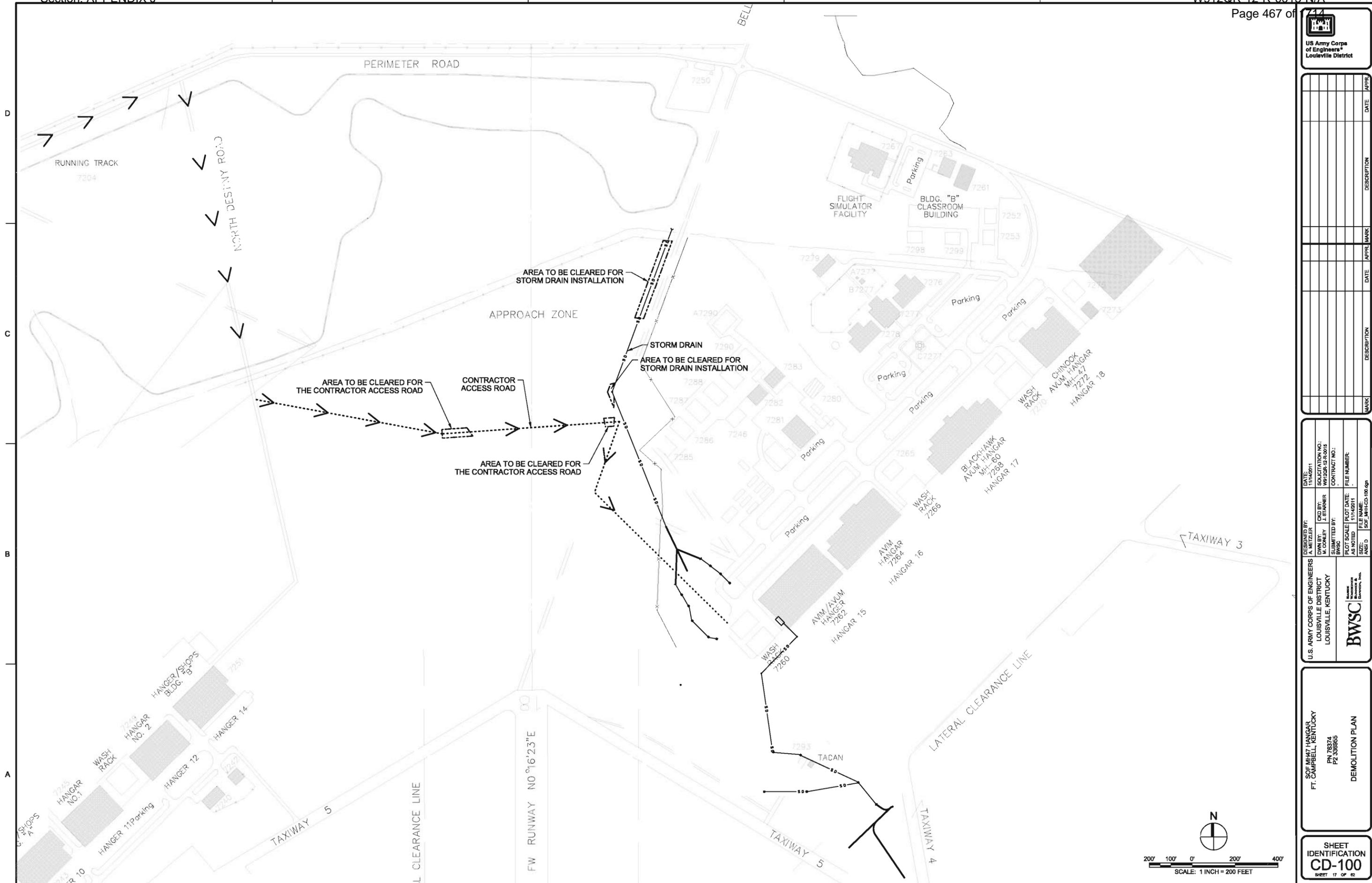
LOCATION MAP

NTS 01

DESIGNED BY: AW/ELZ	DATE: 12/01/11	SUBMITTED BY: M. CONLEY	DATE: 11/14/2011	FILE NAME: SOF_MHH-VF-104.dgn
DESIGNED BY: M. CONLEY	DATE: 11/14/2011	FILE NAME: SOF_MHH-VF-104.dgn	FILE NUMBER:	
U.S. ARMY CORPS OF ENGINEERS LOUISVILLE DISTRICT LOUISVILLE, KENTUCKY	DESIGNED BY: J. STARNER	DATE: 11/14/2011	FILE NAME: SOF_MHH-VF-104.dgn	FILE NUMBER:
BWSC		BUREAU OF WORKS ENGINEERING		

SOF MHH7 HANGAR
FT. CAMPBELL, KENTUCKY
PN 78374
P2 336955
EXISTING SITE PLAN
TACAN RELOCATION

SHEET IDENTIFICATION
VF-104
SHEET 18 OF 82



DATE	DESCRIPTION	APPR.	DATE	APPR.

DESIGNED BY: M. CONLEY	CHECKED BY: J. STARNER	DATE: 11/14/2011	SUBMITTED BY: BWS	AS NOTED	FILE NAME: SOF_MH7CD-100.dgn
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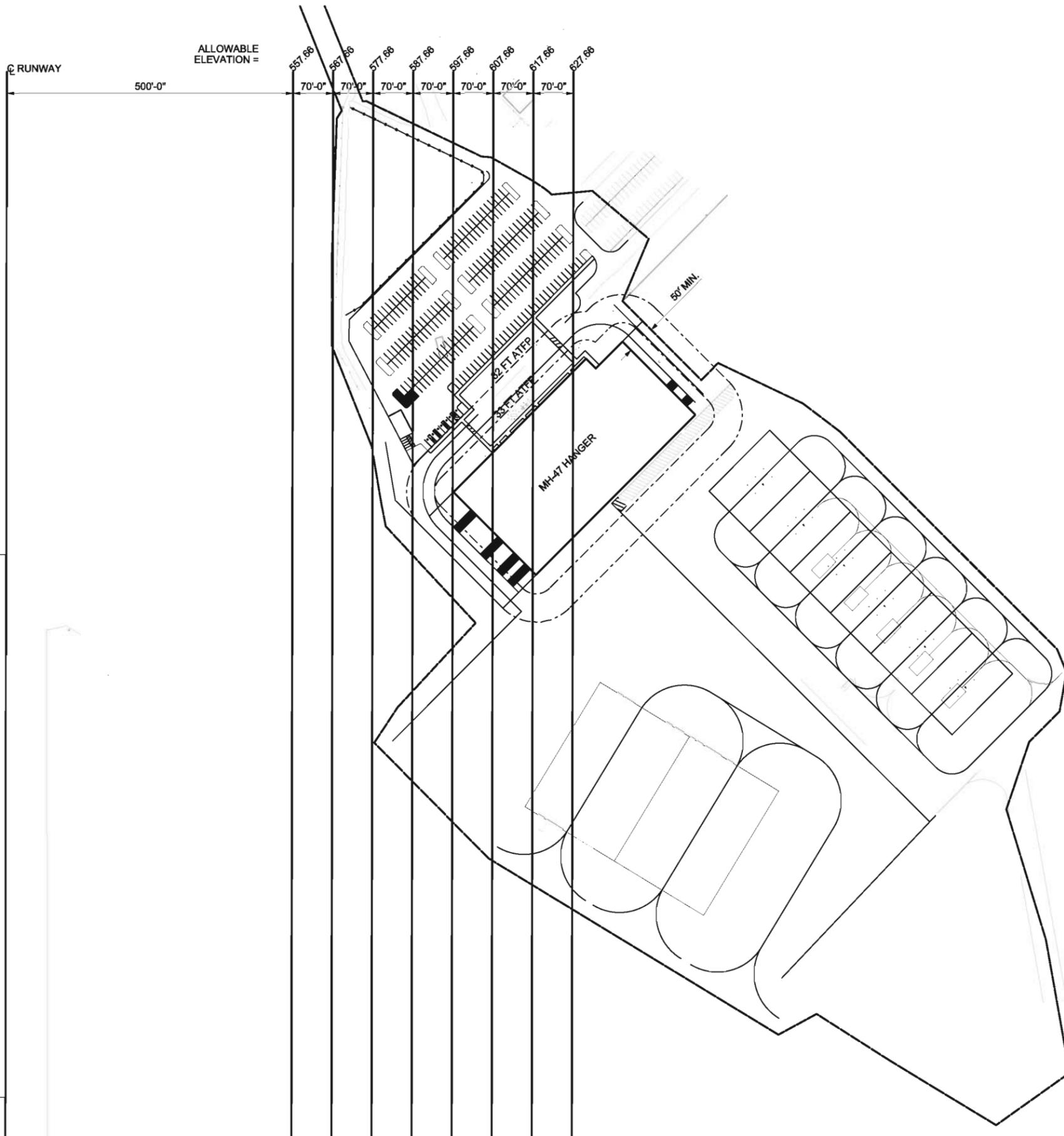
S0F MH7 HANGAR
 FT. CAMPBELL, KENTUCKY
 PN 78374
 P2 336965
 DEMOLITION PLAN

SHEET IDENTIFICATION
CD-100
 SHEET 17 OF 82



GENERAL NOTES:

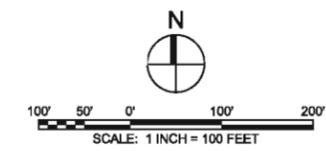
A. SEE SHEET C-001 FOR GENERAL NOTES & LEGEND.



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E 856562.36

N 855618.01
E 1529662.70

HISTORIC SINK HOLE LOCATION



MARK	DESCRIPTION	DATE	APPR.	MARK	DESCRIPTION	DATE	APPR.

DESIGNED BY: A. WETZLER	DATE: 11/14/2011
DRAWN BY: W. CONLEY	SOLICITATION NO.:
CHECKED BY: J. BARNER	CONTRACT NO.:
DATE NOTED: 11/14/2011	FILE NUMBER:
ANSI D:	ANSI D:

U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT
LOUISVILLE, KENTUCKY

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SOF MH47 HANGAR
FT. CAMPBELL, KENTUCKY
PN 78374
PZ 398965

SITE CONSTRAINTS PLAN

SHEET IDENTIFICATION
CS-100
SHEET 21 OF 22

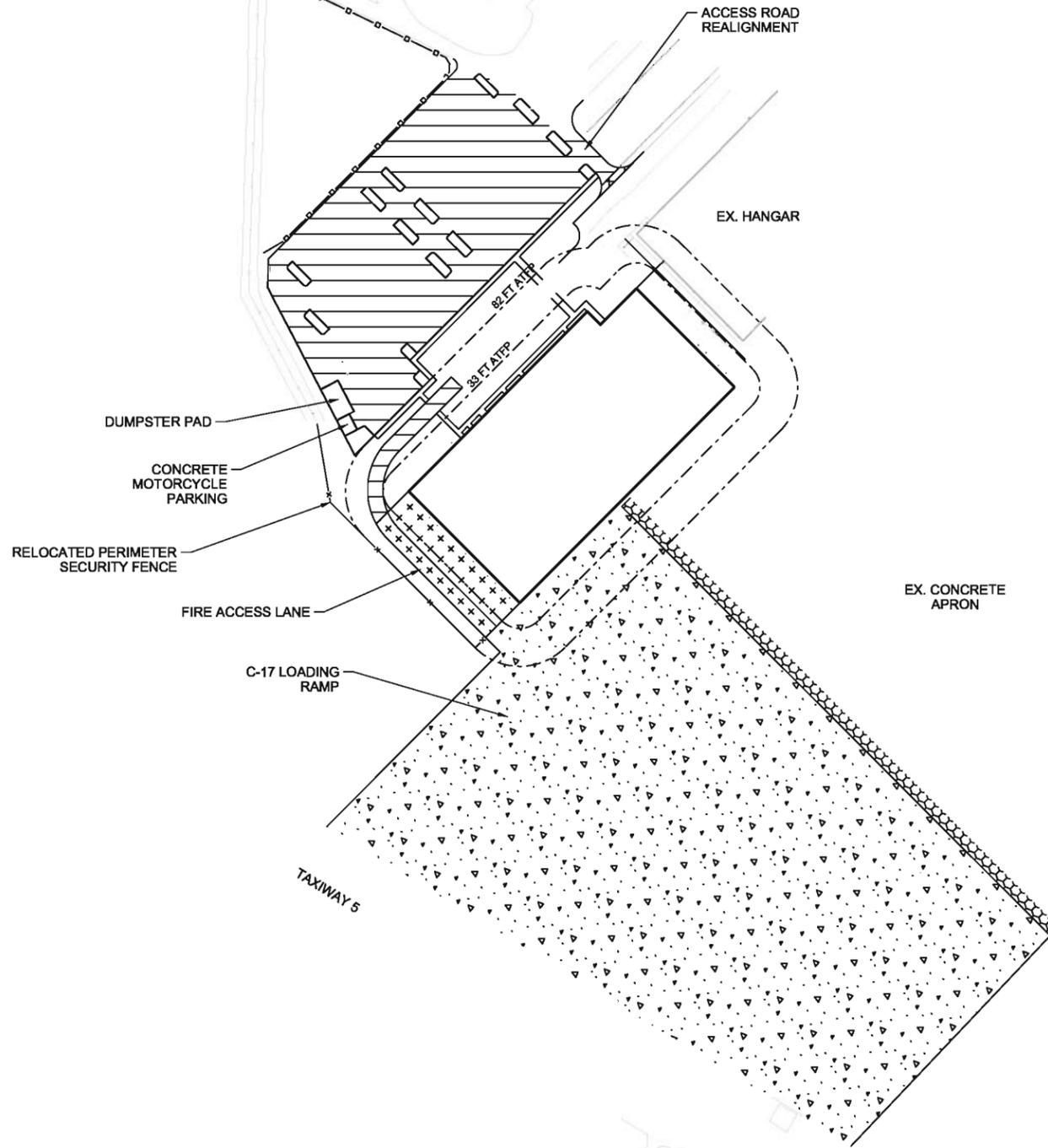
GENERAL NOTES:

A. SEE SHEET C-001 FOR GENERAL NOTES & LEGEND.



US Army Corps of Engineers
Louisville District

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C
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A



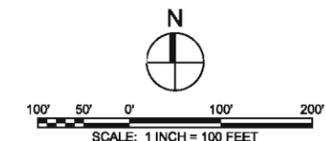
LEGEND

- NEW CONCRETE APRON
- NEW ASPHALT EXPANSION
- NEW ASPHALT PAVEMENT
- CONCRETE PAVEMENT

DATE	APPR.	MARK	DESCRIPTION

DESIGNED BY: DESIGNER: M. CONLEY	CHECKED BY: J. STARNER	DATE: 11/14/2011	SUBMITTED BY: BWS	AS NOTED	FILE NAME: SOF_MHH-CP-100.dgn
U.S. ARMY CORPS OF ENGINEERS LOUISVILLE DISTRICT LOUISVILLE, KENTUCKY		DATE: 11/14/2011 SUBMITTAL NO.: W912QR-12-R-0015 CONTRACT NO.: FILE NUMBER: ANS D			
BWSC Bentley Systems, Inc.					

SOF MHH7 HANGAR
FT. CAMPBELL, KENTUCKY
PN 78374
P2 306955
PAVEMENT PLAN



SHEET IDENTIFICATION
CP-100
SHEET 33 OF 82

GENERAL NOTES:

- A. SEE SHEET C-001 FOR GENERAL NOTES & LEGEND.
- B. REMOVE MARKINGS ON EXISTING CONCRETE APRON.

4" NON-REFLECTIVE YELLOW
EDGE LINE

4" NON-REFLECTIVE YELLOW
STRIPE SPACED 18"
APART AND AT A 45° ANGLE (TYP)

4" NON-REFLECTIVE YELLOW
EDGE LINE

EX. ASPHALT

ASPHALT JOINT MARKING
6" YELLOW @ 70°
6' SPACING
MATCH SIMILAR AREA ON ADJOINING APRONS

EX. CONCRETE APRON

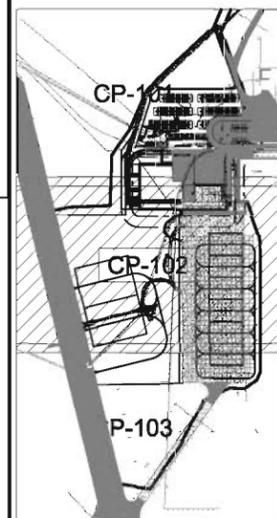
CONTRACTOR TO LOCATE EXISTING
PAVEMENT JOINTS AND ADJUST AS
NECESSARY MOORING POINTS AND
GROUNDING POINTS PER UFC 3-260-01

C-17 RAMP

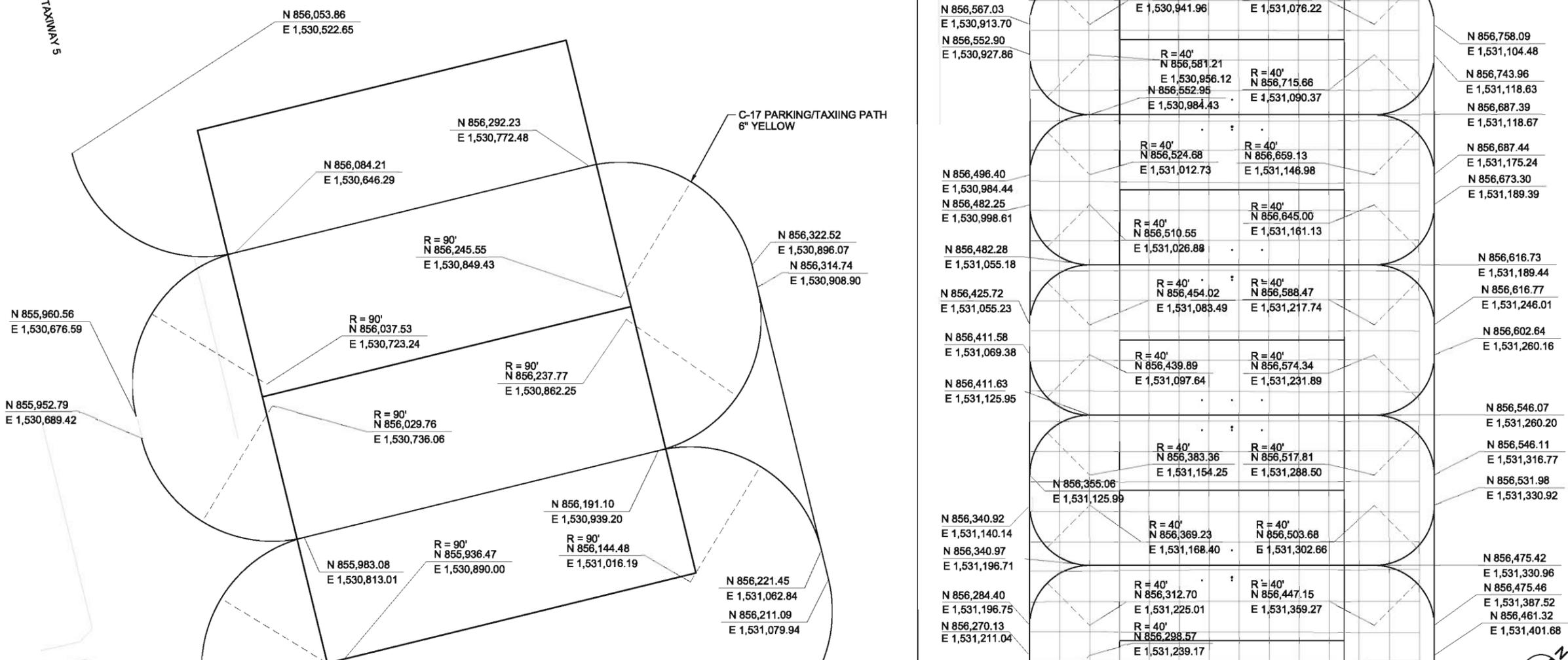
MH-47 PARKING/TAXIING PATH
6" YELLOW

C-17 PARKING/TAXIING PATH
6" YELLOW

TAXIWAY 5



KEY PLAN



MATCHLINE - SEE SHEET CP-103



US Army Corps of Engineers
Louisville District

DATE: 11/14/2011	DESIGNED BY: M. CONLEY	DESIGNATION: W912QR-12-R-0015	FILE NUMBER: 11142011
DATE: 11/14/2011	DRAWN BY: J. BARNER	CONTRACT NO.:	FILE NAME: 11142011
DATE: 11/14/2011	CHECKED BY: M. CONLEY	CONTRACT NO.:	FILE NAME: 11142011
DATE: 11/14/2011	APPROVED BY: M. CONLEY	CONTRACT NO.:	FILE NAME: 11142011

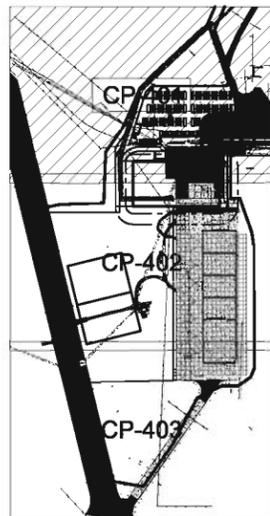
U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT
LOUISVILLE, KENTUCKY

BWSC
Bentley Systems, Inc.

SOF MH-47 HANGAR
FT. CAMPBELL, KENTUCKY
PN 78374
P2 306965

PAVEMENT MARKING PLAN

SHEET IDENTIFICATION
CP-102
SHEET 36 OF 82



GENERAL NOTES:

- A. SEE SHEET C-001 FOR GENERAL NOTES & LEGEND.
- B. SEE SHEETS C-503 AND C-504 FOR PAVEMENT DETAILS.
- C. ANY PANELS CONTAINING PROTRUSIONS SHALL BE REINFORCED.
- D. CONTRACTION AND DOWELED CONSTRUCTION JOINTS ARE INTERCHANGEABLE. PLACE DOWELED CONSTRUCTION JOINTS AT PLANNED CONSTRUCTION JOINTS AND WHERE PAVING OPERATIONS ARE DELAYED OR STOPPED.

PAVEMENT JOINT LEGEND:

- F CONTRACTION OR CONSTRUCTION JOINT
- R REINFORCED CONCRETE PAVEMENT
- B1 THICKENED EDGE BUTT JOINT
- B2 THICKENED EDGE EXPANSION JOINT

DATE	APPR.	MARK	DESCRIPTION

DESIGNED BY: ANSLER M. CONLEY	CDS BY: J. STARNER	DATE: 11/14/2011	DATE: 11/14/2011
SUBMITTED BY: BWS	FILE NAME: SOP_MH-CP-401.dgn	CONTRACT NO.:	FILE NUMBER:

U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT
LOUISVILLE, KENTUCKY

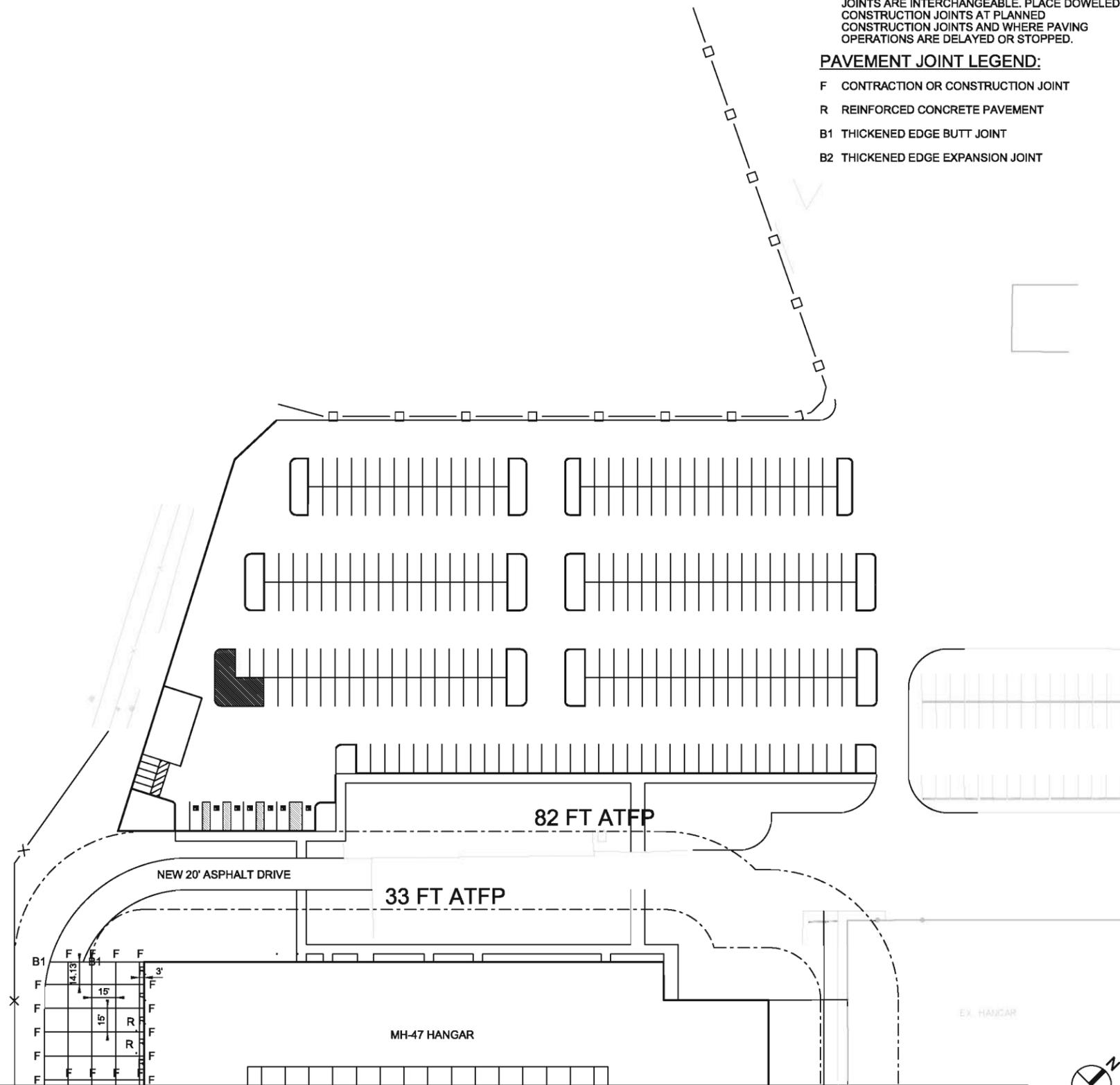
BWSC
Baltimore Washington
Surveying & Consulting
Engineers, Inc.

SOP MH-7 HANGAR
FT. CAMPBELL, KENTUCKY
PN 78374
P2 336965

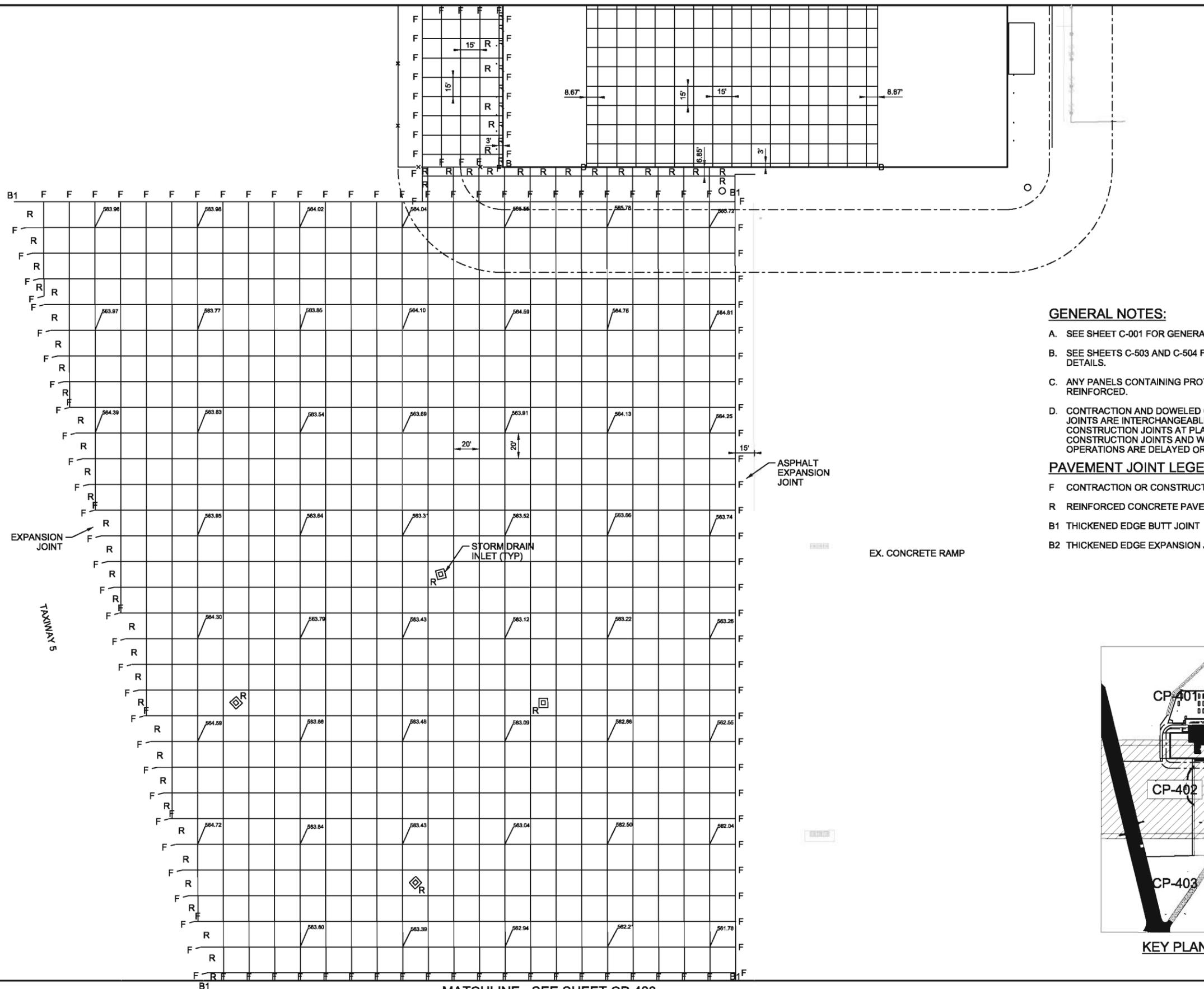
JOINT LAYOUT PLAN

SHEET IDENTIFICATION
CP-401
SHEET 37 OF 82

D
C
B
A



MATCHLINE - SEE SHEET CP-401

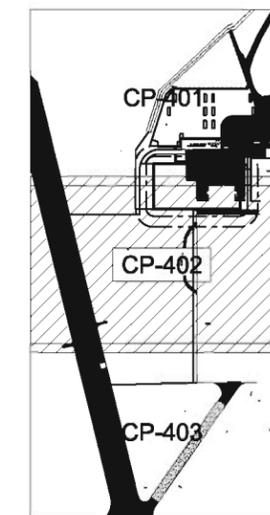


GENERAL NOTES:

- A. SEE SHEET C-001 FOR GENERAL NOTES & LEGEND.
- B. SEE SHEETS C-503 AND C-504 FOR PAVEMENT DETAILS.
- C. ANY PANELS CONTAINING PROTRUSIONS SHALL BE REINFORCED.
- D. CONTRACTION AND DOWELED CONSTRUCTION JOINTS ARE INTERCHANGEABLE. PLACE DOWELED CONSTRUCTION JOINTS AT PLANNED CONSTRUCTION JOINTS AND WHERE PAVING OPERATIONS ARE DELAYED OR STOPPED.

PAVEMENT JOINT LEGEND:

- F CONTRACTION OR CONSTRUCTION JOINT
- R REINFORCED CONCRETE PAVEMENT
- B1 THICKENED EDGE BUTT JOINT
- B2 THICKENED EDGE EXPANSION JOINT

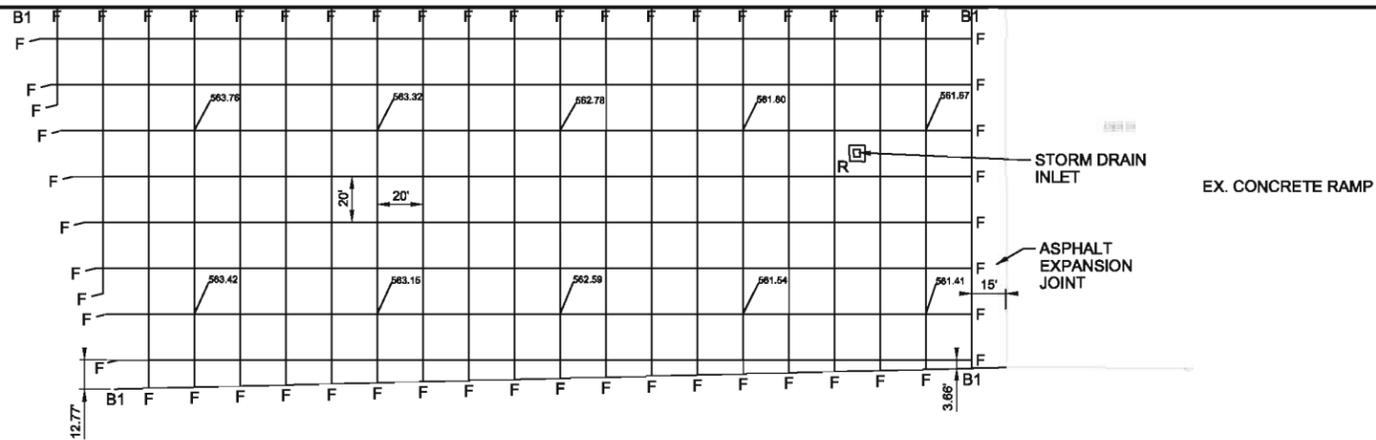


KEY PLAN



<p>US Army Corps of Engineers Louisville District</p>	
DESIGNED BY: M. CONLEY	DATE: 11/14/2011
CHECKED BY: J. STARNER	DATE: 11/14/2011
SUBMITTED BY: BWS	DATE: 11/14/2011
PROJECT NO.: W912QR-12-R-0015	CONTRACT NO.:
FILE NAME: SOF_MHH-CP-402.dgn	FILE NUMBER:
<p>U.S. ARMY CORPS OF ENGINEERS LOUISVILLE DISTRICT LOUISVILLE, KENTUCKY</p> <p>BWSC BWS Consulting Engineers, Inc.</p>	
<p>SOE MHH7 HANGAR FT. CAMPBELL, KENTUCKY</p> <p>PN 78374 P2 336965</p> <p>JOINT LAYOUT PLAN</p>	
<p>SHEET IDENTIFICATION CP-402 SHEET 38 OF 82</p>	

MATCHLINE - SEE SHEET CP-402



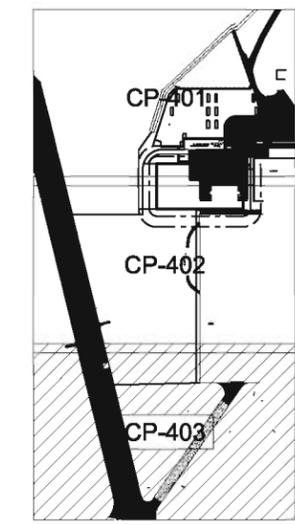
D
C
B
A

TAXIWAY 5

TAXIWAY 4

STORM DRAIN INLET
EX. CONCRETE RAMP
ASPHALT EXPANSION JOINT

- GENERAL NOTES:**
- A. SEE SHEET C-001 FOR GENERAL NOTES & LEGEND.
 - B. SEE SHEETS C-503 AND C-504 FOR PAVEMENT DETAILS.
 - C. ANY PANELS CONTAINING PROTRUSIONS SHALL BE REINFORCED.
 - D. CONTRACTION AND DOWELED CONSTRUCTION JOINTS ARE INTERCHANGEABLE. PLACE DOWELED CONSTRUCTION JOINTS AT PLANNED CONSTRUCTION JOINTS AND WHERE PAVING OPERATIONS ARE DELAYED OR STOPPED.
- PAVEMENT JOINT LEGEND:**
- F CONTRACTION OR CONSTRUCTION JOINT
 - R REINFORCED CONCRETE PAVEMENT
 - B1 THICKENED EDGE BUTT JOINT
 - B2 THICKENED EDGE EXPANSION JOINT



<p>US Army Corps of Engineers Louisville District</p>	
DATE	APPR.
DESCRIPTION	MARK
DATE	APPR.
DESCRIPTION	MARK
DATE	APPR.
DESCRIPTION	MARK
DATE	APPR.
DESCRIPTION	MARK
DATE	APPR.
DESCRIPTION	MARK
DESIGNED BY: M. CONLEY	CHECKED BY: J. STARNER
SUBMITTED BY: BWS	DATE: 11/14/2011
PROJECT NO.: W912QR-12-R-0015	CONTRACT NO.:
FILE NAME: SOF_MHH-CP-403.dgn	FILE NUMBER:
<p>U.S. ARMY CORPS OF ENGINEERS LOUISVILLE DISTRICT LOUISVILLE, KENTUCKY</p>	
<p>SOFT MHH7 HANGAR FT. CAMPBELL, KENTUCKY PN 78374 P2 336965</p>	
<p>JOINT LAYOUT PLAN</p>	
<p>SHEET IDENTIFICATION CP-403 SHEET 39 OF 82</p>	

MATCHLINE - SEE SHEET CU-101

D
C
B
A

8" WATER LINE
RELOCATION
BY OTHERS

FIRE HYDRANT
ON 6" LINE

N 856,456.56
E 1,530,535.52

C-17 RAMP

15KV ELECTRIC

WATER LINE
RELOCATION
BY OTHERS

EX. CONCRETE
APRON

90° BEND ON
FIRE SERVICE
N=856901.44
E=1530783.60

8"x4" TEE
4" WATER SERVICE
N=856903.40
E=1580802.63

90° BEND
N=856648.33
E=1530726.63

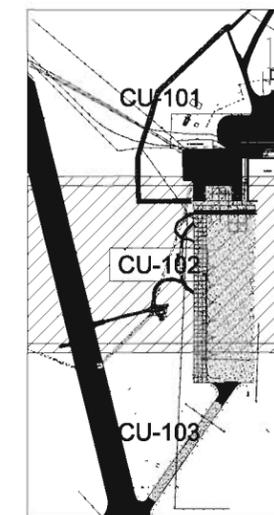
N 856,812.13
E 1,530,876.60

FIRE HYDRANT
ON 6" LINE

90° BEND
N=856821.79
E=1530886.06

GENERAL NOTES:

- A. SEE SHEET C-001 FOR GENERAL NOTES & LEGEND.
- B. UTILITY WORK INDICATED BY OTHERS SHALL BE COORDINATED WITH THE APPROPRIATE UTILITY OWNER A MINIMUM OF 30 DAYS PRIOR TO DESIRED CONSTRUCTION TIME.
- C. CONTRACTOR SHALL FIELD LOCATE THE EXISTING FIRE WATER MAIN AND ADJUST CONNECTION POINT AS NECESSARY.
- D. REFER TO SHEETS ES-106 TO ES-122 FOR 15KV LINE ROUTING.



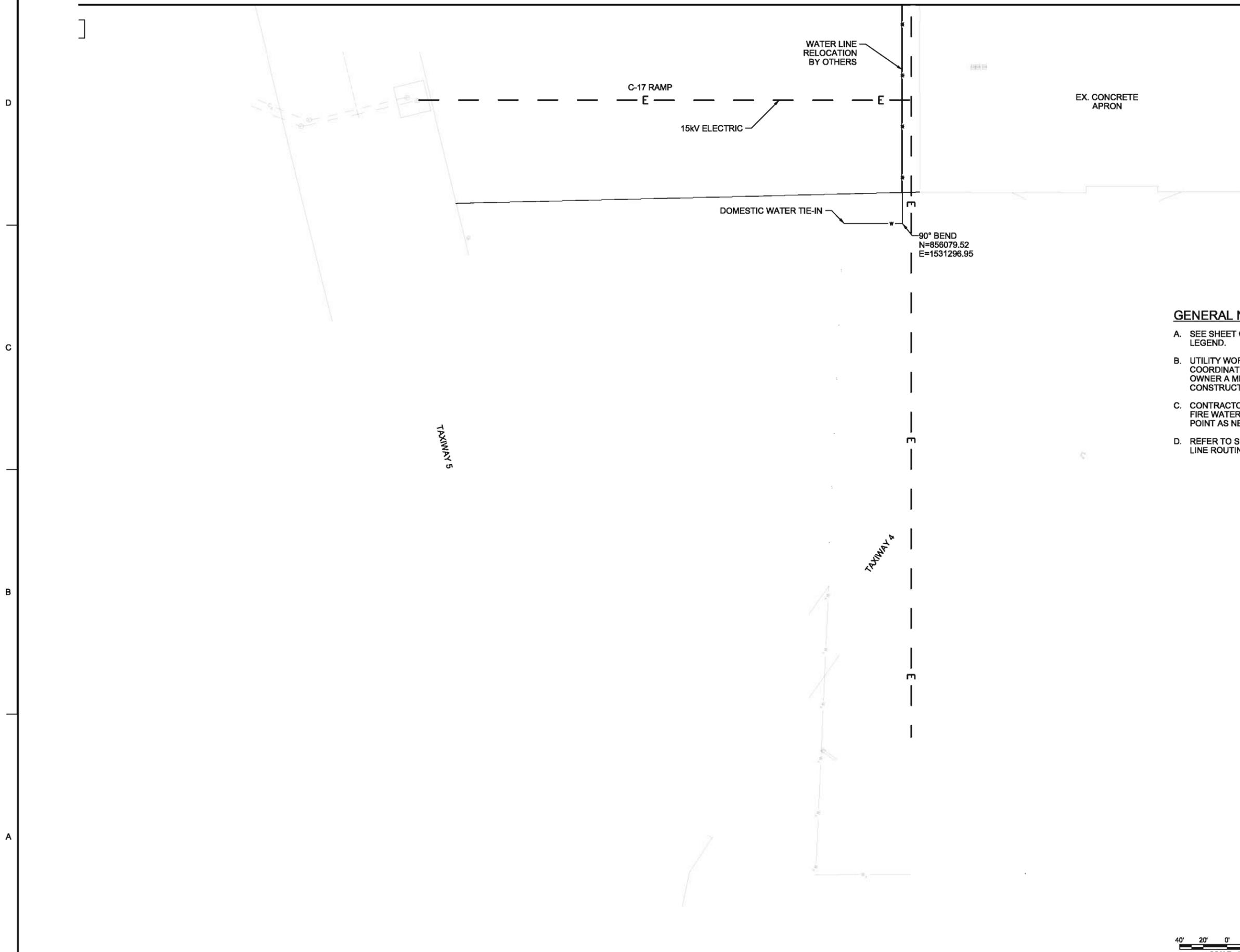
KEY PLAN



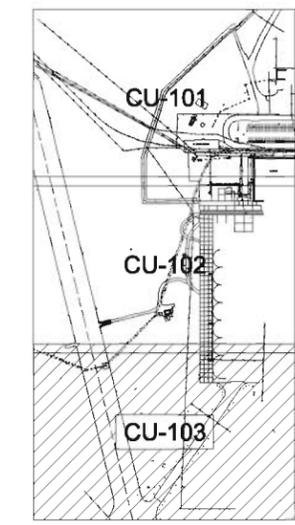
MATCHLINE - SEE SHEET CU-103

<p>US Army Corps of Engineers Louisville District</p>	
DATE: 10/01/11	SUBMITTAL NO.: W912QR-12-R-0015
DESIGNED BY: M. CONLEY	CONTRACT NO.:
CHECKED BY: J. STARNER	FILE NUMBER:
DATE: 11/14/2011	FILE NAME: S0P_MHH-CU-102.dgn
ANSI D	ANSI D
<p>U.S. ARMY CORPS OF ENGINEERS LOUISVILLE DISTRICT LOUISVILLE, KENTUCKY</p>	
<p>SOF MHH7 HANGAR FT. CAMPBELL, KENTUCKY PN 78374 P2 306965</p> <p>ENLARGED UTILITY PLAN</p>	
<p>SHEET IDENTIFICATION CU-102 SHEET 43 OF 82</p>	

MATCHLINE - SEE SHEET CU-102



- GENERAL NOTES:**
- A. SEE SHEET C-001 FOR GENERAL NOTES & LEGEND.
 - B. UTILITY WORK INDICATED BY OTHERS SHALL BE COORDINATED WITH THE APPROPRIATE UTILITY OWNER A MINIMUM OF 30 DAYS PRIOR TO DESIRED CONSTRUCTION TIME.
 - C. CONTRACTOR SHALL FIELD LOCATE THE EXISTING FIRE WATER MAIN AND ADJUST CONNECTION POINT AS NECESSARY.
 - D. REFER TO SHEETS ES-106 TO ES-122 FOR 15KV LINE ROUTING.



KEY PLAN



<p>US Army Corps of Engineers Louisville District</p>	
DESIGNED BY: M. CONLEY	CDS BY: J. STARNER
SUBMITTED BY: BWS	DATE: 11/14/2011
DATE: 11/14/2011	FILE NAME: SOF_MHH-CU-103.dgn
DESIGNATION: W912QR-12-R-0015	CONTRACT NO.:
FILE NUMBER:	
<p>U.S. ARMY CORPS OF ENGINEERS LOUISVILLE DISTRICT LOUISVILLE, KENTUCKY</p> <p>BWSC Bentley Systems, Inc.</p>	
<p>SOF MHH7 HANGAR FT. CAMPBELL, KENTUCKY PN 78374 P2 306965</p> <p>ENLARGED UTILITY PLAN</p>	
<p>SHEET IDENTIFICATION CU-103 SHEET 44 OF 82</p>	

DATE	DESCRIPTION	DATE	APPR.

DESIGNED BY: M. CONLEY	CHECKED BY: J. STARNER	DATE: 11/14/2011
SUBMITTED BY: BWS	APPROVED BY: 	DATE: 11/14/2011
PROJECT NO.: 	CONTRACT NO.: 	FILE NUMBER:
AS NOTED	AS NOTED	AS NOTED

U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT
LOUISVILLE, KENTUCKY

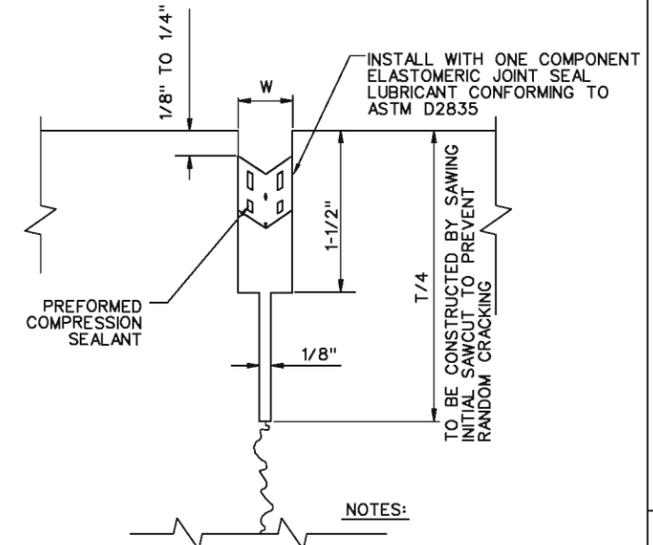
BWSC
Battalion
Waterways
Division, Inc.

SOF M147 HANGAR
FT. CAMPBELL, KENTUCKY

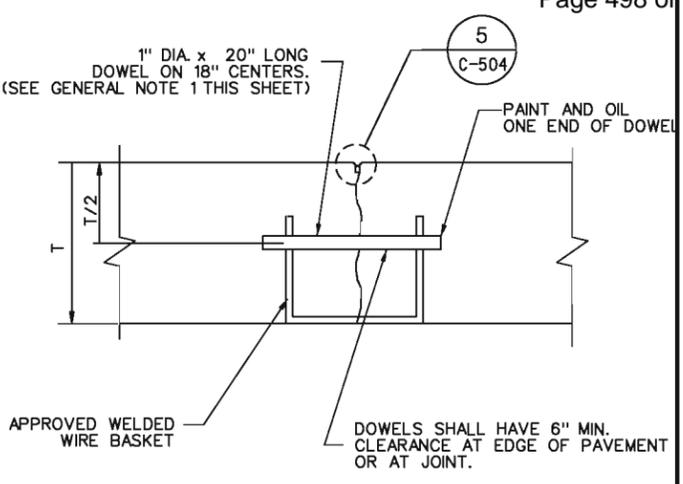
PN 78374
P2 306965

PAVEMENT DETAILS

SHEET IDENTIFICATION
C-504
SHEET 48 OF 82

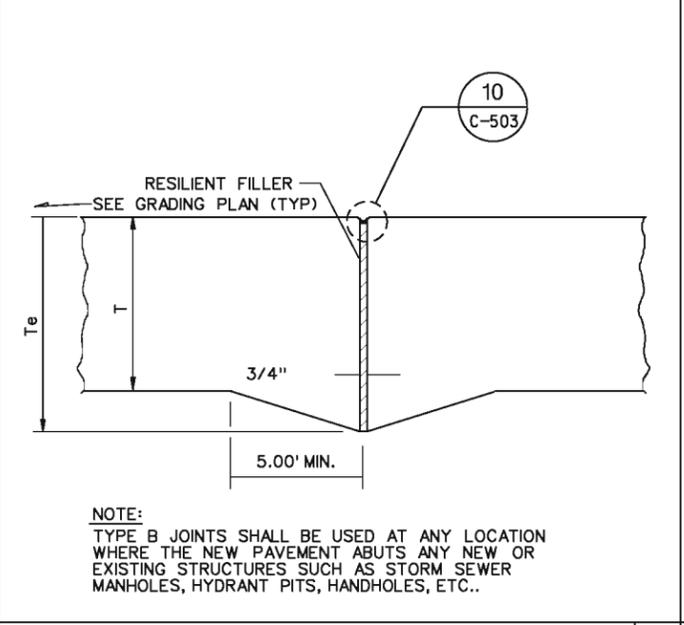


- NOTES:
- ALL JOINTS SHALL CONFORM TO SPECIFICATIONS.
 - W IS 1/8" TO 1/4" ± 1/16" WHEN CONCRETE TEMPERATURE IS BETWEEN 25°F AND 80° F AT TIME OF SAWING.
 - W IS DECREASED 1/16" WHEN CONCRETE TEMPERATURE IS ABOVE 80°F AT TIME OF SAWING. W IS INCREASED 1/16" WHEN CONCRETE IS BELOW 25°F AT TIME OF SAWING.
 - CLOSED CELL RESILIENT FOAM SIZED TO FIT A 1/8" SAWCUT SHALL BE INSTALLED IMMEDIATELY FOLLOWING INITIAL SAWCUT.



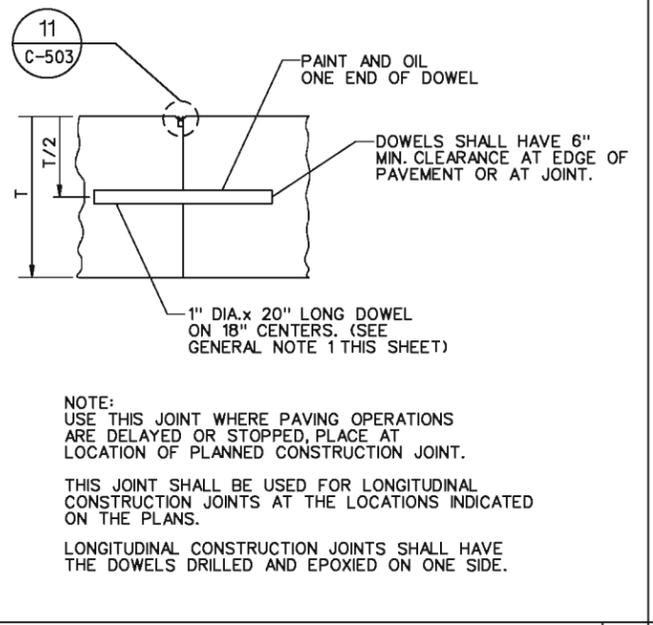
TYPE F-DOWELED CONTRACTION JOINT NTS 03

NOT USED NTS 07



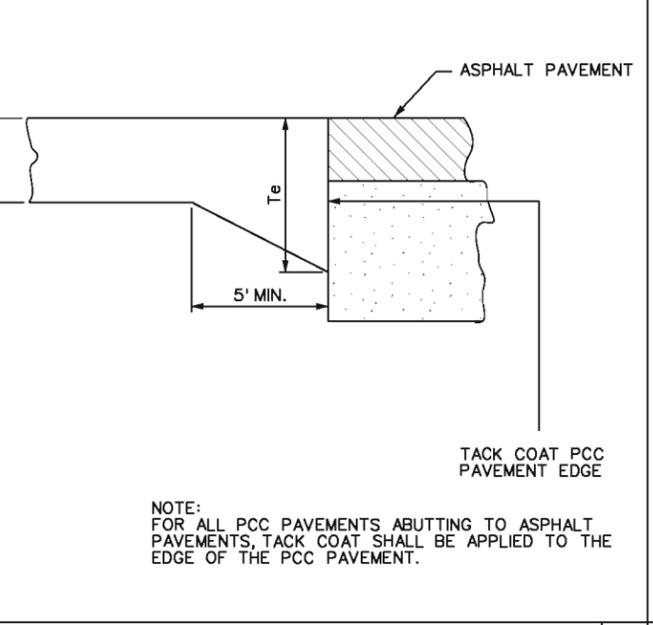
TYPE B-THICKENED EDGE EXPANSION JOINT NTS 08

NOT USED NTS 05



TYPE D-DOWELED CONSTRUCTION JOINT NTS 06

NOT USED NTS 04



TYPE B1-THICKENED EDGE BUTT JOINT NTS 04

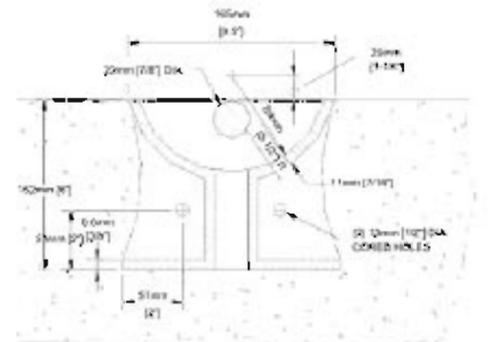
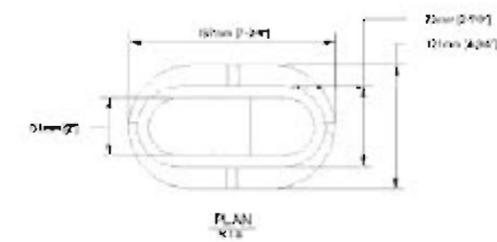
NOT USED NTS 01

TYPE	T	T/2	T/4	Te	T/4+1"
PARKING AND DRIVE AREAS	6"	3"	1.5"	7.5"	2.5"
APRON PCC PAVEMENT	15"	7.5"	3.75"	18.75"	4.75"

GENERAL NOTES:

- THE TOLERANCE FOR DOWEL ALIGNMENT IN EITHER THE HORIZONTAL OR VERTICAL PLANE IS 1/8" INCH PER FOOT.
- SEE TABLE ON THIS SHEET FOR THICKNESS (T) AND OTHER REFERENCED DIMENSIONS.
- SEE SPECIFICATIONS FOR ADDITIONAL INFORMATION REGARDING DOWELS AND DOWEL INSTALLATION REQUIREMENTS.

THICKNESS TABLE & GEN. NOTES NTS 01

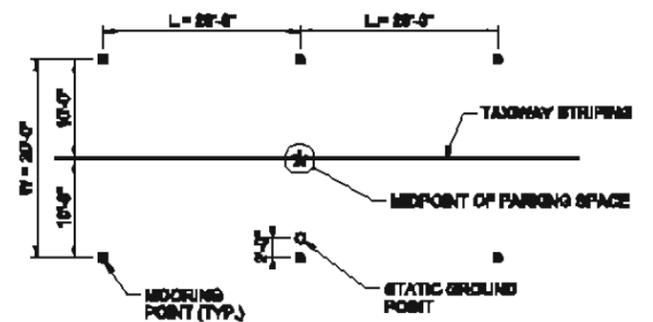


K13
MOORING DEVICE TO BE CAST
IN DUCTILE IRON OR STEEL
OR EQUAL.

NOT USED HTS 00

NOT USED HTS 04

ARMY MOORING POINT HTS 02



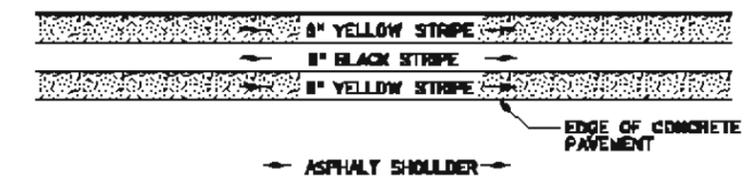
NOTES:

1. IN NEW OR EXISTING ROAD PAVEMENT, THE MOORING POINTS WILL BE AT LEAST 2' AWAY FROM ANY PAVEMENT JOINT OR EDGE. TO MISS THE PAVING JOINTS, THE SPACING OF THE MOORING POINTS MAY BE VARIED AS FOLLOWS:
A. W, LAND L MAY VARY FROM 17 TO 25'.
B. W, LAND L NEED NOT BE EQUAL.
2. THE CONSTRUCTION TOLERANCE ON MOORING POINT LOCATION SHOULD BE ±.

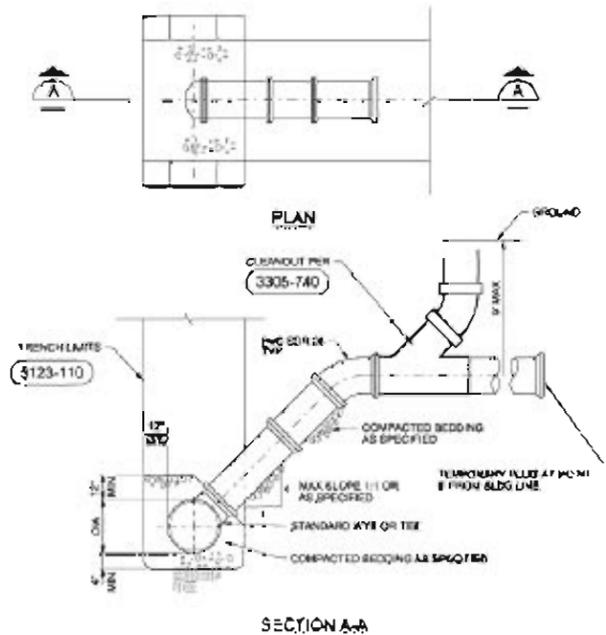
NOT USED HTS 05

ALLOWABLE MOORING POINT SPACING HTS 03

DOUBLE YELLOW LINE MARKING HTS 01

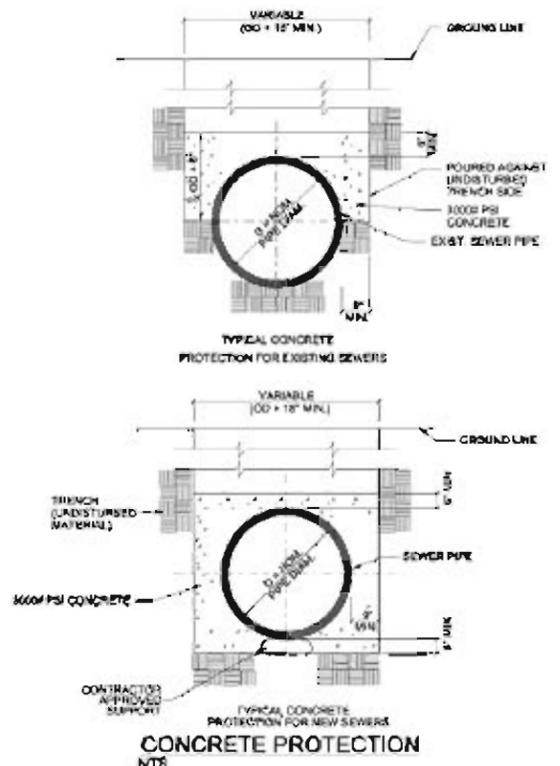


U.S. ARMY CORPS OF ENGINEERS LOUISVILLE DISTRICT LOUISVILLE, KENTUCKY	BWSCL
FL. SHEET NUMBER P. 500	PAVEMENT MARKING DETAILS
SHEET IDENTIFICATION C-508	



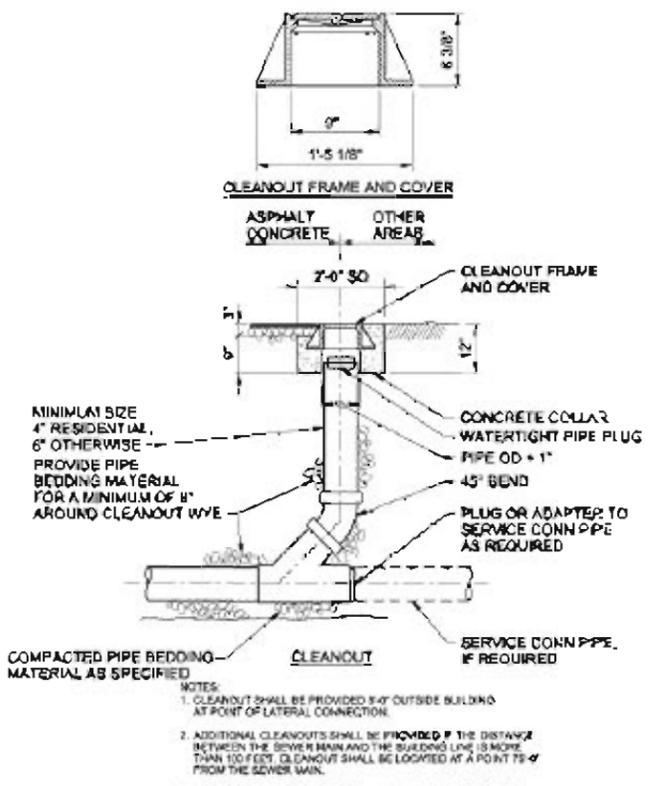
SANITARY SEWER SERVICE CONNECTION

NTS
 3305-731
 FORT CAMPBELL, KY/ FORT IRWIN, CA
 STANDARD DRAWINGS FOR WATER AND
 WASTEWATER CONSTRUCTION
 ISSUED: 02-10
CH2MHILL



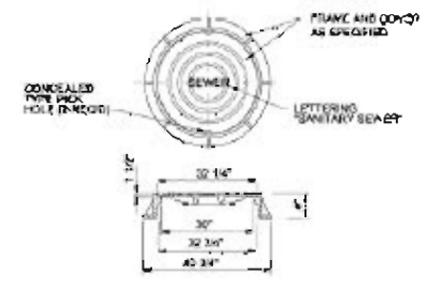
CONCRETE PROTECTION

NTS
 3305-732
 FORT CAMPBELL, KY/ FORT IRWIN, CA
 STANDARD DRAWINGS FOR WATER AND
 WASTEWATER CONSTRUCTION
 ISSUED: 02-10
CH2MHILL



EXTERIOR CLEANOUT

NTS
 3305-740
 FORT CAMPBELL, KY/ FORT IRWIN, CA
 STANDARD DRAWINGS FOR WATER AND
 WASTEWATER CONSTRUCTION
 ISSUED: 02-10
CH2MHILL



STANDARD MANHOLE FRAME AND COVER

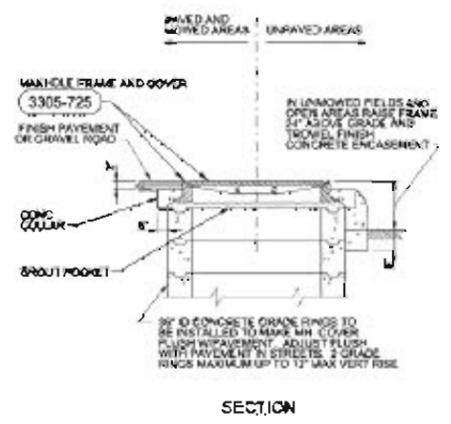
NTS
 3305-735
 FORT CAMPBELL, KY/ FORT IRWIN, CA
 STANDARD DRAWINGS FOR WATER AND
 WASTEWATER CONSTRUCTION
 ISSUED: 02-10
CH2MHILL

SANITARY SEWER SERVICE CONNECTION NTS 06

CONCRETE PROTECTION NTS 06

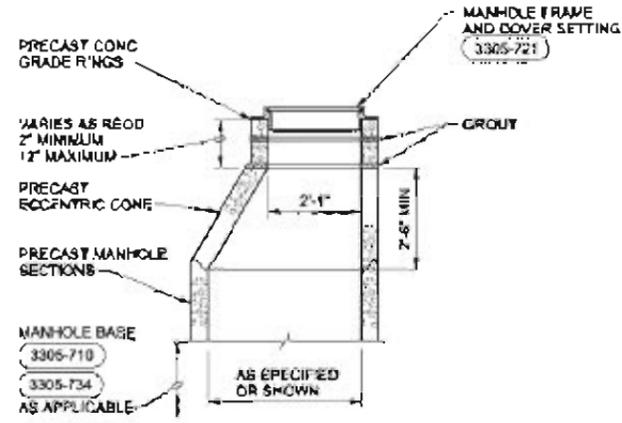
EXTERIOR CLEANOUT NTS 04

STANDARD MANHOLE FRAME & COVER NTS 02



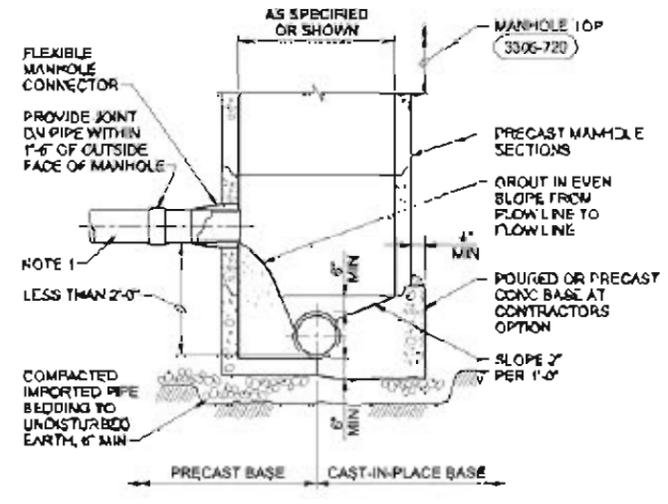
MANHOLE FRAME AND COVER SETTING WITH GRADE EXTENSION

NTS
 3305-731
 FORT CAMPBELL, KY/ FORT IRWIN, CA
 STANDARD DRAWINGS FOR WATER AND
 WASTEWATER CONSTRUCTION
 ISSUED: 02-10
CH2MHILL



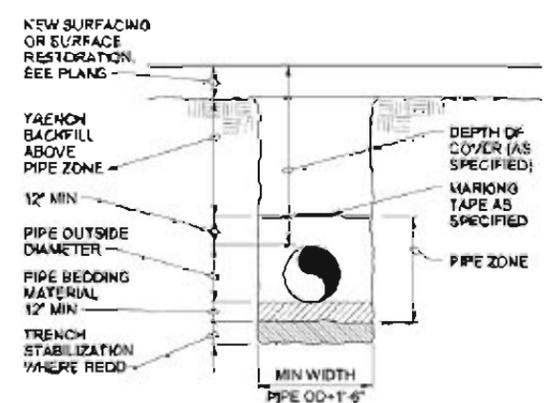
ECCENTRIC MANHOLE TOP SECTION

NTS
 3305-730
 FORT CAMPBELL, KY/ FORT IRWIN, CA
 STANDARD DRAWINGS FOR WATER AND
 WASTEWATER CONSTRUCTION
 ISSUED: 02-10
CH2MHILL



MANHOLE BASE SECTION - 6" TO 24" PIPE

NTS
 3305-710
 FORT CAMPBELL, KY/ FORT IRWIN, CA
 STANDARD DRAWINGS FOR WATER AND
 WASTEWATER CONSTRUCTION
 ISSUED: 02-10
CH2MHILL



TYPICAL TRENCH

NTS
 3125-110
 FORT CAMPBELL, KY/ FORT IRWIN, CA
 STANDARD DRAWINGS FOR WATER AND
 WASTEWATER CONSTRUCTION
 ISSUED: 02-10
CH2MHILL

MANHOLE FRAME & COVER SETTING W/ GRADE EXT. NTS 05

ECCENTRIC MANHOLE TOP SECTION NTS 05

MANHOLE BASE SECTION - 6" TO 24" PIPE NTS 03

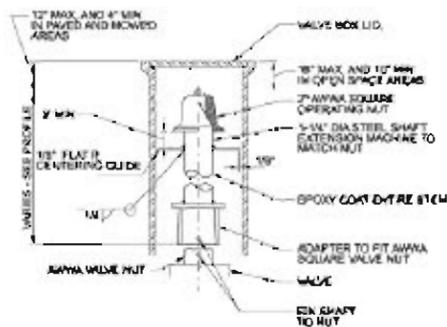
TYPICAL TRENCH NTS 01

U.S. Army Corps of Engineers
 Louisville District
 Louisville, Kentucky

BWSC

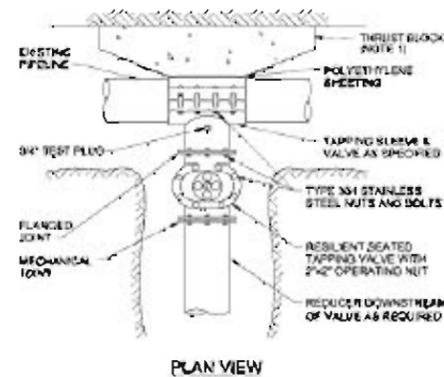
PT. SCAMP, Kentucky
 KY 40364
 UTILITY DETAILS

SHEET IDENTIFICATION
C-509



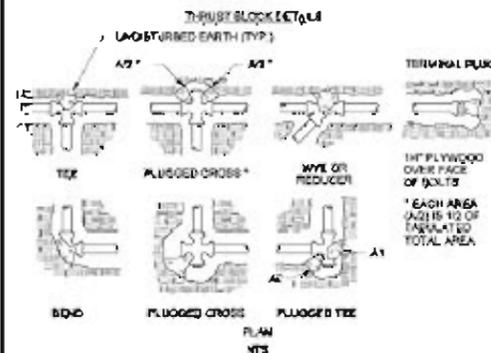
VALVE BOX/OPERATOR STEM NTS

4027-543
 FORT CAMPBELL, KY/FORT IRWIN, CA
 STANDARD DRAWINGS FOR WATER AND
 WASTEWATER CONSTRUCTION
 ISSUED: 02-10
 CH2MHILL



TAPPING TEE NTS

3311-823
 FORT CAMPBELL, KY/FORT IRWIN, CA
 STANDARD DRAWINGS FOR WATER AND
 WASTEWATER CONSTRUCTION
 ISSUED: 02-10
 CH2MHILL

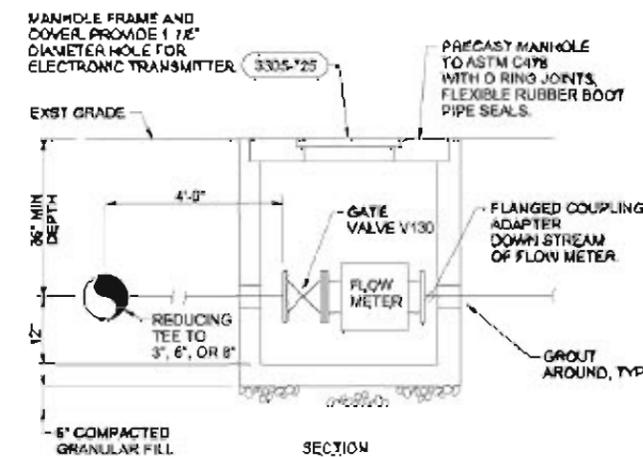


BEARING AREA OF THRUST BLOCKS IN SQ. FT. (HORIZONTAL BENDS)

FITTING SIZE	TEE, WYE, PLUG, OR CAP	SCHEDULE PLUGGED CROSS		TEE PLUGGED W/IN		BEND ANGLE (DEGREES)		
		A1	A2	45	22 1/2	11 1/4		
4	1.0	1.4	1.4	1.4	1.0	-	-	-
6	2.1	3.0	4.3	3.0	1.8	1.0	-	-
8	3.6	5.5	7.6	5.4	2.5	1.5	1.0	-
10	5.3	8.4	11.0	8.4	4.0	2.4	1.3	-
12	8.5	12.0	17.0	13.0	6.6	3.4	1.7	-
14	14.5	18.3	23.0	18.3	8.4	4.1	2.5	-
16	18.0	21.0	28.0	21.0	11.0	5.0	3.0	-
18	19.5	27.0	33.0	27.0	14.8	7.8	3.8	-
20	23.5	33.3	47.5	33.5	18.1	9.4	4.7	-
24	34.0	48.0	68.0	48.0	26.2	13.0	6.8	-

CONCRETE THRUST BLOCKS (SHEET 2 OF 2) NTS

3311-822
 FORT CAMPBELL, KY/FORT IRWIN, CA
 STANDARD DRAWINGS FOR WATER AND
 WASTEWATER CONSTRUCTION
 ISSUED: 02-10
 CH2MHILL



WATER SERVICE FOR 2-1/2 INCH AND LARGER INSTALLATIONS NTS

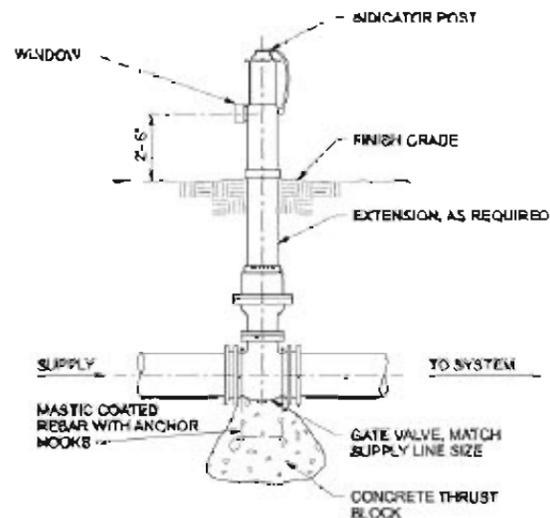
3311-826
 FORT CAMPBELL, KY/FORT IRWIN, CA
 STANDARD DRAWINGS FOR WATER AND
 WASTEWATER CONSTRUCTION
 ISSUED: 02-10
 CH2MHILL

VALVE BOX/ OPERATOR STEM NTS 05

TAPPING TEE NTS 04

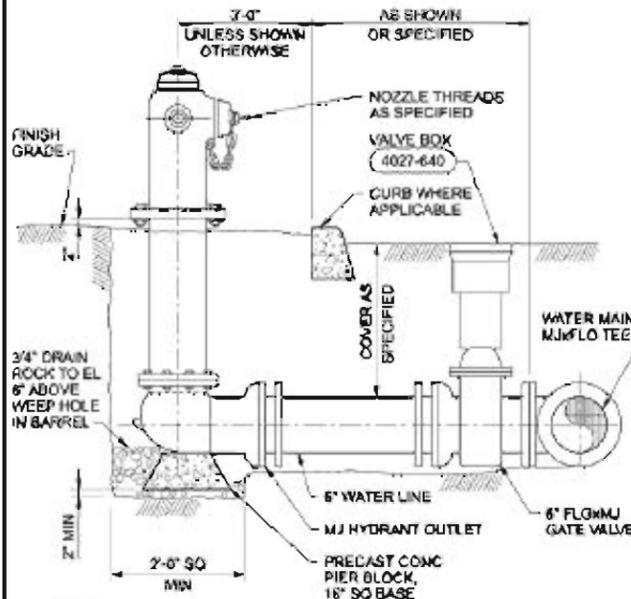
CONCRETE THRUST BLOCKS (2 OF 2) NTS 04

WATER SERVICE FOR ≥2.5" INSTALLATIONS NTS 02



POST INDICATOR VALVE NTS

3312-959
 FORT CAMPBELL, KY/FORT IRWIN, CA
 STANDARD DRAWINGS FOR WATER AND
 WASTEWATER CONSTRUCTION
 ISSUED: 02-10
 CH2MHILL



FIRE HYDRANT NTS

3312-770
 FORT CAMPBELL, KY/FORT IRWIN, CA
 STANDARD DRAWINGS FOR WATER AND
 WASTEWATER CONSTRUCTION
 ISSUED: 02-10
 CH2MHILL

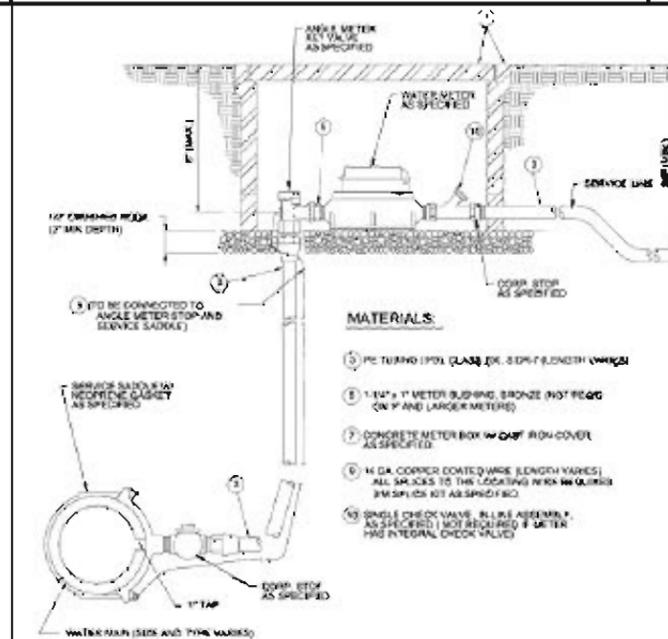
- THRUST BLOCK NOTES
- KEEP CONCRETE CLEAN OF JOINT AND JOINT ACCESSORIES.
 - CONCRETE THRUST BLOCKING SHALL BE POURED AGAINST UNDISTURBED EARTH.
 - REQUIRED VOLUMES OR BEARING AREAS AT FITTINGS SHALL BE AS INDICATED, ADJUSTED, IF NECESSARY, TO CONFORM TO THE TEST PRESSURES AND ALLOWABLE SOIL BEARING STRESSES AS SPECIFIED.
 - THRUST BLOCK VOLUMES FOR VERTICAL BENDS HAVING UPWARD RESULTANT THRUSTS ARE BASED ON TEST PRESSURES OF 100 PSIG AND TWO WEIGHTS OF CONCRETE IS 1450 LBS/CY. TO COMPUTE VOLUMES FOR DIFFERENT TEST PRESSURES, USE THE FOLLOWING EQUATION: VOLUME = (TEST PRESS/100) x (TABLE VALUE).
 - BEARING AREAS FOR HORIZONTAL BEND THRUST BLOCKS ARE BASED ON TEST PRESSURES OF 100 PSIG AND AN ALLOWABLE SOIL BEARING STRESS OF 2000 LBS/SQ. FT. TO COMPUTE BEARING AREAS FOR DIFFERENT TEST PRESSURES AND SOIL BEARING STRESSES, MULTIPLY TABLE VALUES BY THE FACTOR (100/TEST PRESS) WHERE: P = ACTUAL TEST PRESSURE, PSIG; S = ACTUAL ALLOWABLE SOIL BEARING PRESSURE, PSF.
 - TEST PRESSURES PER SPECIFICATIONS.
 - THRUST BLOCKS FOR VERTICAL BENDS HAVING DOWNWARD RESULTANT THRUSTS SHALL BE THE SAME AS FOR HORIZONTAL BENDS.
 - BEARING AREAS, VOLUMES, AND SPECIAL BLOCKING DETAILS SHOWN ON DRAWINGS TAKE PRECEDENCE OVER THIS STANDARD.
 - BEARING AREA OF THRUST BLOCK SHALL NOT BE LESS THAN 1/8 SQ. FT.
 - VERTICAL BENDS THAT REQUIRE A THRUST BLOCK VOLUME EXCEEDING 4 CUBIC YARDS REQUIRE SPECIAL BLOCKING DETAILS.

VOLUME OF THRUST BLOCK IN CUBIC YARDS (VERTICAL BENDS)

FITTING SIZE	BEND ANGLE (DEGREES)		
	45	22 1/2	11 1/4
4	1.1	0.4	0.2
6	2.7	1.6	0.4
8	4.0	1.5	0.6
10	6.0	2.3	0.9
12	9.6	3.7	1.3
14	11.9	4.3	1.6
16	14.8	5.1	2.3

CONCRETE THRUST BLOCKS (SHEET 1 OF 2) NTS

3311-821
 FORT CAMPBELL, KY/FORT IRWIN, CA
 STANDARD DRAWINGS FOR WATER AND
 WASTEWATER CONSTRUCTION
 ISSUED: 02-10
 CH2MHILL



WATER SERVICE INSTALLATION NTS

3311-820
 FORT CAMPBELL, KY/FORT IRWIN, CA
 STANDARD DRAWINGS FOR WATER AND
 WASTEWATER CONSTRUCTION
 ISSUED: 02-10
 CH2MHILL

POST INDICATOR VALVE NTS 05

FIRE HYDRANT NTS 03

CONCRETE THRUST BLOCKS (1 OF 2) NTS 03

WATER SERVICE INSTALLATION NTS 01

BY ORDER OF THE ENGINEER
 LOUISVILLE DISTRICT
 BWSCL

UTILITY DETAILS

CHEET IDENTIFICATION
 C-510

D

C

B

A

MARK	DESCRIPTION	DATE	APPR. MARK	DATE	APPR. MARK

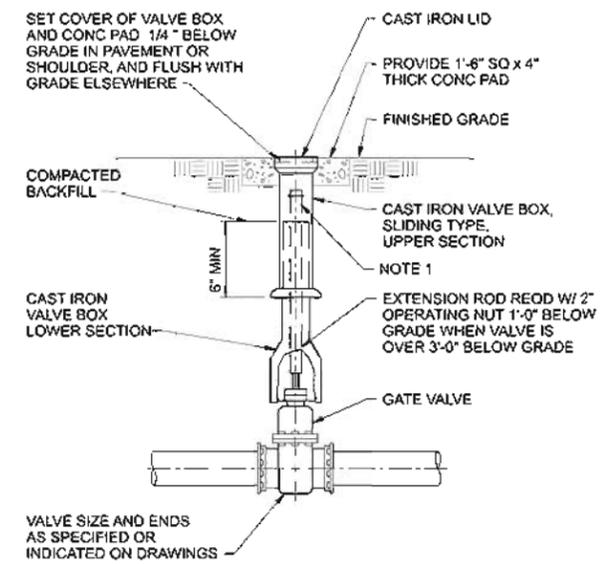
DESIGNED BY: A. WOODRUFF	CHECKED BY: M. COBLEY	DATE: 11/14/2011	PROJECT NO. / CONTRACT NO.:
DRAWN BY: M. COBLEY	APPROVED BY: J. STANER	DATE: 11/14/2011	FILE NUMBER:
SCALE:	DATE:	DATE:	FILE NAME:
AS NOTED	11/14/2011	11/14/2011	SOFT: BWH12-P11.dwg

U.S. ARMY CORPS OF ENGINEERS LOUISVILLE DISTRICT LOUISVILLE, KENTUCKY	BWSC Bentley Systems, Inc.
---	--------------------------------------

SGT. MIKEY HANIGAR FT. CAMPBELL, KENTUCKY PN 73574 P2 338866 UTILITY DETAILS
--

SHEET IDENTIFICATION C-511

NOT USED NTS 06 NOT USED NTS 04 NOT USED NTS 04 NOT USED NTS 02



NOTE:
1. VALVE BOX OPERATOR STEM NOT SHOWN. SEE 4027-643

BURIED GATE VALVE BOX

NTS

4027-640
FORT CAMPBELL, KY/ FORT IRWIN, CA
STANDARD DRAWINGS FOR WATER AND
WASTEWATER CONSTRUCTION
ISSUED: 02-10
CH2MHILL

NOT USED NTS 05 NOT USED NTS 03 NOT USED NTS 03 BURIED GATE VALVE BOX NTS 01

GENERAL NOTES:

- A. SEE SHEET C-001 FOR GENERAL NOTES & LEGEND.
- B. ALL DISTURBED AREAS SHALL BE HYDROSEEDDED UNLESS INDICATED TO BE SODDED.



DATE	DESCRIPTION	APPR.	DATE	DESCRIPTION	APPR.

DESIGNED BY: M. CONLEY	CHECKED BY: J. STARNER	DATE: 11/14/2011	SUBMITTED BY: BWS	DATE: 11/14/2011	FILE NAME: SOF_MHH-L-100.dgn
PROJECT NO.:	CONTRACT NO.:	FILE NO.:			

U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT
LOUISVILLE, KENTUCKY

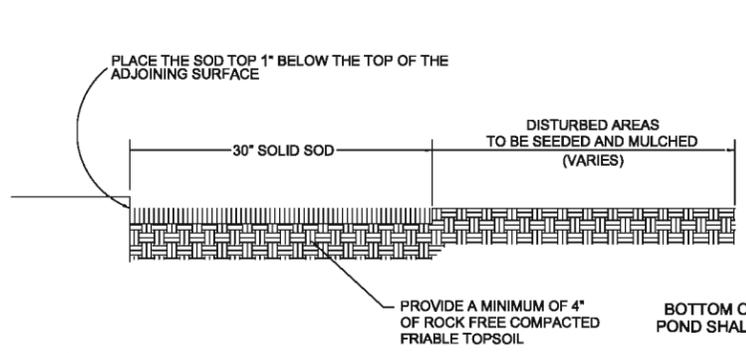
BWSC
BWS Consulting, Inc.

SOFT MIH7 HANGAR
FT. CAMPBELL, KENTUCKY

PN 78374
P2 306955

LANDSCAPING PLAN

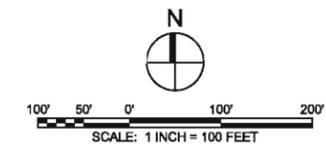
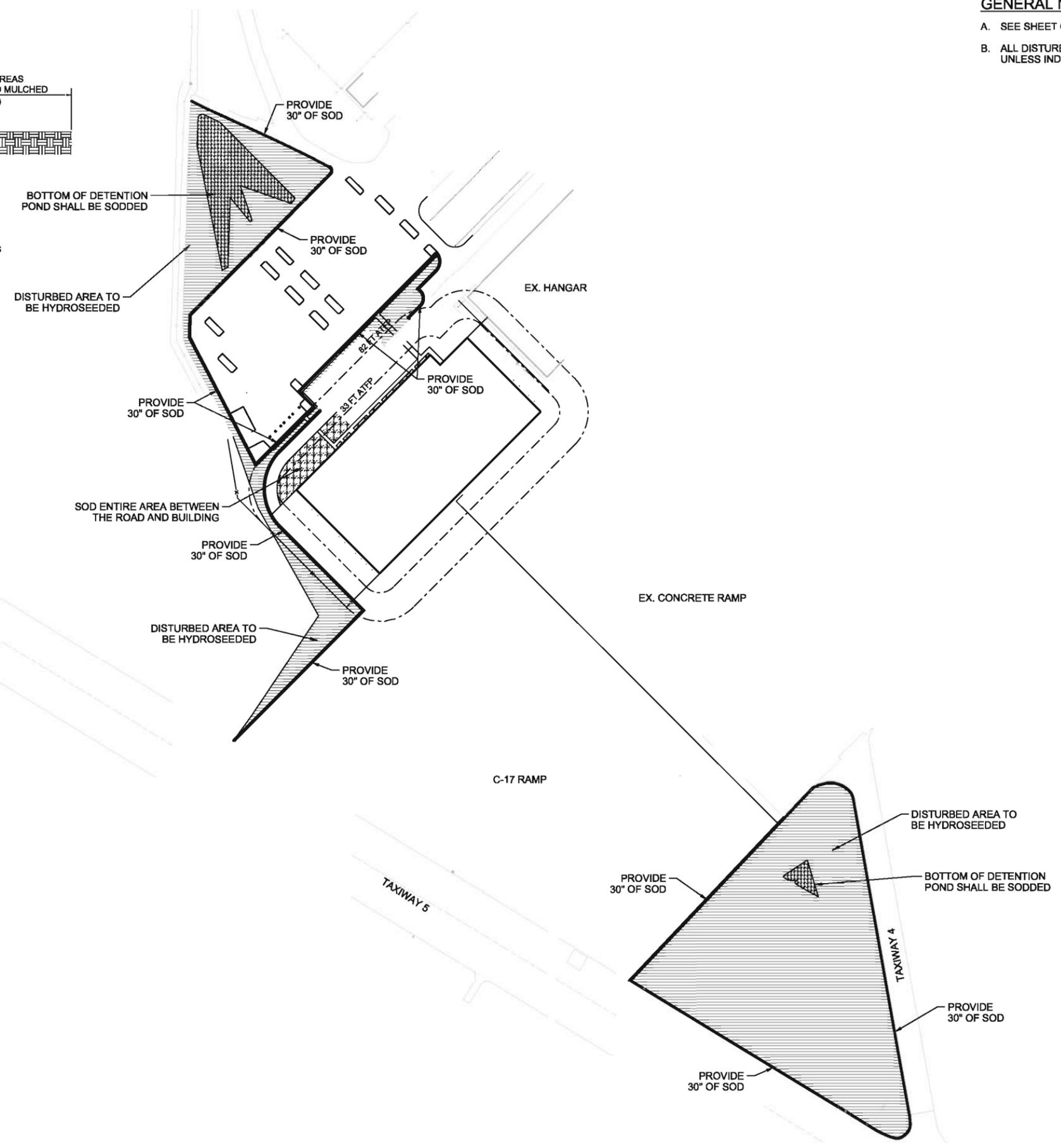
SHEET IDENTIFICATION
L-100
SHEET 88 OF 82



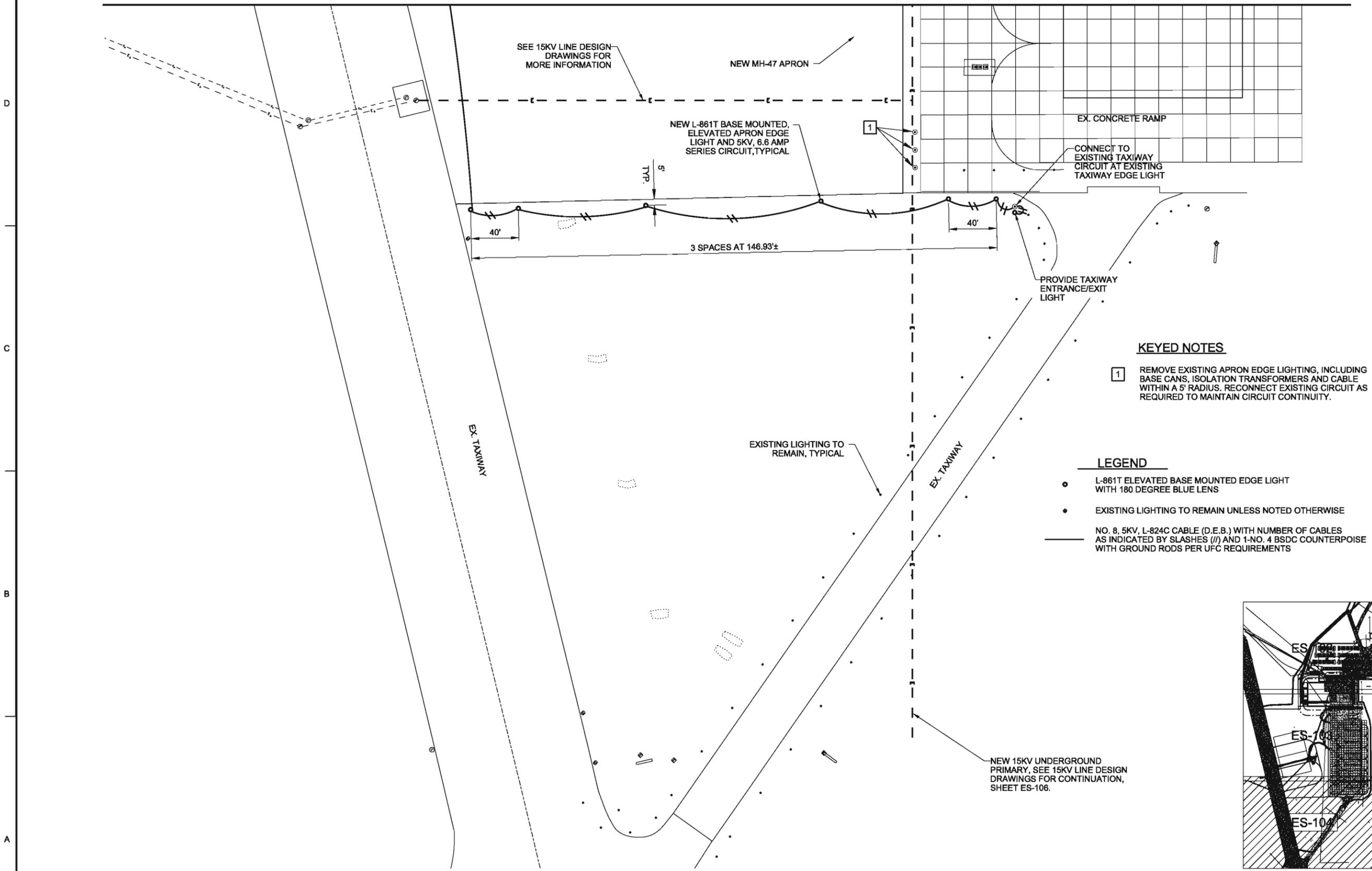
NOTES:

- 1. THE COMPACTED TOPSOIL SHALL MATCH THE TOP OF THE SOD AT ALL AREAS WHERE SEED AND MULCH ARE TO BE PLACED.
- 2. PLACE GRASS SEED ON THE AREA TO BE SODDED.

SODDING
NOT TO SCALE



MATCHLINE - SEE SHEET ES-103

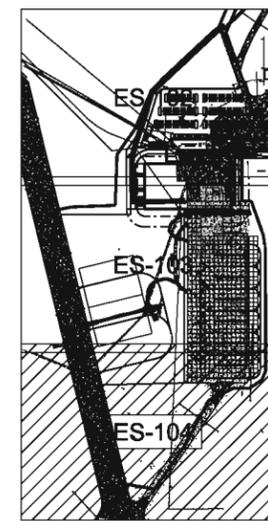


KEYED NOTES

1 REMOVE EXISTING APRON EDGE LIGHTING, INCLUDING BASE CANS, ISOLATION TRANSFORMERS AND CABLE WITHIN A 5' RADIUS. RECONNECT EXISTING CIRCUIT AS REQUIRED TO MAINTAIN CIRCUIT CONTINUITY.

LEGEND

- L-861T ELEVATED BASE MOUNTED EDGE LIGHT WITH 180 DEGREE BLUE LENS
- EXISTING LIGHTING TO REMAIN UNLESS NOTED OTHERWISE
- NO. 8, 5KV, L-824C CABLE (D.E.B.) WITH NUMBER OF CABLES AS INDICATED BY SLASHES (//) AND 1-NO. 4 BSDC COUNTERPOISE WITH GROUND RODS PER UFC REQUIREMENTS



KEY PLAN

NEW 15KV UNDERGROUND PRIMARY, SEE 15KV LINE DESIGN DRAWINGS FOR CONTINUATION, SHEET ES-106.

DATE	DESCRIPTION	APPR.	MARK

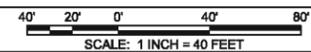
DESIGNED BY: K. POWERS	DATE: 11/14/2011	SUBMITTED BY: K. POWERS	DATE: 11/14/2011	CONTRACT NO.:	FILE NUMBER:
U.S. ARMY CORPS OF ENGINEERS LOUISVILLE DISTRICT LOUISVILLE, KENTUCKY	BWSC	U.S. ARMY CORPS OF ENGINEERS LOUISVILLE DISTRICT LOUISVILLE, KENTUCKY	BWSC		

SOF MH47 HANGAR FT. CAMPBELL, KENTUCKY PN 78374 P2 336965	APRON LIGHTING PLAN
--	---------------------

SHEET IDENTIFICATION ES-104 SHEET 81 OF 82

SITE LAYOUT

Information Only - Subject to Revision



SCALE: 1" = 40'-0"

01

APPENDIX K
Fuel Cost Information

APPENDIX K Fuel Cost Information

The following utility rates for this installation are provided for design

Electrical:

Demand Charge -

Summer Demand Rate (June-Sept) - \$23.87/kW

Winter Demand Rate (Dec-Mar) - \$17.72/kW

Transition Period (Apr, May, Oct, Nov) - \$13.12/kW

Energy Charge -

Summer (June-Sept) - \$0.03710/kWh

Winter (Dec-Mar) - \$0.03355/kWh

Transition Period (Apr, May, Oct, Nov) - \$0.03277/kWh

Blended Rate - \$0.07101/kWh

Natural Gas:

Commodity Charge Rate - \$8.072 per thousand cubic feet

Water:

Commodity Charge Rate - \$3.00 per 1,000 gal

Sewer:

Commodity Charge Rate - \$3.00 per 1,000 gal

APPENDIX L
LEED Project Credit Guidance

See Appendix O LEED Contractor Responsibilities Table

APPENDIX M
LEED Owner's Project Requirements

Not Used

APPENDIX N
LEED Requirements for Multiple Contractor Combined Projects

Not Used

APPENDIX O
LEED Strategy Tables

LEED Credit Paragraph	LEED Contractor Responsibilities Table	CTR Substitution Permitted	Required Points Strategy	NIC=Not in Contract N/A=Not Applicable R=Required
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PROJECT: Ft. Campbell SOF MH-47 Hangar

PAR	FEATURE			REMARKS
CATEGORY 1 – SUSTAINABLE SITES				
SSPR1	Construction Activity Pollution Prevention (PREREQUISITE)	NO	R	Required.
SS1	Site Selection	YES		
SS2	Development Density & Community Connectivity	N/A	0	Project site does not comply with requirements.
SS3	Brownfield Redevelopment	N/A	0	Not Applicable to the scope of the project.
SS4.1	Alternative Transportation: Public Transportation Access	YES		
SS4.2	Alternative Transportation: Bicycle Storage & Changing Rooms	NO		Not Preferred
SS4.3	Alternative Transportation: Low Emitting & Fuel Efficient Vehicles - OPTION 1	NO		
SS4.3	Alternative Transportation: Low Emitting & Fuel Efficient Vehicles - OPTION 2	YES		
SS4.3	Alternative Transportation: Low Emitting & Fuel Efficient Vehicles - OPTION 3	NO		
SS4.4	Alternative Transportation: Parking Capacity	YES		
SS5.1	Site Development: Protect or Restore Habitat	NO	0	Not Applicable to the scope of the project.
SS5.2	Site Development: Maximize Open Space	YES		
SS6.1	Stormwater Design: Quantity Control	NO	1	Required.
SS6.2	Stormwater Design: Quality Control	NO	1	Required.
SS7.1	Heat Island Effect: Non-Roof	YES	1	
SS7.2	Heat Island Effect: Roof	NO	1	Required.
SS8	Light Pollution Reduction	NO	1	Required.
CATEGORY 2 – WATER EFFICIENCY				
WEPR1	Water Use Reduction (v3 only)	NIC	N/A	Building CTR responsible.
WE1	Water Efficient Landscaping: Reduce by 50% OPTION 1	NO	1	Required.
WE1	Water Efficient Landscaping: No Potable Water Use or No Irrigation OPTION 2	NO	1	Required.

LEED Credit Paragraph	LEED Contractor Responsibilities Table	CTR Substitution Permitted	Required Points Strategy	
NIC=Not in Contract N/A=Not Applicable R=Required				

PROJECT: Ft. Campbell SOF MH-47 Hangar

PAR	FEATURE	CTR	Points	REMARKS
WE2	Innovative Wastewater Technologies - OPTION 1	YES	1	
WE2	Innovative Wastewater Technologies - OPTION 2	NO		Not Applicable to the scope of the project.
WE3	Water Use Reduction	NO	2	Required by ECB 2011-1. Minimum 2 points required.
CATEGORY 3 – ENERGY AND ATMOSPHERE				
EAPR1	Fundamental Commissioning of the Building Energy Systems (PREREQUISITE)	NO	R	Required.
EAPR2	Minimum Energy Performance (PREREQUISITE)	NIC	R	Required.
EAPR3	Fundamental Refrigerant Management (PREREQUISITE)	NIC	R	Required.
EA1	Optimize Energy Performance	YES	15	Required by ECB 2011-1. Minimum 15 points preferred.
EA2	On-Site Renewable Energy	YES		
EA3	Enhanced Commissioning	NO	2	Required by ECB 2011-1.
EA4	Enhanced Refrigerant Management	YES		
EA5	Measurement & Verification	NO	3	Required by ECB 2011-1.
EA6	Green Power	YES		
CATEGORY 4 – MATERIALS AND RESOURCES				
MRPR1	Storage & Collection of Recyclables (PREREQUISITE)	NIC	R	Required.
MR1	Building Reuse	N/A		Not Applicable to the scope of the project.
MR2.1	Construction Waste Management: Divert 50% From Disposal	NO	1	Required.
MR2.2	Construction Waste Management: Divert 75% From Disposal	YES		
MR3.1	Materials Reuse: 5%	N/A	0	Not Applicable to the scope of the project.
MR3.2	Materials Reuse: 10%	N/A	0	Not Applicable to the scope of the project.

LEED Credit Paragraph	LEED Contractor Responsibilities Table	CTR Substitution Permitted	Required Points Strategy	NIC=Not in Contract N/A=Not Applicable R=Required
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PROJECT: Ft. Campbell SOF MH-47 Hangar

PAR	FEATURE			REMARKS
MR4.1	Recycled Content: 10% (post-consumer + 1/2 pre-consumer)	NO	1	Required.
MR4.2	Recycled Content: 20% (post-consumer + 1/2 pre-consumer)	YES		
MR5.1	Regional Materials:10% Extracted, Processed & Manufactured Regionally	YES	1	
MR5.2	Regional Materials:20% Extracted, Processed & Manufactured Regionally	YES		
MR6	Rapidly Renewable Materials	YES		Correlates to USDA BioPreferred requirements. See other sections of the RFP.
MR7	Certified Wood	NO	1	Required.
CATEGORY 5 – INDOOR ENVIRONMENTAL QUALITY				
EQPR1	Minimum IAQ Performance (PREREQUISITE)	NIC	R	Required.
EQPR2	Environmental Tobacco Smoke (ETS) Control (PREREQUISITE)	NO	R	
EQ1	Outdoor Air Delivery Monitoring	YES		
EQ2	Increased Ventilation	YES		
EQ3.1	Construction IAQ Management Plan: During Construction	NO	1	Required.
EQ3.2	Construction IAQ Management Plan: Before Occupancy	YES	1	Required.
EQ4.1	Low Emitting Materials: Adhesives & Sealants	NO	1	Required.
EQ4.2	Low Emitting Materials: Paints & Coatings	NO	1	Required.
EQ4.3	Low Emitting Materials: Carpet/Flooring Systems	NO	1	Required.
EQ4.4	Low Emitting Materials: Composite Wood & Agrifiber Products	NO	1	Required.
EQ5	Indoor Chemical & Pollutant Source Control	YES		
EQ6.1	Controllability of Systems: Lighting	YES		
EQ6.2	Controllability of Systems: Thermal Comfort	YES		
EQ7.1	Thermal Comfort: Design	NO	1	Required.
EQ7.2	Thermal Comfort: Verification	NO	0	Not allowed.

LEED Credit Paragraph	LEED Contractor Responsibilities Table	CTR Substitution Permitted	Required Points Strategy	
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NIC=Not in Contract N/A=Not Applicable R=Required

PROJECT: Ft. Campbell SOF MH-47 Hangar

PAR	FEATURE			REMARKS
EQ8.1	Daylight & Views: Daylight 75% of Spaces	YES		
EQ8.2	Daylight & Views: Views for 90% of Spaces	YES		
CATEGORY 6 – INNOVATION IN DESIGN				
IDc1.1	Innovation in Design	YES		TBD by CTR.
IDc1.2	Innovation in Design	YES		TBD by CTR.
IDc1.3	Innovation in Design	YES		TBD by CTR.
IDc1.4	Innovation in Design	YES		TBD by CTR.
IDc2	LEED Accredited Professional	NO	1	Required.
CATEGORY 7 – REGIONAL PRIORITY CREDITS (v3 only)				
		YES		TBD by CTR.
		YES		TBD by CTR.
		YES		TBD by CTR.
		YES		TBD by CTR.
	TOTAL		42	

APPENDIX P
LEED Project Registration

Not Used

See Paragraph 6 and Specification Section 01 33 29.10 06 for more information.

APPENDIX Q
REV 2.1 – 30 SEP 2010
AREA COMPUTATIONS

Computation of Areas: Compute the “gross area” and “net area” of facilities (excluding family housing) in accordance with the following subparagraphs:

(1) Enclosed Spaces: The “gross area” is the sum of all floor spaces with an average clear height $\geq 6'-11"$ (as measured to the underside of the structural system) and having perimeter walls which are $\geq 4'-11"$. The area is calculated by measuring to the exterior dimensions of surfaces and walls.

(2) Half-Scope Spaces: Areas of the following spaces shall count as one-half scope when calculating “gross area”:

- Balconies
- Porches
- Covered exterior loading platforms or facilities
- **Covered but not enclosed spaces, canopies, training, and assembly areas**
- Covered but not enclosed passageways and walks
- Open stairways (both covered and uncovered)
- Covered ramps
- Interior corridors (Unaccompanied Enlisted Personnel Housing Only)

(3) Excluded Spaces: The following spaces shall be excluded from the “gross area” calculation:

- Crawl spaces
- Uncovered exterior loading platforms or facilities
- Exterior insulation applied to existing buildings
- Open courtyards
- Open paved terraces
- Uncovered ramps
- Uncovered stoops
- Utility tunnels and raceways
- Roof overhangs and soffits measuring less than 3'-0" from the exterior face of the building to the fascia

(4) Net Floor Area: Where required, “net area” is calculated by measuring the inside clear dimensions from the finish surfaces of walls. If required, overall “assignable net area” is determined by subtracting the following spaces from the “gross area”:

- Basements not suited as office, special mechanical, or storage space
- Elevator shafts and machinery space
- Exterior walls
- Interior partitions
- Mechanical equipment and water supply equipment space
- Permanent corridors and hallways
- Stairs and stair towers
- Janitor closets
- Electrical equipment space
- Electronic/communications equipment space

APPENDIX R
Preliminary Submittal Register

SUBMITTAL REGISTER

CONTRACT NO.
3473465

Section: APPENDIX R

W912QR-12-R-0015-N/A
Page 526 of 1714

TITLE AND LOCATION		CONTRACTOR															
TRANSMITTAL NO	S E C T	DESCRIPTION ITEM SUBMITTED	P A R A G R A P H	G O V T O R A / E R E V I E W R C L A S S I F I C A T I O N	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY			MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS			
					APPROVAL NEEDED BY	MATERIAL NEEDED BY	A C T I O N C O D E	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	A C T I O N C O D E	DATE OF ACTION					
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
01 32 01.00 06		SD-01 Preconstruction Submittals															
		Preliminary Project Schedule		G													
		Project Schedule	3.4	G													
		SD-05 Design Data															
		Narrative Report															
		Schedule Reports															
		Periodic Schedule Updates; G															
01 33 29.10 06		SD-01 Preconstruction Submittals															
		LEED Implementation Plan	1.3	G RE													
		LEED-AP	1.2.1	G RE													
		LEED Final Design		G RE													
		Documentation															
		LEED Project Checklist	1.2	G RE													
		SD-05 Design Data															
		LEED Correction Plan	1.2.2	G RE													
		LEED Correction Plan	1.2.2	G RE													
		SD-11 Closeout Submittals															
		LEED Documentation Notebook	1.4	G RE													
01 35 29.00 06		SD-01 Preconstruction Submittals															
		Accident Prevention Plan (APP)	1.8	G													
		Activity Hazard Analysis (AHA)	1.9	G													
		Site Safety & Health Officer		G													
		Qualifications(SSHO)															
		Proof of qualification for Crane		G													
		Operators															
		Crane Critical Lift Plan	1.8.1	G													

Information Only - Subject to Revision

Tuesday, December 20, 2011

SUBMITTAL REGISTER

CONTRACT NO.
3473465

Section: APPENDIX R

W912QR-12-R-0015-N/A
Page 527 of 1714

TITLE AND LOCATION		CONTRACTOR															
TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT OR A/E REVIEW CLASSIFICATION	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY			MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS			
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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
	01 35 29.00 06	SD-06 Test Reports															
		Reports	1.13														
		Accident Reports	1.13.1														
		Monthly Exposure Reports	1.13.3														
		Crane Reports	1.13.4														
		Regulatory Citations and Violations	1.13.3														
		SD-07 Certificates															
		Confined Space Entry Permit	1.10														
		Hot work permit	1.10														
	01 46 00.00 06	SD-06 Test Reports															
		Final Commissioning Report		G ED													
		Reports															
		SD-07 Certificates															
		Commissioning Agent		G ED													
		Certificate of Readiness		G RE													
		SD-10 Operation and Maintenance Data															
		Systems Manual		G ED													
	01 50 00	SD-01 Preconstruction Submittals															
		Construction site plan	1.4	G													
		Traffic control plan	3.3.1	G													
		SD-06 Test Reports															
		Backflow Preventer Tests		G													
		SD-07 Certificates															
		Backflow Tester	1.5.1	G													

Information Only - Subject to Revision

Tuesday, December 20, 2011

CONTRACT NO.
3473465

SUBMITTAL REGISTER

TITLE AND LOCATION		CONTRACTOR															
TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT OR A/E REVIEW CLASSIFICATION	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY			REMARKS				
					APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE FWD TO APPR AUTH/	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE		DATE OF ACTION	MAILED TO CONTR/	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
01 50 00		Backflow Preventers	1.5														
01 57 23		SD-01 Preconstruction Submittals															
		Storm Water Pollution Prevention Plan	1.3.2														
		Storm Water Notice of Intent	1.3.2														
		SD-06 Test Reports															
		Storm Water Inspection Reports for General Permit	1.3.2														
		Erosion and Sediment Controls	1.3														
		SD-07 Certificates															
		Mill Certificate or Affidavit	2.1.3														
01 74 19		SD-01 Preconstruction Submittals															
		Waste Management Plan	1.6	G													
		SD-11 Closeout Submittals															
		Records	1.7														
03 30 00.00 10		SD-03 Product Data															
		Recycled Content Products	Part 2														
		Portland Cement	1.4														
		Portland Cement	2.1														
		Ready-Mixed Concrete	3.2.1														
		Vapor Barrier	2.12														
		Latex Bonding Agent	2.7														
		Floor Finish	1.4.10														
		Floor Hardener	2.10														
		Chemical Admixtures	2.3														
		Epoxy Resin	2.8														

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03 30 00.00 10		Low-Emitting Materials																
		Local/Regional Materials																
		Recycled Content																
		SD-04 Samples																
		Surface Retarder	2.3.5															
		SD-05 Design Data																
		Mixture Proportions	1.4.1	G														
		Lightweight Aggregate Concrete	3.4															
		SD-06 Test Reports																
		Testing and Inspection for CQC	3.14	G														
		SD-07 Certificates																
		Qualifications	1.6															
26 05 00.00 40		SD-01 Preconstruction Submittals																
		Material, Equipment, and Fixture Lists	1.6															
		Conduits, Raceway sand Fittings	3.1															
		Wire and Cable	2.2															
		Splices and Connectors	2.3															
		Switches	2.4															
		Circuit Breakers	2.8															
		Panelboards	2.7															
		Dry-Type Distribution Transformers	2.10															
		SD-03 Product Data																
		Conduits, Raceway sand Fittings	3.1															
		Wire and Cable	2.2															

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	26 05 00.00 40		Splices and Connectors	2.3													
			Switches	2.4													
			Circuit Breakers	2.8													
			Panelboards	2.7													
			Dry-Type Distribution Transformers	2.10													
			Spare Parts	1.5													
			Certification	1.6													
			SD-06 Test Reports														
			Continuity Test	3.11													
			Phase-Rotation Tests	3.11													
			Insulation Resistance Test	3.11													
			SD-08 Manufacturer's Instructions														
			Manufacturer's Instructions	1.6													
	26 05 13.00 40		SD-03 Product Data														
			Multiple-Conductor Shielded Cables	2.4													
			Multiple-Conductor Nonshielded Cables	2.5													
			Single-Conductor Shielded Cables	2.6													
			Single-Conductor Nonshielded Cables	2.7													
			Portable Cables	2.8													
			Nonmetallic Jacket	2.9													
			SD-06 Test Reports														

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26 05 13.00 40		Dielectric Absorption Tests	3.2														
		High-Voltage Tests	3.2														
		Radiographic Tests	3.2														
		SD-07 Certificates															
		Certificates	1.3														
		Lead Sheath	2.4.1														
		Flammability	2.3														
		Minimum Bending Radius	3.1.4														
		High-Voltage Tests	3.2														
		Dielectric Absorption Tests	3.2														
		Cable Splicers	1.6														
		SD-08 Manufacturer's Instructions															
		Medium-Voltage Power Cables	1.7														
		High-Voltage Power Cables	3.2														
		Pothead Terminations	3.1.5														
26 05 19.00 10		SD-03 Product Data															
		Installation Instructions	3.1														
		SD-06 Test Reports															
		Tests, Inspections, and Verifications	3.2														
26 09 23.00 40		SD-03 Product Data															
		Photoconductive Control Devices	2.1														
		Installation Drawings	1.2														
		Light-Sensitive Control Devices															
		Dimming ballast controls															
		Light Level Sensor															

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(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)	(s)	(t)	(u)	(v)
26 09 23.00 40		Dimmer Switch	2.4	G											
		Lighting Contactor	2.5	G											
		Time Switch	2.6	G											
		Photocell Switch		G											
		Occupancy Sensors		G											
		Motion Sensors	2.1												
		SD-06 Test Reports													
		System Operation Tests	3.2												
		SD-08 Manufacturer's Instructions													
		Light-Sensitive Control Devices													
		SD-10 Operation and Maintenance Data													
		Lighting Control System, Data Package 5	2.1	G											
26 35 43		SD-02 Shop Drawings													
		Frequency converter drawings	1.4.1	G											
		SD-03 Product Data													
		Frequency converter	2.1	G											
		Aircraft power cable assembly	2.2	G											
		Remote Monitoring and Control Panel		G											
		SD-06 Test Reports													
		Work Plan	1.4.3	G											
		Routine Factory Test Plan	1.4.4	G											
		Special Factory Test Plan	1.4.5	G											
		Performance Test Plan	1.4.6	G											

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26 35 43		Test Schedule	2.3.1	G													
		Routine Factory Tests	1.4.8	G													
		Routine Factory Tests	2.3.2	G													
		Special Factory Tests	1.4.9	G													
		Special Factory Tests	2.3.3	G													
		SD-07 Certificates															
		Qualifications of manufacturer	1.4.2	G													
		UL Listing	1.4.7	G													
		SD-09 Manufacturer's Field Reports															
		Initial Inspection and Tests	3.2.3	G													
		Performance Tests	1.4.10	G													
		Performance Tests	3.2.4	G													
		Training Syllabus	3.3.1	G													
		SD-10 Operation and Maintenance Data															
		Frequency converter	2.1	G													
		Preliminary Operation and Maintenance Manuals	1.5.1.2	G													
		Remote Monitoring and Control Panel		G													
	26 56 00	SD-02 Shop Drawings															
		Luminaire drawings	1.4.1.1	G													
		Poles	1.4.1.2	G													
		SD-03 Product Data															
		Local/Regional Materials	1.6.1														

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26	56	00	Environmental Data	1.6.2													
			Energy Efficiency	1.6.3													
			Luminaires	2.2	G												
			Lamps	2.2.1	G												
			Ballasts	2.2.2	G												
			Lighting contactor	2.3	G												
			Time switch	2.4	G												
			Photocell switch	2.5	G												
			Concrete poles	2.6.1	G												
			Aluminum poles	2.6.2	G												
			Steel poles	2.6.3	G												
			Fiberglass poles	2.6.5	G												
			Brackets	2.7													
			Auxiliary instant-on quartz system		G												
			SD-04 Samples														
			Luminaires	2.2	G												
			SD-05 Design Data														
			Design Data for luminaires	1.4.2	G												
			SD-06 Test Reports														
			Pressure treated wood pole														
			quality														
			Tests for fiberglass poles		G												
			Operating test	3.2													
			SD-08 Manufacturer's Instructions														
			Concrete poles	2.6.1													
			Fiberglass poles	2.6.5													

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26 56 00		SD-10 Operation and Maintenance Data															
26 56 20.00 10		Operational Service	1.9														
		SD-02 Shop Drawings															
		Lighting and Visual Navigation Aids	1.2														
		As-Built Drawings	1.4.5														
		SD-03 Product Data															
		Materials and Equipment	2.1														
		Protection Plan	1.4.3														
		Training	3.20														
		Special Tools	3.20														
		List of Parts	3.20														
		Maintenance and Repair	3.20														
		Posted Instructions	3.22	G													
		SD-06 Test Reports															
		Field Quality Control	3.18														
		Visual Inspection	3.18.3														
		SD-07 Certificates															
		Qualifications	1.4.2														
		Materials and Equipment	2.1														
		SD-10 Operation and Maintenance															
		Data															
		Operation and Maintenance	3.20														
		Procedures															
26 56 36.00 40		SD-03 Product Data															

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26	56	36.00	40	Local/Regional Materials	1.6.1												
				Energy Efficiency	1.6.3												
				Environmental Data	1.6.2												
				Equipment and Performance	1.2												
				Data													
				Luminaires	2.3												
				Floodlighting Fixtures	1.2												
				Floodlighting Fixtures	2.2												
				Floodlighting Luminaires	2.3												
				FLUORESCENT													
				FLOODLIGHTS, EXTERIOR													
				High-Intensity-Discharge (HID)	2.4												
				Luminaires													
				Quartz-Iodine Luminaires	2.5												
				Substation-Yard Lighting													
				Luminaires													
				Series Circuit Transformers													
				Lamp Ballasts	2.6												
				Lamp Ballasts	2.6												
				SD-02 Shop Drawings													
				Installation Drawings	3.1												
				Floodlighting Systems	3.1												
				luminaire drawings	1.5.1.1												
				SD-04 Samples													
				Luminaires	2.3												
				SD-05 Design Data													

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26	56	36.00	40	Design Data for luminaires	1.5.2	G											
				SD-06 Test Reports													
				Operational Tests	3.2												
				SD-07 Certificates													
				Certificates	1.2												
				Floodlighting Fixtures	1.2												
				Floodlighting Fixtures	2.2												
				SD-10 Operation and Maintenance													
				Data													
				Operational Service	3.2												
27	10	00		SD-02 Shop Drawings													
				Telecommunications drawings	1.6.1.1	G											
				SD-03 Product Data													
				Telecommunications cabling	2.2	G											
				Equipment support frame	2.3.2	G											
				Connector blocks	2.3.3	G											
				SD-07 Certificates													
				Telecommunications Contractor	1.6.2.1	G											
				Key Personnel	1.6.2.2	G											
				Manufacturer Qualifications	1.6.2.3	G											
				Test plan	1.6.3	G											
				SD-09 Manufacturer's Field													
				Reports													
				Factory reel tests	2.8.1	G											
				SD-10 Operation and Maintenance													
				Data													

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27	10 00			1.10.1	G												
		Telecommunications cabling and pathway system															
		SD-11 Closeout Submittals															
		Record Documentation		1.10.2	G												
31	00 00																
		SD-01 Preconstruction Submittals															
		Shoring		3.5	G												
		Dewatering Work Plan		1.3.3	G												
		Blasting		1.3.2	G												
		SD-03 Product Data															
		Utilization of Excavated Materials		3.9	G												
		Rock Excavation		1.3.1.2													
		Opening of any Excavation or Borrow Pit		3.4													
		Shoulder Construction		3.15													
		SD-06 Test Reports															
		Testing		3.18													
		Borrow Site Testing		2.1													
		SD-07 Certificates															
		Testing		3.18													
31	11 00																
		SD-03 Product Data															
		Nonsaleable Materials		3.6.2	G												
		SD-04 Samples															
		Tree wound paint		2.1													
		Herbicide		2.2													
31	21 13																
		SD-02 Shop Drawings															
		Radon mitigation systems		2.1	G RO												

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31 21 13		SD-11 Closeout Submittals																
		Radon Detector Location Log	1.7	G RO														
		Testing laboratory certification	1.9.2	G RO														
		Proof of current calibration for testing devices	1.9.3	G RO														
31 31 16		SD-03 Product Data																
		Termiticide Application Plan	3.3.6	G														
		Termiticides	2.1															
		Foundation Exterior	3.3.3															
		Utilities and Vents	3.3.4															
		Crawl and Plenum Air Spaces	3.3.5															
		Verification of Measurement	3.1															
		Application Equipment	3.4.1															
		Warranty	1.6															
		SD-04 Samples																
		Termiticides	2.1															
		SD-06 Test Reports																
		Equipment Calibration and Tank Measurement	3.4.1															
		Soil Moisture	1.5.1															
		Quality Assurance	1.3															
		SD-07 Certificates																
		Qualifications	1.3.1															
31 32 11		SD-01 Preconstruction Submittals																
		Work sequence schedule		G														
		Erosion control plan		G														

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31	32	11	SD-02 Shop Drawings Layout	3.2.2													
			Obstructions Below Ground	3.2.4													
			Erosion Control	3.2.2													
			Seed Establishment Period	2.5.12.1													
			Maintenance Record	3.6													
			SD-03 Product Data														
			Geosynthetic Binders	2.2.2													
			Recycled Plastic	2.1													
			Wood Cellulose Fiber	2.3.3													
			Paper Fiber	2.3.4													
			Mulch Control Netting and Filter	2.3.9													
			Fabric														
			Hydraulic Mulch	2.3.10													
			Erosion Control Blankets Type XI	2.5.11													
			Geotextile Fabrics	2.4													
			G:														
			Aggregate														
			Synthetic Grid Systems														
			Articulating Cellular Concrete														
			Block Systems														
			Equipment	1.2													
			Finished Grade	3.1.1													
			Erosion Control Blankets	2.5													
			SD-04 Samples														
			Materials	1.5													

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31	32	11	SD-06 Test Reports														
			Geosynthetic Binders	2.2.2													
			Hydraulic Mulch	2.3.10													
			Geotextile Fabrics	2.4													
			Erosion Control Blankets	2.5													
			Synthetic Grid Systems														
			Articulating Cellular Concrete														
			Block Systems														
			Sand														
			Gravel														
			SD-07 Certificates														
			Fill Material														
			Mulch	2.3													
			Hydraulic Mulch	2.3.10													
			Geotextile Fabrics	2.4													
			Geosynthetic Binders	2.2.2													
			Synthetic Soil Binders	2.2.1													
			Installer's Qualification	1.4.1													
			Recycled Plastic	2.1													
			Seed	2.5.12													
			Asphalt Adhesive	2.3.8													
			Tackifier	2.3.11													
			Wood By-Products	2.3.6													
			Wood Cellulose Fiber	2.3.3													
			SD-10 Operation and Maintenance														
			Data														

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31	32 11	Maintenance Instructions	3.6.2														
		SD-11 Closeout Submittals															
		Local/Regional Materials	1.4.3.1														
		Recycled Plastic	2.1														
		Wood Cellulose Fiber	2.3.3														
		Paper Fiber	2.3.4														
		Mulch Control Netting and Filter Fabric	2.3.9														
		Hydraulic Mulch	2.3.10	G													
		Erosion Control Blankets Type XI	2.5.11														
		Geotextile Fabrics	2.4	G													
		Aggregate															
32	01 19	SD-03 Product Data	1.2.2.3	G													
		Manufacturer's Recommendations															
		Equipment	1.2														
		SD-04 Samples															
		Materials	1.4.2	G													
		SD-06 Test Reports															
		Certified copies of the test reports	1.4.2	G													
32	05 33	SD-01 Preconstruction Submittals															
		Integrated Pest Management Plan	2.4	G													
		SD-03 Product Data															
		Fertilizer	2.1	G													
		Hose	2.2.1														

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32 05 33		Mulches Topdressing	2.3														
		Organic Mulch Materials	2.3.1														
		SD-07 Certificates															
		Maintenance inspection report	3.5.1														
		Plant quantities		G													
		SD-10 Operation and Maintenance															
		Data															
		Maintenance															
		SD-11 Closeout Submittals															
		Tree, staking and guying removal	3.5.2														
32 11 10		SD-03 Product Data															
		Waybills and Delivery Tickets															
		SD-06 Test Reports															
		Sampling and Testing	1.4.1														
		Approval of Materials	1.4.6	G													
		Evaluation	3.2.7														
32 11 23		SD-03 Product Data															
		Plant, Equipment, and Tools	1.3														
		Waybills and Delivery Tickets															
		Local/Regional Materials															
		Recycled Content															
		SD-06 Test Reports															
		Sampling and Testing	1.5	G													
		Field Density Tests	1.5.2.4	G													
32 12 10		SD-03 Product Data															
		Waybills and Delivery Tickets															

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32 12 10		Local/Regional Materials	1.4														
		SD-06 Test Reports															
		Sampling and Testing	3.7														
32 12 15		SD-02 Shop Drawings															
		Placement Plan	1.2	G													
		SD-03 Product Data															
		Mix Design	2.3	G													
		Contractor Quality Control	3.1	G													
		SD-04 Samples															
		Asphalt Cement Binder	2.2														
		Aggregates	2.1														
		SD-06 Test Reports															
		Aggregates	2.1	G													
		QC Monitoring	3.1.3.10														
		SD-07 Certificates															
		Asphalt Cement Binder	2.2	G													
		Testing Laboratory	3.7														
32 12 16		SD-03 Product Data															
		Mix Design	2.3	G													
		Contractor Quality Control	3.10	G													
		Material Acceptance	3.11	G													
		Percent Payment		G													
		SD-04 Samples															
		Asphalt Cement Binder	2.2														
		Aggregates	2.1														
		SD-06 Test Reports															

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32 12 16		Aggregates	2.1	G													
		QC Monitoring	3.10.3.10														
		SD-07 Certificates															
		Asphalt Cement Binder	2.2	G													
		Testing Laboratory	3.6														
32 13 11		SD-03 Product Data															
		Equipment	2.10														
		Proposed Techniques	3.1.2	G													
		SD-05 Design Data															
		Proportioning Studies	2.12.2	G ED													
		SD-06 Test Reports															
		Sampling and Testing	1.2.4	G ED													
		SD-07 Certificates															
		Contractor Quality Control Staff	1.4.1	G ED													
		Laboratory Accreditation	1.4.3	G ED													
		Commercial Laboratory	1.4.3	G ED													
32 13 73		SD-03 Product Data															
		Equipment	1.3														
		Manufacturer's Instructions	3.1.1														
		SD-04 Samples															
		Compression Seals	2.1	G													
		SD-06 Test Reports															
		Test Requirements	1.3.3														
32 16 13		SD-03 Product Data															
		Concrete	2.1														
		SD-06 Test Reports															

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32 16 13		Field Quality Control	3.8														
32 17 24.00 10		SD-03 Product Data															
		Equipment	1.3	G													
		Composition Requirements															
		Qualifications	1.5.1														
		SD-06 Test Reports															
		Sampling and Testing	2.4														
		SD-07 Certificates															
		Volatile Organic Compound (VOC)															
32 31 13		SD-02 Shop Drawings															
		Fence Assembly	1.3	G													
		Location of Gate, Corner, End, and Pull Posts	3.16.1	G													
		Gate Assembly	1.3	G													
		Gate Hardware and Accessories	2.17	G													
		Erection/Installation Drawings	1.3	G													
		SD-03 Product Data															
		Fence Assembly	1.3	G													
		Gate Assembly	1.3	G													
		Gate Hardware and Accessories	2.17	G													
		Recycled Material Content	2.1	G													
		Zinc Coating	2.2	G													
		PVC Coating	1.5.1	G													
		Aluminum Alloy Coating	1.5.1	G													
		Fabric	2.3	G													

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32	31	13	Stretcher Bars	2.12	G												
			Concrete	2.20	G												
			SD-04 Samples														
			Fabric	2.3	G												
			Posts		G												
			Braces		G												
			Line Posts	2.5	G												
			Sleeves	2.7	G												
			Top Rail	2.8	G												
			Bottom Rail		G												
			Tension Wire	2.11	G												
			Stretcher Bars	2.12	G												
			Gate Posts	2.15	G												
			Gate Hardware and Accessories	2.17	G												
			Padlocks	2.22	G												
			Wire Ties	2.19	G												
			SD-07 Certificates														
			Certificates of Compliance	1.5.2	G												
			SD-08 Manufacturer's Instructions														
			Fence Assembly	1.3	G												
			Gate Assembly	1.3	G												
			Hardware Assembly	1.3	G												
			Accessories	1.3	G												
			SD-03 Product Data														
			Wood cellulose fiber mulch														
			Fertilizer	2.4													

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						Submit		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
	32	92 19	SD-06 Test Reports																
			Topsoil composition tests	2.2.3															
			SD-07 Certificates																
			seed	2.1															
			SD-08 Manufacturer's Instructions																
			Erosion Control Materials																
	32	92 23	SD-03 Product Data																
			Fertilizer	2.4															
			SD-06 Test Reports																
			Topsoil composition tests	2.2.3															
			SD-07 Certificates																
			sods	2.1															
	33	05 23.19	SD-01 Preconstruction Submittals																
			Microtunneling Boring Machine	3.2.4															
			SD-03 Product Data																
			Piping casing	2.1															
			Bentonite	2.3															
			SD-05 Design Data																
			Design calculations of pipe casing	1.5.1															
			SD-07 Certificates																
			Piping casing	2.1															
			linings	2.1.1.1															
			SD-08 Manufacturer's Instructions																
			Installation	3.2															
	33	11 00	SD-03 Product Data																

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33	11 00	Piping Materials	2.1.1														
		Water distribution main	2.1														
		Water service line	2.2														
		Hydrants	2.1.2.2														
		Indicator posts	2.1.2.3														
		Corporation stops	2.2.2.1														
		Valve boxes	2.1.2.4														
		Valve boxes	2.2.2.9														
		SD-05 Design Data															
		Design calculations of water piping															
		SD-06 Test Reports															
		Disinfection	2.2.2.15														
		G ₁															
		SD-07 Certificates															
		Water distribution main	2.1														
		Water service line	2.2														
		lining and coating															
		Lining	2.1.1.1														
		Lining	2.1.1.2														
		hydrants	2.1.2.2														
		Displacement Type Meters	2.2.2.11														
		Compound Type Meters	2.2.2.12														
		SD-08 Manufacturer's Instructions															
		Delivery, storage, and handling	1.5														
		Installation	3.1.1														

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33 30 00		SD-01 Preconstruction Submittals																
		Existing Conditions	1.6															
		SD-02 Shop Drawings																
		Drawings	1.4.2															
		Precast concrete manhole	2.3.1															
		Metal items	2.3.4															
		Frames, covers, and gratings	2.3.4.1															
		SD-03 Product Data																
		Pipeline materials	2.1															
		SD-06 Test Reports																
		Reports	2.4															
		SD-07 Certificates																
		Portland Cement	2.2.2															
		Gaskets																
33 40 00		SD-03 Product Data																
		Placing Pipe	3.3															
		SD-04 Samples																
		Pipe for Culverts and Storm	2.1															
		Drains																
		SD-07 Certificates																
		Resin Certification																
		Pipeline Testing	3.8															
		Hydrostatic Test on Watertight	2.7															
		Joints																
		Determination of Density	3.7.5															
		Frame and Cover for Gratings	2.3.7															

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33 71 01		SD-03 Product Data																
		Conductors	2.6	G														
		Insulators	2.5	G														
		Steel poles		G														
		Wood Poles	2.2.1															
		Nameplates	2.18	G														
		Pole top switch	3.1.8	G														
		Cutouts	2.13	G														
		Surge arresters	2.12	G														
		Guy strand	2.8															
		Anchors	2.10															
		SD-05 Design Data																
		Steel poles		G														
		SD-06 Test Reports																
		Ground resistance test reports	1.5.3	G														
		SD-07 Certificates																
		Steel poles		G														
		Wood poles	2.2.1	G														
		Fiberglass crossarms	2.3.1	G														
		SD-10 Operation and Maintenance																
		Data																
		Operation and Maintenance		G														
		Manuals																
	33 82 00	SD-02 Shop Drawings																
		Telecommunications Outside	1.6.1.1	G														
		Plant																

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	33 82 00	(c)	Telecommunications Entrance	1.6.1.2	G												
			Facility Drawings														
			SD-03 Product Data														
			Wire and cable	2.7	G												
			Cable splices, and connectors	2.4	G												
			Closures	2.3	G												
			Building protector assemblies	2.2.1	G												
			Protector modules	2.2.2	G												
			SD-06 Test Reports														
			Pre-installation tests	3.5.1	G												
			Acceptance tests	3.5.2	G												
			Outside Plant Test Plan	1.6.3	G												
			SD-07 Certificates														
			Telecommunications Contractor	1.6.2.1	G												
			Key Personnel	1.6.2.2	G												
			Manufacturer's Qualifications	1.6.2.3	G												
			SD-08 Manufacturer's Instructions														
			Building protector assembly	2.2.1													
			installation														
			Cable tensions	3.1.6.1	G												
			Fiber Optic Splices	3.1.7.2	G												
			SD-09 Manufacturer's Field														
			Reports														
			Factory Reel Test Data	2.13.1	G												
			SD-10 Operation and Maintenance														
			Data														

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33 70 02.00 10		SD-02 Shop Drawings															
		Detail Drawings	1.4.1	G													
		As-Built Drawings	1.4.2	G													
		SD-03 Product Data															
		Precast concrete structures	2.6.1	G													
		Sealing Material	2.6.4														
		Manhole frames and covers	2.7	G													
		Handhole frames and covers	2.8	G													
		Frames and Covers for Airfield Facilities	2.9	G													
		Ductile Iron Frames and Covers for Airfield Facilities	2.10	G													
		Composite/fiberglass handholes	2.12	G													
		Cable supports	2.12	G													
		Material and Equipment	2.1	G													
33 70 03.00 10		SD-02 Shop Drawings															
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Appendix S

REV 1.1 JUL 2011.

Manufacturing Performance Requirements for Plumbing Fixtures From The Energy Policy Act of 1992 (PL 102-486) (Including Exceptions for Projects Registered for LEED 3.0 or higher)

Note: This information is for use in establishing the Baseline to calculate flow rate reductions from said Baseline, where required by the contract.

Subtitle C--Appliance and Equipment Energy Efficiency Standards

SEC. 123. ENERGY CONSERVATION REQUIREMENTS FOR CERTAIN LAMPS AND PLUMBING PRODUCTS.

... (j) STANDARDS FOR SHOWERHEADS AND FAUCETS- (1) The maximum water use allowed for any showerhead manufactured after January 1, 1994, is 2.5 gallons per minute when measured at a flowing water pressure of 80 pounds per square inch. Any such showerhead shall also meet the requirements of ASME/ANSI A112.18.1M-1989, 7.4.3(a).

`(2) The maximum water use allowed for any of the following faucets manufactured after January 1, 1994, when measured at a flowing water pressure of 80 pounds per square inch, is as follows:

`Lavatory faucets: 2.5 gallons per minute **(BUT SEE BELOW**)**

`Lavatory replacement aerators: 2.5 gallons per minute

`Kitchen faucets : 2.5 gallons per minute

`Kitchen replacement aerators: 2.5 gallons per minute

`Metering faucets: 0.25 gallons per cycle

`(k) STANDARDS FOR WATER CLOSETS AND URINALS- (1)(A) Except as provided in subparagraph (B), the maximum water use allowed in gallons per flush for any of the following water closets manufactured after January 1, 1994, is the following:

`Gravity tank-type toilets --1.6 gpf.

`Flushometer tank toilets --1.6 gpf.

`Electromechanical hydraulic toilets --1.6 gpf.

`Blowout toilets --3.5 gpf.

`(B) The maximum water use allowed for any gravity tank-type white 2-piece toilet which bears an adhesive label conspicuous upon installation consisting of the words 'Commercial Use Only' manufactured after January 1, 1994, and before January 1, 1997, is 3.5 gallons per flush.

`(C) The maximum water use allowed for flushometer valve toilets, other than blowout toilets, manufactured after January 1, 1997, is 1.6 gallons per flush.

`(2) The maximum water use allowed for any urinal manufactured after January 1, 1994, is 1.0 gallon per flush.

**** EXCEPTIONS for Projects Registered under LEED 3.0 or higher.**

1. Any exceptions identified in the applicable LEED criteria.
2. Public lavatory faucets shall deliver a maximum flow rate of 0.5 gallons per minute, when tested in accordance with ASME A 112.18/CSA B125. Use that flow rate as the Baseline figure for calculating any required reductions from the Baseline.

APPENDIX T

FUNCTIONAL AREA LIGHTING CONTROL STRATEGY (FALCS)

A. GENERAL LIGHTING CONTROL SYSTEM ENERGY MANAGEMENT STRATEGIES

SUMMARY: This appendix describes various lighting energy management strategies to utilize across functional areas. These strategies are intended to supplement and NOT supersede the requirements of ASHRAE 90.1.

1. Consider **LIGHT LEVEL TUNING** to maintain the appropriate light level for a given space. Initial light levels are set high to compensate for light depreciation over time. Where dimming ballasts or dimmable LED drivers are used, they shall be digital and addressable in nature (where available) that can provide individual fixture light level tuning and reconfigurability that dims the light level to the target level, saving the energy that otherwise would be used to compensate for future light depreciation. Provide a life-cycle cost-benefit analysis (LCCBA) of light level tuning for all spaces where the general lighting luminaires are equipped with digital addressable dimming ballasts or LED drivers. The LCCBA shall follow the methodology contained in the IESNA Lighting Handbook. Provide light level tuning where the LCCBA shows it to be economical.
2. Use **OCCUPANCY/VACANCY SENSORS** to automatically turn off lighting a specified time after all occupants leave the space. The off time shall be adjustable settable to 1, 5, 15, or 30 minutes. Select the type (single or dual technology, wired or wireless) based on the use and configuration of the space. Lighting control system shall have the capability to manage both hard-wired and wireless sensors where applicable. Single technology solutions shall incorporate signal processing technology that distinguishes between background noise and actual motion without automatically changing their sensitivity threshold. To maximize energy savings potential, all occupancy sensors shall be either **MANUAL ON – AUTOMATIC OFF** (vacancy sensor) or **AUTOMATIC ON** (to a specified light level of 50% or less) – **AUTOMATIC OFF** to maximize energy savings. Occupancy/Vacancy sensors properly located in the space and set appropriately can offer typical lighting energy savings of 15% or more.
3. Use **DAYLIGHT HARVESTING** to control lighting in areas within at least two window head heights (head height is the distance from the floor to the top of the glazing) adjacent to exterior view windows. Typical daylight penetrates three times the window head height into the space. To maximize energy savings, daylight dimming strategies need to penetrate beyond the first row of luminaires (first daylight zone). When daylighting installed fluorescent or LED luminaires, accomplish daylight harvesting by digitally addressable dimming ballasts or drivers. As the natural light in the space increases, the artificial light level should dim gradually to maintain a uniform light level and prevent disruption to the occupants. One daylight sensor must be able to control multiple daylighting zones (cross-zoning) without the need of adding more sensors. All controls (daylight sensors, occupancy sensors, wall stations) shall have the capability to connect to the system via hard wire or wireless. Apply the same daylighting strategies to areas where skylights are available (refer to ASHRAE 189.1 daylight zone definitions). Daylighting systems properly tuned and calibrated can offer typical lighting energy savings of 15% or more.
4. Consider **AUTOMATED SHADING** in spaces utilizing daylight harvesting to maximize the energy savings of the day lighting system. The shades shall be controlled to reduce glare and unwanted heat gain while still allowing natural light to enter the space. When utilizing automated shading consider the following :
 - A. For ease of use and space aesthetics, operate the automated shades by common controls, wired or wireless (i.e. same appearance and design) with the lighting control system.
 - B. For maximum energy savings the automated shading system shall predictably position the shades based on a combination of time of day, façade direction, and sky conditions.
 - C. For maximum design flexibility and ease of installation, shade system should have the capability to address and control each shade individually.
 - D. The shading system shall have a manual override that allows the occupant to temporarily adjust the shades to any desired position. The system will revert back to automatic control after a specified period of time.

Provide a life-cycle cost-benefit analysis (LCCBA) of automated shading for all spaces where daylight harvesting is provided. The LCCBA shall follow the methodology contained in the IESNA Lighting Handbook. Provide automated shading where the LCCBA shows it to be economical.

5. Use SCENE BASED DIMMING in multiple-use areas including auditoriums, conference rooms and classrooms. Also provide scene based dimming in dining rooms and gymnasiums with multiple functions. One button preset touch recall shall allow multiple zones of light within a space to go to the appropriate light levels, known as a scene, for a specific task or use. Scene based control shall allow the integration of AV controls, shading/projection screens and lighting to work seamlessly with one button preset touch (i.e. lights dim, projection screen lowers, and shades go down). If dimming ballasts or LED drivers are used, they shall also be digital and addressable in nature (where available) to take advantage of installation and life-cycle reconfiguration benefits.
6. Provide PERSONAL CONTROL of lighting in spaces to allow the user of the space to vary the general light level based on the task at hand. Personal control can be achieved by wall mounted controls (hard wired or wireless), Infrared or Radio Frequency (RF) wireless devices, or via computer. Digital addressable ballasts and LED drivers allow the control flexibility of personal dimming of installed lighting on the occupant's work area (i.e. dim the luminaire over their cubicle to the appropriate light level).
7. Consider WIRELESS lighting control options for all installations, including retrofit projects (easy installation, lower installed cost, no power packs necessary). Wireless products shall include but not be limited to occupancy / vacancy sensors, daylight sensors, local wall controls, plug in switching and dimming appliance and parasitic load modules. To avoid interference, wireless products should communicate in an FCC frequency band that does not allow continuous transmissions and is free of Wi-Fi devices.

B. FUNCTIONAL TESTING AND MANUFACTURER SUPPORT

SUMMARY: This section describes functional testing to be performed on the lighting control system and the support required from the lighting control manufacturer.

1. Hire an independent agent with no less than three years experience in testing of complex lighting control systems to conduct and certify functional testing of lighting control devices and control systems. The testing agent shall not be directly involved in either the design or construction of the project and shall certify the installed lighting controls meet or exceed all requirements of ASHRAE 90.1 and all documented performance criteria. The lighting control manufacturer's authorized technical representative may serve as the testing agent. Submit qualifications of the testing agent for approval. Submit copies of test results to the Government.
2. LIGHTING CONTROL MANUFACTURER SUPPORT shall include technical phone support located in the United States. The technical phone support shall be available 24 hours a day, 365 days a year.

APPENDIX AA
Technical Specifications

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SECTION 01 32 01.00 06

PROJECT SCHEDULE
01/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

ECB 2005-10 (2005) Scheduling Requirements for Testing of Mechanical Systems in Construction

ER 1-1-11 (1995) Progress, Schedules, and Network Analysis Systems

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with LRL Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Preliminary Project Schedule; G

Project Schedule; G

Two copies of the schedules showing codes, dates, durations, categories, etc., as required.

SD-05 Design Data

Narrative Report

Schedule Reports

Two copies of the reports showing activity numbers, descriptions, dates float, starts, finishes, durations, sequences, etc., as required.

Periodic Schedule Updates; G

Two copies of the schedules showing dates, float, starts, finishes, etc., as required.

1.3 QUALITY ASSURANCE

Designate an authorized representative to be responsible for the preparation of the schedule and all required updating (activity status) and

preparation of reports. The authorized representative shall be experienced in scheduling and shall have previously developed, created, and maintained at least 2 electronic schedules for projects similar in nature and complexity to this project and shall be experienced in the use of the scheduling software that meets the requirements of this specification.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Prepare for approval a Project Schedule, as specified herein, pursuant to the Contract Clause, SCHEDULE FOR CONSTRUCTION CONTRACTS. Show in the schedule the sequence in which the Contractor proposes to perform the work and dates on which the Contractor contemplates starting and completing all schedule activities. The scheduling of the entire project, including the design, if applicable, and construction sequences, is required. The scheduling of construction is the responsibility of the Contractor. Contractor management personnel shall actively participate in its development. Subcontractors and suppliers working on the project shall also contribute in developing and maintaining an accurate Project Schedule. Provide a schedule that is a forward planning as well as a project monitoring tool.

3.1.1 Approved Project Schedule

Use the approved Project Schedule to measure the progress of the work and to aid in evaluating time extensions. Make the schedule cost loaded and activity coded. The schedule will provide the basis for all progress payments. If the Contractor fails to submit any schedule within the time prescribed, the Contracting Officer may withhold approval of progress payments until the Contractor submits the required schedule.

3.1.2 Schedule Status Reports

Status the schedule and provide a Schedule Status Report on at least a monthly basis. If, in the opinion of the Contracting Officer, the Contractor falls behind the approved schedule, the Contractor shall take steps necessary to improve its progress including those that may be required by the Contracting Officer, without additional cost to the Government. In this circumstance, the Contracting Officer may require the Contractor to increase the number of shifts, overtime operations, days of work, and/or the amount of construction plant, and to submit for approval any supplementary schedule or schedules as the Contracting Officer deems necessary to demonstrate how the approved rate of progress will be regained.

3.1.3 Default Terms

Failure of the Contractor to comply with the requirements of the Contracting Officer shall be grounds for a determination, by the Contracting Officer, that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the time specified in the contract. Upon making this determination, the Contracting Officer may terminate the Contractor's right to proceed with the work, or any separable part of it, in accordance with the default terms of the contract.

3.2 BASIS FOR PAYMENT AND COST LOADING

The schedule shall be the basis for determining contract earnings during each update period and therefore the amount of each progress payment. Lack of an approved schedule update, or qualified scheduling personnel, will result in the inability of the Contracting Officer to evaluate contract earned value for the purposes of payment. Failure of the Contractor to provide all required information will result in the disapproval of the entire project schedule submission and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes. In the absence of an approved schedule, the Contracting Officer may withhold approval of requests for progress payments. In the case where project schedule revisions are directed by the Contracting Officer and those revisions have not been included in subsequent revisions or updates, the Contracting Officer may hold retainage up to the maximum allowed by contract, each payment period, until such revisions to the Project Schedule have been made. Activity cost loading shall be reasonable, as determined by the Contracting Officer. The aggregate value of all activities coded to a contract CLIN shall equal the value of the CLIN on the Schedule.

3.3 PROJECT SCHEDULE DETAILED REQUIREMENTS

The computer software system utilized by the Contractor to produce and update the Project Schedule shall be capable of meeting all requirements of this specification. Failure of the Contractor to meet the requirements of this specification will result in the disapproval of the schedule. Scheduling software that meets the activity coding structure defined in the Standard Data Exchange Format (SDEF) in ER 1-1-11 are Primavera Enterprise products P5.0 or P6 (and subsequent versions). Will accept Primavera 3.1. Other project software of manual methods used to produce any required information shall require approval by the Contracting Officer.

3.3.1 Critical Path Method

The Critical Path Method (CPM) of network calculation shall be used to generate the Project Schedule. Prepare the Project Schedule using the Precedence Diagram Method (PDM).

3.3.2 Level of Detail Required

Develop the Project Schedule to an appropriate level of detail. Failure to develop the Project Schedule to an appropriate level of detail, as determined by the Contracting Officer, will result in its disapproval. The Contracting Officer will consider, but is not limited to, the following characteristics and requirements to determine appropriate level of detail:

3.3.2.1 Activity Durations

Contractor submissions shall follow the direction of the Contracting Officer regarding reasonable activity durations. Reasonable activity durations are those that allow the progress of ongoing activities to be accurately determined between update periods. Less than 2 percent of all non-procurement activities shall have Original Durations (OD) greater than 20 work days or 30 calendar days. Procurement activities are defined herein.

3.3.2.2 Procurement Activities

The schedule must include separate activities associated with the

submittal, approval, procurement, fabrication and delivery of long lead materials, equipment, fabricated assemblies and supplies. Long lead procurement activities are those with an anticipated procurement sequence of over 90 calendar days. A typical procurement sequence includes, but is not limited to, the string of activities: submit, approve, procure, fabricate, and deliver.

3.3.2.3 Mandatory Tasks

The following tasks must be included and listed as separate line activities. Furthermore, the preparation of submittals are to be separate activities from the review/approval/acceptance activities, with the government review/approval/acceptance having appropriate durations as specified in submittal procedures and properly scheduled:

- a. Submission, review and acceptance of design packages (for design build projects).
- b. Submission of mechanical/electrical/information systems layout drawings.
- c. Submission and approval of O & M manuals.
- d. Submission and approval of as-built drawings.
- e. Submission and approval of 1354 data and installed equipment lists.
- f. Submission and approval of testing and air balance (TAB).
- g. Submission of TAB specialist design review report.
- h. Submission and approval of fire protection specialist.
- i. Submission and approval of testing and balancing of HVAC plus commissioning plans and data. Develop the schedule logic associated with testing and commissioning of mechanical systems to a level of detail consistent with [ECB 2005-10](#).
- j. Air and water balancing.
- k. HVAC commissioning.
- l. Controls testing plan submission.
- m. Controls testing.
- n. Performance Verification testing.
- o. Other systems testing, if required.
- p. Contractor's pre-final inspection.
- q. Correction of punchlist from Contractor's pre-final inspection.
- r. Government's pre-final inspection.
- s. Correction of punch list from Government's pre-final inspection.
- t. Final inspection.

3.3.2.4 Government Activities

Show Government and other agency activities that could impact progress. These activities include, but are not limited to: [approvals/acceptance](#), inspections, utility tie-in, Government Furnished Equipment (GFE) and Notice to Proceed (NTP) for phasing requirements.

3.3.2.5 Activity Responsibility Coding (RESP)

All activities shall be identified in the project schedule by the party responsible to perform the work. Responsibility includes, but is not limited to, the subcontracting firm, contractor, or government agency performing a given task. Activities coded with a Government Responsibility code include, but are not limited to: Government approvals, Government design reviews, environmental permit approvals by State regulators, Government Furnished Equipment (GFE) and Notice to Proceed (NTP) for phasing requirements. Code all activities not coded with a Government Responsibility Code to the Prime Contractor or Subcontractor responsible to perform the work. Activities shall not have more than one Responsibility Code. Examples of acceptable activity code values are: DOR (for the designer of record); ELEC (for the electrical subcontractor); MECH (for the mechanical subcontractor); and GOVT (for USACE). Unacceptable code values are abbreviations of the names of subcontractors.

3.3.2.6 Activity Work Area Coding (AREA)

Assign Work Area code to activities based upon the work area in which the activity occurs. Define work areas based on resource constraints or space constraints that would preclude a resource, such as a particular trade or craft work crew, from working in more than one work area at a time due to restraints on resources or space. Examples of Work Area Coding include different areas within a floor of a building, different floors within a building, and different buildings within a complex of buildings. Activities shall not have more than one Work Area Code. Not all activities are required to be Work Area coded. A lack of Work Area coding will indicate the activity is not resource or space constrained.

3.3.2.7 Contract Changes/Requests for Equitable Adjustment (REA) Coding (MODF)

Assign an Activity code to any activity or sequence of activities added to the schedule as a result of a Contract Modification, when approved by the Contracting Officer, with a Contract Changes/REA Code. Key all Code values to the Government's modification numbering system. Any activity or sequence of activities added to the schedule as a result of alleged constructive changes made by the Government may be added to a copy of the current schedule, subject to the approval of the Contracting Officer. Assign Activity codes for these activities with a Contract Changes/REA Code. Key the code values to the Contractor's numbering system. Approval to add these activities does not necessarily mean the Government accepts responsibility and, therefore, liability for such activities and any associated impacts to the schedule, but rather the Government recognizes such activities are appropriately added to the schedule for the purposes of maintaining a realistic and meaningful schedule. Such activities shall not be Responsibility Coded to the Government unless approved. An activity shall not have more than one Contract Changes/REA Code.

3.3.2.8 Contract Line Item (CLIN) Coding (BIDI)

Code all activities to the CLIN on the Contract Line Item Schedule to which the activity belongs. An activity shall not contain more than one CLIN Item Code. CLIN Item code all activities, even when an activity is not cost loaded.

3.3.2.9 Phase of Work Coding (PHAS)

Assign Phase of Work Code to all activities based upon the phase of work in which the activity occurs. Code activities to a [Construction Phase](#). Code fast track [construction](#) phases proposed by the Contractor to allow filtering and organizing the schedule by fast track design and construction packages. If the contract specifies construction phasing with separately defined performance periods, identify a Construction Phase Code to allow filtering and organizing the schedule accordingly. Each activity shall be identified with a single project phase and have only one Phase of Work code.

3.3.2.10 Category of Work Coding (CATW)

Assign Category of Work Code to all activities according to the category of work to which best describes the activity. Category of Work Code shall include, but is not limited to: [construction submittal](#) approvals, acceptance, procurement, fabrication, delivery, weather sensitive installation, non-weather sensitive installation, start-up, test and turnover. Assign a Category of Work Code to each activity. Each activity shall have only one Category of Work Code.

3.3.2.11 Definable Features of Work Coding (FOW1, FOW2, FOW3)

Assign a Definable Feature of Work Code to appropriate activities based on the definable feature of work to which the activity belongs. Definable Feature of Work is defined in LRL Section [01 45 04.10 06](#) CONTRACTOR QUALITY CONTROL. An activity shall not have more than one Definable Feature of Work Code. Not all activities are required to be Definable Feature of Work Coded.

3.3.3 Scheduled Project Completion and Activity Calendars

The schedule interval shall extend from NTP date to the required contract completion date. The contract completion activity (End Project) shall finish based on the required contract duration in the accepted contract proposal, as adjusted for any approved contract time extensions. The first scheduled work period shall be the day after NTP is acknowledged by the Contractor. Schedule activities on a calendar to which the activity logically belongs. Activities may be assigned to a 7 day calendar when the contract assigns calendar day durations for the activity such as a Government Acceptance activity. If the Contractor intends to perform physical work less than seven days per week, schedule the associated activities on a calendar with non-work periods identified including weekends and holidays. Assign the Category of Work Code - Weather Sensitive Installation to those activities that are weather sensitive. Original durations must account for anticipated normal adverse weather. The Government will interpret all work periods not identified as non-work periods on each calendar as meaning the Contractor intends to perform work during those periods.

3.3.3.1 Project Start Date

The schedule shall start no earlier than the date on which the NTP was acknowledged. Include as the first activity in the project schedule an activity called "Start Project" or NTP. The "Start Project" activity shall have an "ES" constraint date equal to the date that the NTP was acknowledged, and a zero day duration.

3.3.3.2 Schedule Constraints and Open Ended Logic

Completion of the last activity in the schedule shall be constrained by the contract completion date. Schedule calculations shall result in a negative float when the calculated early finish date of the last activity is later than the contract completion date. The Contractor shall include as the last activity in the project schedule an activity called "End Project". The "End Project" activity shall have an "LF" constraint date equal to the contract completion date for the project, and with a zero day duration or by using the "project must finish by" date in the scheduling software. The schedule shall have no constrained dates other than those specified in the contract. The use of artificial float constraints such as "zero free float" or "zero total float" are typically prohibited. There shall only be 2 open ended activities: Start Project (or NTP) with no predecessor logic and End Project with no successor logic.

3.3.3.3 Early Project Completion

The last activity shall have a late finish constraint equal to the contract required completion date so that the schedule calculation will result in positive float if the project schedule projects a completion date prior to the contract required completion date. In the event the project schedule calculates an early completion date of the last activity prior to the contract have been accelerated and/or those activities that are scheduled in parallel to support the Contractor's "early" completion. The Contractor shall specifically address each of those activities in the narrative report and at every project schedule update period to assist the Contracting Officer in evaluating the Contractor's ability to actually complete prior to the contract period. The Government will not approve an early completion schedule with zero float on the longest path. The Government is under no obligation to accelerate activities for which it is responsible to support a proposed early contract completion.

3.3.4 Interim Completion Dates

Contractually specified interim completion dates shall be constrained to show negative float if the calculated early finish date of the last activity in that phase is later than the specified interim completion date.

3.3.4.1 Start Phase

The Contractor shall include as the first activity for a project phase an activity called "Start Phase X" where "X" refers to the phase of work and the activity will have a zero day duration.

3.3.4.2 End Phase

The Contractor shall include as the last activity for a project phase an activity called "End Phase X" where "X" refers to the phase of work and the activity will have a zero day duration.

3.3.4.3 Phase "X" Hammock

The Contractor shall include a hammock type activity for each project phase called "Phase X" where "X" refers to the phase of work. The "Phase X" hammock activity shall be logically tied to the earliest and latest activities in the phase.

3.3.5 Default Progress Data Disallowed

Actual Start and Finish dates shall not be automatically updated by default mechanisms that may be included in the scheduling software. Activity Actual Start (AS) and Actual Finish (AF) dates assigned during the updating process shall match those dates provided from Contractor Quality Control Reports. Failure of the Contractor to document the AS and AF dates on the Daily Quality Control report for every in-progress or completed activity, and failure to ensure that the data contained on the Daily Quality Control reports shall result in the disapproval of the Contractor's updated schedule and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes. Updating of the percent complete and the remaining duration of any activity shall be independent functions. Disable program features which calculate one of these parameters from the other.

3.3.6 Out-of-Sequence Progress

Activities that have progressed before all preceding logic has been satisfied (Out-of-Sequence Progress) will be allowed only on a case-by-case basis subject to approval by the Contracting Officer. Propose logic corrections to eliminate all out of sequence progress or justify not changing the sequencing for approval prior to submitting an updated project schedule. Correct out of sequence progress that continues for more than two update cycles by logic revision, as approved by the Contracting Officer.

3.3.7 Negative Lags and Start to Finish Relationships

Lag durations contained in the project schedule shall not have a negative value. Do not use Start to Finish (SF) relationships.

3.3.8 Calculation Mode

Schedule calculations shall retain the logic between predecessors and successors even when the successor activity starts and the predecessor activity has not finished. Software features that in effect sever the tie between predecessor and successor activities when the successor has started and the predecessor logic is not satisfied ("progress override") will not be allowed.

3.3.9 Milestones

The schedule must include milestone activities for each significant project event including but not limited to: milestone activities for each fast track design package released for construction; design complete; foundation/substructure construction complete; superstructure construction complete; building dry-in or enclosure complete to allow the initiation of finish activities; permanent power complete; and building systems commissioning complete.

3.4 PROJECT SCHEDULE SUBMISSIONS

The Contractor shall provide the submissions as described below. The data CD, reports, and network diagrams required for each submission are contained in paragraph SUBMISSION REQUIREMENTS. When design/build requirements are not within the project scope of work, all design submittals are not applicable

3.4.1 Preliminary Project Schedule Submission

Submit the Preliminary Project Schedule, defining the Contractor's planned operations for the first 90 calendar days for approval within 15 calendar days after the NTP is acknowledged. The approved Preliminary Project Schedule will be used for payment purposes not to exceed 90 calendar days after NTP. Completely cost load the Preliminary Project Schedule to balance the contract award CLINS shown on the Price Schedule. Detail it for the first 90 calendar days. It may be summary in nature for the remaining performance period. It must be early start and late finish constrained and logically tied as previously specified. The Preliminary Project Schedule forms the basis for the Initial Project Schedule specified herein and must include all of the required Plan and Program preparations, submissions and approvals identified in the contract (for example, Quality Control Plan, Safety Plan, and Environmental Protection Plan) as well as design activities, the planned submissions of all early design packages, permitting activities, design review conference activities and other non-construction activities intended to occur within the first 90 calendar days. Schedule any construction activities planned for the first 90 calendar days after NTP. Constrain planned construction activities by Government acceptance of the associated design package(s) and all other specified Program and Plan approvals. Activity code any activities that are summary in nature after the first 90 calendar days with Responsibility Code (RESP) and Feature of Work code (FOW1, FOW2, FOW3).

3.4.2 Initial Project Schedule Submission

Submit the Initial Project Schedule for approval within 42 calendar days after NTP. The schedule shall demonstrate a reasonable and realistic sequence of activities which represent all work through the entire contract performance period. The Initial Schedule shall be at a reasonable level of detail as determined by the Contracting Officer. The Contractor shall participate in a review and evaluation of the proposed schedule and analysis by the Contracting Officer.

3.4.3 Design Package Schedule Submission

With each design package submitted to the Government, submit a frag-net schedule extracted from the then current Preliminary, Initial or Updated schedule which covers the activities associated with that Design Package including construction, procurement and permitting activities.

3.4.4 Periodic Schedule Updates

Based on the result of the meeting, specified in PERIODIC SCHEDULE UPDATE MEETINGS, submit periodic schedule updates. These submissions will enable the Contracting Officer to assess Contractor's progress. If the Contractor fails or refuses to furnish the information and project schedule data, which in the judgment of the Contracting Officer or authorized representative is necessary for verifying the Contractor's progress, the Contractor shall be deemed not to have provided an estimate upon which

progress payment may be made.

3.4.5 Standard Activity Coding Dictionary

Use the activity coding structure defined in the Standard Data Exchange Format (SDEF) in [ER 1-1-11](#), Appendix A. This exact structure is mandatory, even if some fields are not used. A template SDEF compatible schedule backup file (sdef.prx) is available on the QCS website: www.rmssupport.com. The SDEF format is as follows:

Field	Activity Code	Length	Description
1	WRKP	3	Workers per Day
2	RESP	4	Responsible Party (e.g. GC, subcontractor, USACE)
3	AREA	4	Area of Work
4	MODF	6	Modification or REA number
5	BIDI	6	Bid Item (CLIN)
6	PHAS	2	Phase of Work
7	CATW	1	Category of Work
8	FOW1	10	Feature of Work (up to 10 characters in length)
9	FOW2	10	Feature of Work (up to 20 characters in length)
10	FOW3	10	Feature of Work (up to 30 characters in length)

3.5 SUBMISSION REQUIREMENTS

Submit the following items for the Preliminary Schedule, Initial Schedule, and every Periodic Schedule Update throughout the life of the project in addition to the requirements for submission of schedules and reports in paragraphs 1.2 "SUBMITTALS":

3.5.1 Data CD's

Provide two sets of data CD's containing the project schedule in the backup format. Each CD shall also contain all previous update backup files. File medium shall be CD. Label each CD indicating the type of schedule (Preliminary, Initial, Update), full contract number, Data Date and file name. Each schedule file submitted shall have a unique file name as determined by the Contractor and acceptable to the Government.

3.5.2 Narrative Report

A Narrative Report shall be provided with the Preliminary, Initial, and each Periodic Update of the project schedule, as the basis of the progress payment request. The Narrative Report shall include: a description of activities along the 2 most critical paths where the total float is less than or equal to 20 work days, a description of current and anticipated problem areas or delaying factors and their impact, and an explanation of corrective actions taken or required to be taken. The narrative report is expected to communicate to the Government, the Contractor's thorough analysis of the schedule output and its plans to compensate for any problems, either current or potential, which are revealed through that analysis. Identify and explain why any activities that, based their calculated late dates, should have either started or finished during the update period but did not.

3.5.3 Approved Changes Verification

Only those project schedule changes that have been previously approved by

the Contracting Officer shall be included in the schedule submission. The Narrative Report shall specifically reference, on an activity by activity basis, all changes made since the previous period and relate each change to documented, approved schedule changes.

3.5.4 Schedule Reports

The format, filtering, organizing and sorting for each schedule report shall be as directed by the Contracting Officer. Typically reports shall contain: Activity Numbers, Activity Description, Original Duration, Actual Duration, Remaining Duration, Early Start Date, Early Finish Date, Late Start Date, Late Finish Date, Total Float, Actual Start Date, Actual Finish Date, and Percent Complete. The following lists typical reports that will be requested. One or all of these reports may be requested for each schedule submission.

3.5.4.1 Activity Report

A list of all activities sorted according to activity number.

3.5.4.2 Logic Report

A list of detailed predecessor and successor activities for every activity in ascending order by activity number.

3.5.4.3 Total Float Report

A list of all incomplete activities sorted in ascending order of total float. Activities which have the same amount of total float shall be listed in ascending order of Early Start Dates. Completed activities shall not be shown on this report.

3.5.4.4 Earnings Report by CLIN

A compilation of the Contractor's Total Earnings on the project from the NTP to the data date. This report shall reflect the earnings of specific activities based on the agreements made in the schedule update meeting defined herein. Provided that the Contractor has furnished a complete schedule update, this report shall serve as the basis of determining progress payments. Group activities by CLIN item number and sort by activity number. This report shall: sum all activities coded to a particular CLIN and provide a CLIN item percent earned value; and complete and sum CLIN items to provide a total project percent complete. The printed report shall contain, for each activity: the Activity Number, Activity Description, Original Budgeted Amount, Total Quantity, Quantity to Date, Percent Complete (based on cost), and Earnings to Date.

3.5.5 Network Diagram

The network diagram is required for the Preliminary, Initial and Periodic Updates. The network diagram shall depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished. The Contracting Officer will use, but is not limited to, the following conditions to review compliance with this paragraph:

3.5.5.1 Continuous Flow

Diagrams shall show a continuous flow from left to right with no arrows from right to left. The activity number, description, duration, and

estimated earned value shall be shown on the diagram.

3.5.5.2 Project Milestone Dates

Dates shall be shown on the diagram for start of project, any contract required interim completion dates, and contract completion dates.

3.5.5.3 Critical Path

The critical path shall be clearly shown.

3.5.5.4 Banding

Organize activities as directed to assist in the understanding of the activity sequence. Typically, this flow will group activities by category of work, work area and/or responsibility.

3.5.5.5 S-Curves

Earnings curves showing projected early and late earnings and earnings to date.

3.6 PERIODIC SCHEDULE UPDATE MEETINGS

Conduct periodic schedule update meetings for the purposes of reviewing the Contractor's proposed out of sequence corrections, determining causes for delay, correcting logic, maintaining schedule accuracy and determining earned value. Meetings shall occur at least monthly within five days of the proposed schedule data date and after the Contractor has updated the schedule with Government concurrence respecting actual start dates, actual finish dates, remaining durations and percent complete for each activity it intend to status. Provide a computer with the scheduling software loaded and a projector during the meeting which allows all meeting participants to view the proposed schedule update during the meeting. The meeting and resultant approvable schedule update shall be a condition precedent to a formal submission of the update as described in SUBMISSION REQUIREMENTS and to the submission of an invoice for payment. The meeting will be a working interactive exchange which will allow the Government and the Contractor the opportunity to review the updated schedule on a real time and interactive basis. The Contractor's authorized scheduling representative will organize, sort, filter and schedule the update as requested by the Government. The meeting will last no longer than 8 hours. A rough draft of the proposed activity logic corrections and narrative report shall be provided to the Government 48 hours in advance of the meeting. The Contractor's Project Manager and Authorized Scheduler shall attend the meeting with the Authorized Representative of the Contracting Officer.

3.6.1 Update Submission Following Progress Meeting

Submit a complete update of the project schedule containing all approved progress, revisions, and adjustments, pursuant to paragraph SUBMISSION REQUIREMENTS not later than 4 working days after the periodic schedule update meeting, reflecting only those changes made during the previous update meeting.

3.6.2 Status of Activities

Update information, including Actual Start Dates (AS), Actual Finish Dates (AF), Remaining Durations (RD), and Percent Complete shall be subject to

the approval of the Government prior to the meeting. As a minimum, address the following items on an activity by activity basis during each progress meeting.

3.6.2.1 Start and Finish Dates

Accurately show the status of the AS and/or AF dates for each activity currently in-progress or completed since the last update. The Government may allow an AF date to be assigned with the percent complete less than 100% to account for the value of work remaining but not restraining successor activities. Only assign AS dates when actual progress occurs on an activity.

3.6.2.2 Remaining Duration

Update the estimated RD for all incomplete activities independent of Percent Complete. Remaining Durations may exceed the activity OD or may exceed the activity's prior update RD if the Government considers the current OD or RD to be understated based on current progress, insufficient work crews actually manning the job, unrealistic OD or deficiencies that must be corrected that restrain successor activities.

3.6.2.3 Percent Complete

Update the percent complete for each activity started, based on the realistic assessment of earned value. Activities which are complete but for remaining minor punch list work and which do not restrain the initiation of successor activities may be declared 100 percent complete. To allow for proper schedule management, cost load the correction of punch list from Government pre-final inspection activity(ies) not less than 1 percent of the total contract value, which activity(ies) may be declared 100 percent complete upon completion and correction of all punch list work identified during Government pre-final inspection(s).

3.6.2.4 Logic Changes

Specifically identify and discuss all logic changes pertaining to NTP on change orders, change orders to be incorporated into the schedule, Contractor proposed changes in work sequence, corrections to schedule logic for out-of-sequence progress, and other changes that have been made pursuant to contract provisions. The Government will only approve logic revisions for the purpose of keeping the schedule valid in terms of its usefulness in calculating a realistic completion date, correcting erroneous logic ties, and accurately sequencing the work.

3.6.2.5 Other Changes

Other changes required due to delays in completion of any activity or group of activities include: 1) delays beyond the Contractor's control, such as strikes and unusual weather. 2) delays encountered due to submittals, Government Activities, deliveries or work stoppages which make re-planning the work necessary. 3) Changes required to correct a schedule that does not represent the actual or planned prosecution and progress of the work.

3.7 REQUESTS FOR TIME EXTENSIONS

In the event the Contractor believes it is entitled to an extension of the contract performance period, completion date, or any interim milestone date, furnish the following for a determination by the Contracting

Officer: justification, project schedule data, and supporting evidence as the Contracting Officer may deem necessary. Submission of proof of excusable delay, based on revised activity logic, duration, and costs (updated to the specific date that the delay occurred) is a condition precedent to any approvals by the Government. In response to each Request For Proposal issued by the Government, the Contractor shall submit a schedule impact analysis demonstrating whether or not the change contemplated by the Government impacts the critical path.

3.7.1 Justification of Delay

The project schedule shall clearly display that the Contractor has used, in full, all the float time available for the work involved with this request. The Contracting Officer's determination as to the number of allowable days of contract extension shall be based upon the project schedule updates in effect for the time period in question, and other factual information. Actual delays that are found to be caused by the Contractor's own actions, which result in a calculated schedule delay, will not be a cause for an extension to the performance period, completion date, or any interim milestone date.

3.7.2 Submission Requirements

Submit a justification for each request for a change in the contract completion date of less than 2 weeks based upon the most recent schedule update at the time of the NTP or constructive direction issued for the change. Such a request shall be in accordance with the requirements of other appropriate Contract Clauses and shall include, as a minimum:

- a. A list of affected activities, with their associated project schedule activity number.
- b. A brief explanation of the causes of the change.
- c. An analysis of the overall impact of the changes proposed.
- d. A sub-network of the affected area.

Identify activities impacted in each justification for change by a unique activity code contained in the required data file.

3.7.3 Additional Submission Requirements

The Contracting Officer may request an interim update with revised activities for any requested time extension of over 2 weeks. Provide this disk within 4 days of the Contracting Officer's request.

3.8 DIRECTED CHANGES

If the NTP is issued for changes prior to settlement of price and/or time, submit proposed schedule revisions to the Contracting Officer within 2 weeks of the NTP being issued. The Contracting Officer will approve proposed revisions to the schedule prior to inclusion of those changes within the project schedule. If the Contractor fails to submit the proposed revisions, the Contracting Officer may furnish the Contractor with suggested revisions to the project schedule. The Contractor shall include these revisions in the project schedule until revisions are submitted, and final changes and impacts have been negotiated. If the Contractor has any objections to the revisions furnished by the Contracting Officer, advise

the Contracting Officer within 2 weeks of receipt of the revisions. Regardless of the objections, the Contractor shall continue to update the schedule with the Contracting Officer's revisions until a mutual agreement in the revisions is reached. If the Contractor fails to submit alternative revisions within 2 weeks of receipt of the Contracting Officer's proposed revisions, the Contractor will be deemed to have concurred with the Contracting Officer's proposed revisions. The proposed revisions will then be the basis for an equitable adjustment for performance of the work.

3.9 WEEKLY PROGRESS MEETINGS

a. The Government and the Contractor shall meet weekly (or as otherwise mutually agreed to) between the meetings described in paragraph PERIODIC SCHEDULE UPDATE MEETINGS for the purpose of jointly reviewing the actual progress of the project as compared to the as planned progress and to review planned activities for the upcoming two weeks. The then current and approved schedule update shall be used for the purposes of this meeting and for the production and review of reports. The Contractor's Project Manager and the Authorized Representative of the Contracting Officer shall attend. The weekly progress meeting will address the status of RFI's, RFP's and Submittals.

b. Provide a bar chart produced by the scheduling software, organized by Total Float and Sorted by Early Start Date, and a two week "look-ahead" schedule by filtering all schedule activities to show only current ongoing activities and activities scheduled to start during the upcoming two weeks, organized by Work Area Code (AREA) and sorted by Early Start Date.

c. The Government and the Contractor shall jointly review the reports. If it appears that activities on the longest path(s) which are currently driving the calculated completion date (driving activities), are not progressing satisfactorily and therefore could jeopardize timely project completion, corrective action must be taken immediately. Corrective action includes but is not limited to: increasing the number of work crews; increasing the number of work shifts; increasing the number of hours worked per shift; and determining if Government responsibility coded activities require Government corrective action.

3.10 OWNERSHIP OF FLOAT

Float available in the schedule, at any time, shall not be considered for the exclusive use of either the Government or the Contractor.

3.11 TRANSFER OF SCHEDULE DATA INTO RMS/QCS

The Contractor shall download and upload the schedule data into the Resident Management System (RMS) prior to RMS databases being transferred to the Government and is considered to be additional supporting data in a form and detail required by the Contracting Officer pursuant to FAR 52.232-5 - Payments under Fixed-Price Construction Contracts. The receipt of a proper payment request pursuant to FAR 52.232-27 - Prompt Payment for Construction Contracts is contingent upon the Government receiving both acceptable and approvable hard copies and electronic export from QCS of the application for progress payment.

-- End of Section --

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LEED™ DOCUMENTATION FOR GOVERNMENT VALIDATION
04/09

PART 1 GENERAL

1.1 SUBMITTALS

Government approval/acceptance is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following that "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with LRL Section 01 33 00 Submittal Procedures:

SD-01 Preconstruction Submittals

LEED Implementation Plan; G, RE

LEED-AP; G, RE

LEED Final Design Documentation; G, RE

LEED Project Checklist; G, RE

SD-05 Design Data

LEED Correction Plan; G, RE

SD-11 Closeout Submittals

LEED Documentation Notebook; G, RE

Submitted to the Government at the LEED Rating Validation meeting.

1.2 DESCRIPTION

This project shall be designed and constructed to achieve a rating of silver in accordance with LEED. A [LEED Project Checklist](#), shall be completed by the Designer of Record based on the credit and prerequisite requirements incorporated into the project and shall be submitted to the Government with each design submittal. Appendix PP identifies the documentation required for each credit and the stage of design or construction at which to submit the documentation. Documentation is only required for those credits and prerequisites indicated to be attempted in the LEED Project Checklist as completed by the Designer of Record.

1.2.1 LEED Accredited Professional ([LEED-AP](#))

A GBCI LEED Accredited Professional shall be responsible for assembling documentation and ensuring that LEED credits and prerequisites are earned and documented as required by this specification section for both the design and construction phases of the project. The LEED Accredited

Professional shall be identified on the Contractor's Quality Control Staff in accordance with specification LRL Section 01 45 04.10 06 CONTRACTOR QUALITY CONTROL.

The LEED Accredited Professional shall review all requests for information, Contractor proposals, modifications, deviations from the design documents, or any other items that could potentially impact the LEED rating of the project.

1.2.2 Contractor Responsibilities

The Contractor shall be responsible for designing and constructing the project to obtain the required LEED rating. Should there be a case where there is any current or projected problem meeting the full requirements of a LEED credit or prerequisite identified for this project, the Contractor shall notify the Contracting Officer in writing immediately. A [LEED Correction Plan](#) shall be submitted to the Government for acceptance detailing the method by which the LEED rating for the project will be preserved. The plan shall include the LEED credit or prerequisite impacted, the reason for non-compliance, the proposed correction or solution, an alternate credit, and a schedule for completion of the correction, solution, or alternate credit. If an alternate credit is proposed, documentation, including the implementation plan, shall be submitted with the LEED Correction Plan for the credit.

The Contractor shall be responsible for complying with the requirements of the credits indicated in Appendix O LEED Strategy Tables where those credits are indicated. No variation or substitutions to the LEED credits identified for this contract shall be allowed without written consent from the Contracting Officer. Should there be a case where there is any current or projected problem meeting the full requirements of a LEED credit or prerequisite identified for this project, the Contractor shall notify the Contracting Officer in writing immediately. A [LEED Correction Plan](#) shall be submitted to the Government for acceptance detailing the method by which the LEED rating for the project will be preserved. The plan shall include the LEED credit or prerequisite impacted, the reason for non-compliance, the proposed correction or solution, an alternate credit, and a schedule for completion of the correction, solution, or alternate credit. If an alternate credit is proposed, documentation, including the implementation plan, shall be submitted with the LEED Correction Plan for the credit.

Deviations from the contract documents may impact the LEED rating of the project. In any case where a pending action, either by the Contractor or the Government, may cause failure to meet the requirements of an attempted LEED credit or prerequisite, the Contractor shall bring this to the attention of the Contracting Officer immediately.

1.2.3 Documentation

The Contractor shall be responsible for providing the documentation required by Section 01 33 16, Attachment E - LEED Submittals for all credits and prerequisites required. The Contractor shall provide documentation indicated to be required at the Preconstruction stage with the LEED Implementation Plan. Documentation required at Construction Closeout for each credit and prerequisite shall be updated in LEED Online as it is completed. Documentation indicated to be provided quarterly shall be updated monthly.

The project has not been and **SHALL NOT** be registered with USGBC. All documentation that is required, shall be uploaded to the Contracting Officer utilizing a secure transfer method. Documentation shall be completed in LEED Online in accordance with the schedule in the LEED Implementation Plan.

The Contractor shall be responsible for complying with the requirements of the credits and prerequisites attempted. The **LEED Final Design Documentation** shall be submitted with the Final Design. The Contractor shall provide documentation indicated to be required at the Preconstruction stage with the LEED Implementation Plan. Documentation required at Construction Closeout shall be submitted with the LEED Documentation Notebook. Documentation indicated to be provided quarterly shall be updated monthly.

The Contractor shall submit a monthly LEED Progress Report that identifies the LEED credits and prerequisites completed and documented to date. The LEED Progress Report shall be submitted on the same day of each month. The Government will compare the LEED Progress Report and the documentation uploaded in LEED Online to the schedule in the LEED Implementation Plan. Failure to adhere to the schedule for completion of requirements for credits and prerequisites, including the associated documentation, in the LEED Implementation Plan shall be cause for withholding the monthly progress payment. Documentation in LEED Online and the LEED Documentation Notebook specified elsewhere in this section, shall be completed and submitted before final payment is made to the Contractor.

1.2.4 Innovation in Design Credits

The Contractor may choose to attempt Innovation in Design credits by using strategies that are not addressed by the existing LEED credits and prerequisites. Any such attempted credits shall be developed in accordance with the requirements of LEED and the LEED-NC version 3 Reference Guide. Innovation in Design credits shall conform to the requirements of USGBC Credit Interpretation Rulings. Innovation in Design credits not covered by exemplary performance requirements in the LEED-NC version 3 Reference Guide or Credit Interpretation Rulings will be evaluated by the Government and accepted based on their merit. The Government will not be obligated to accept credits that do not conform to exemplary performance requirements in the LEED-NC version 3 Reference Guide or Credit Interpretation Rulings.

The Contractor shall identify the intent of the credit, the requirements for compliance with the credit, the submittals necessary to demonstrate compliance, and the design approach or strategies that may be used to meet the requirements. The specific compliance path for this project to meet the requirements for the proposed Innovation in Design credit shall be indicated. The Innovation in Design description shall be submitted with the Final Design. The Innovation in Design credits developed shall be fully described in the LEED Implementation Plan.

1.2.5 Credit Interpretation Rulings

The Contractor shall apply existing USGBC Credit Interpretation Rulings available at www.usgbc.org when pursuing credits using non-standard compliance paths, or when there are special circumstances making compliance difficult. Existing Credit Interpretation Rulings will be used by the Government to evaluate compliance in the circumstances referenced above. If a Credit Interpretation Ruling is to be used to substantiate compliance with attempted credits and prerequisites, a copy of the request and ruling,

including the dates, must be included in the documentation on LEED Online and in the LEED Documentation Notebook for the associated credit or prerequisite. Compliance methods that are not prescriptively defined in the LEED-NC version 2.2 Reference Guide or are not addressed by existing Credit Interpretation Rulings shall not be accepted.

1.2.6 Government Coordination

The Government may provide assistance or resources to the Contractor in order to complete the compliance requirements for a credit or prerequisite; however, the Government is not obligated to provide this assistance or resources. The Contractor shall not select credits for which Government assistance or resources are required without written confirmation from the Government that such assistance or resource will be provided. The Contractor shall identify to the Government credit or prerequisite requirements for which Government assistance is sought. The Contractor shall obtain written confirmation from the Contracting Officer that the Government will comply with the identified requirements. Written confirmation and any supporting documentation shall be included in the documentation and in the LEED Documentation Notebook for the associated credit or prerequisite.

1.3 LEED IMPLEMENTATION PLAN

The LEED Implementation Plan shall be submitted within 30 days after the accepted design submittal but at least 14 days prior to the LEED Implementation Plan Meeting and before the start of any construction activity. The plan shall provide a detailed description of all activities that relate to accomplishing project LEED requirements, including construction practices and procurement practices. The documentation required at the Preconstruction Phase for each LEED credit and prerequisite shall also be included in the plan. The plans shall also include:

- a. The name of the LEED Accredited Professional (LEED-AP).
- b. Preliminary copies of required documentation to be used for tracking and documenting LEED credits and prerequisites. Include any additional documentation used for tracking and documenting LEED credits and prerequisites as described by Appendix B. Include proposed materials, estimated costs, and other calculation details as indicated by Appendix B in order to determine if the specified LEED credits and prerequisites can be attained.
- c. The schedule for completion of the requirements and documentation for each credit and prerequisite.
- d. List all plans required by the attempted LEED credits and prerequisites and the proposed completion date of each plan. The plans shall be added to the LEED Implementation Plan as they are completed.
- e. List all applicable Credit Interpretation Rulings that will be used to substantiate compliance with credits and prerequisites. The complete text of each Credit Interpretation Request and Ruling, and the date of each, shall be included.
- f. The Innovation in Design credits attempted including the intent of the credit, the requirements for compliance with the credit, the submittals necessary to demonstrate compliance, and the design approach or strategies that may be used to meet the requirements. The specific compliance path

for this project to meet the requirements for the proposed Innovation in Design credit shall be indicated. Any associated plans, construction practices, and procurement practices shall be described.

g. For fast-track design projects with multiple stages of design, the documentation as indicated above shall be submitted for each stage of design within the time indicated in this paragraph.

1.4 LEED DOCUMENTATION NOTEBOOK

The LEED Documentation Notebook shall be submitted to the Government at the LEED Rating Validation meeting. The LEED Documentation Notebook shall be formatted to match the LEED credit and prerequisite numbering system and tabbed for each credit and prerequisite. The LEED Documentation Notebook shall be submitted electronically and in hardcopy.

The LEED Documentation Notebook shall include the completed LEED Credit Checklist showing all credits, prerequisites, and points believed to be attained, and a copy of all completed documentation. Any Credit Interpretation Ruling applied for each credit or prerequisite shall be included. A copy of each LEED Correction Plan shall be included in the LEED Documentation Notebook.

1.5 CONTRACTOR CREDIT REQUIREMENTS

Compliance with the requirements of the credits listed in this paragraph and the associated documentation is the sole responsibility of the Contractor. Documentation shall be provided as specified elsewhere in this specification section.

1.5.1 Materials and Resources Credit 2, Construction Waste Management

The Contractor shall comply with the requirements of Materials and Resources Credit 2, Construction Waste Management. Notwithstanding the requirements of Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT, the Contractor shall develop and implement a construction waste management plan that identifies the materials to be diverted from disposal and whether the materials will be sorted on-site or comingled. At least 50 percent of non-hazardous construction and demolition debris shall be recycled or salvaged.

Calculations are by weight or volume, but must be consistent throughout. Excavated soil and land-clearing debris does not contribute to credit compliance.

1.5.2 Materials and Resources Credit 4, Recycled Content

The Contractor shall comply with the requirements of Materials and Resources Credit 4, Recycled Content. Notwithstanding the requirements of Section 01 62 35 RECYCLED/RECOVERED MATERIALS, the Contractor shall select materials so that the sum of post-consumer recycled content value plus one-half of post-industrial recycled content value constitutes at least 10 percent of the total materials cost for the project. EPA Comprehensive Procurement Guidelines has a supplier database. California Integrated Waste Management Board (CIWMB) Recycled Content Directory also contains product and supplier data at www.ciwmb.ca.gov/rcp.

1.5.2.1 Substitutions

In the case of conflict between this requirement and individual technical section requirements, the Contractor may submit for Government approval proposed alternative products or systems that provide equivalent performance and appearance and have greater contribution to project recycled content requirements. All such proposed substitutions shall be submitted with the LEED Implementation Plan accompanied by product data that demonstrates equivalence.

1.5.3 Materials and Resources Credit 5, Regional Materials

The Contractor shall comply with the requirements of Materials and Resources Credit 5, Regional Materials. The Contractor shall select materials so that a minimum of 10 percent by dollar value of materials and products for the project are extracted, harvested, or recovered, as well as manufactured, regionally within a 500 mile radius of the project site.

1.5.4 Materials and Resources Credit 7, Certified Wood

The Contractor shall comply with the requirements of Materials and Resources Credit 7, Certified Wood. Contractor shall select materials so that a minimum of 50 percent by dollar value of permanently installed wood-based materials and products for the project are certified in accordance with FSC STD 01 001.

1.5.5 Indoor Environmental Quality Credit 3.1, Construction IAQ Management Plan: During Construction

The Contractor shall comply with the requirements of Indoor Environmental Quality Credit 3.1. The Contractor shall develop and implement an Indoor Air Quality Management Plan for the construction phase of the building. The plan shall incorporate all recommended Control Measures of the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, Second Edition, November 2007, chapter 3. The plan shall address protecting absorptive materials from moisture damage.

The plan shall include the provision for MERV 8 filters, as determined by ASHRAE 52.2-1999, to be used at each return grille for any permanently installed air handling unit system that is used during construction. The filters shall remain in place until construction and punchlist items are complete.

Prior to occupancy, all filters in the air handling unit systems shall be replaced. Filters shall be as designed for post-occupancy use.

1.5.6 Indoor Environmental Quality Credit 3.2, Construction IAQ Management Plan: Before Occupancy

The Contractor shall comply with the requirements of Indoor Environmental Quality Credit 3.1. The Contractor shall develop and implement an Indoor Air Quality Management Plan to include either Building Flushout Option 1, Building Flushout Option 2, or Building IAQ Testing.

1.5.6.1 Building Flushout Option 1

The building shall be flushed by outdoor air until a total of 14,000 cubic feet of outdoor air per square foot of floor area is introduced to the

building prior to building occupancy. The building internal temperature shall be maintained at 60 degrees F or higher, and the building relative humidity shall be maintained at 60% or lower. Prior to building flushout, the following must be completed:

- a. All construction including completion of punch-list items, interior finishes, and cleaning.
- b. Testing, adjusting, and balancing.
- c. HVAC control system.
- d. Removal of any temporary filters and duct coverings.
- e. Replacement of any HVAC system filters used during construction. This will satisfy the filter replacement requirement for Indoor Environmental Quality Credit 3.1.

1.5.6.2 Building Flushout Option 2

Building Flushout Option 2 shall have the same requirements as Building Flushout Option 1 except that 3500 cubic feet of outdoor air per square foot of floor area is introduced to the building prior to building occupancy. After the building is occupied, it shall be ventilated at a minimum rate of 0.30 cfm of outdoor air per square foot of floor area. Each day of occupancy, flushout shall begin a minimum of three hours prior to the scheduled start of the occupancy period of the building for that day. Flushout shall continue until the scheduled end of the occupancy period for that day. During flushout of the occupied building, the temperature shall be maintained at 60 degrees F or higher, and the humidity shall be maintained at 60% or lower. The building shall be flushed with outdoor air until a total of 14,000 cubic feet of outdoor air per square foot of floor area has been reached; this includes the initial pre-occupancy amount.

1.5.6.3 Building IAQ Testing

Indoor Air Quality testing shall be performed for the building after construction and prior to occupancy. Test protocols shall be in accordance with US Environmental Protection Agency Compendium of Methods for the Determination of Air Pollutants in Indoor Air.

Prior to building IAQ testing, the following must be completed:

- a. All construction including completion of punch-list items, interior finishes, and cleaning.
- b. Testing, adjusting, and balancing.
- c. HVAC control system.
- d. Removal of any temporary filters and duct coverings.
- e. Replacement of any HVAC system filters used during construction. This will satisfy the filter replacement requirement for Indoor Environmental Quality Credit 3.1.

All measurements shall be conducted prior to occupancy, but during normal scheduled occupied hours with the building HVAC systems starting at the beginning of the normal scheduled occupancy period. The ventilation systems shall operate at the minimum outdoor air flow rate for occupied mode during the IAQ tests. For each part of the building served by a separate ventilation system, the number of sampling points shall be one per 25,000 square foot of floor area or more. There shall be at least one sample point per floor. Sampling points shall be taken at areas with the least ventilation and greatest anticipated contaminant source strength. Air samples shall be taken between 3 feet and 6 feet from the finished

floor level. Samples shall be taken over a minimum 4 hour period.

The IAQ testing shall demonstrate that the following contaminant maximum concentrations are not exceeded:

Contaminant	Maximum Concentration
Formaldehyde	50 parts per billion
Particulates (PM10)	50 micrograms per cubic meter
Total Volatile Organic Compounds (TVOC)	500 micrograms per cubic meter
Carbon Monoxide (CO)	9 parts per million and 2 parts per million or less above outdoor levels
*4-Phenylcyclohexene (4PCH)	6.5 micrograms per cubic meter

* - Test for 4PCH is only required if styrene butadiene rubber latex backing material is installed with carpets and fabrics.

Each sampling point for which the maximum contaminant concentration limits are exceeded shall result in building flushout with outdoor air. After flushout, the contaminant concentration shall be sampled at the same point. The procedure shall be repeated until the contaminant concentrations for each sampling point are below the maximum concentrations. Samples taken for repeating the procedure after a failed test shall be taken at the same location as for the initial test.]

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 LEED Partnering Meeting

The LEED Partnering meeting shall occur during either the Pre-Construction Meeting or the Coordination Meeting or the Pre-Design Meeting. The meeting shall be attended by the Contracting Officer or representatives of the Contracting Officer, the Designer of Record, and the QC System Manager. Representatives of the Director of Public Works may also be in attendance. The overall LEED requirements of the project and the LEED credits attempted shall be discussed.

3.2 LEED Implementation Plan Meeting

The LEED Implementation Plan Meeting shall occur after submission of the LEED Implementation Plan and prior to the start of any construction activity. The meeting shall be attended by the Contracting Officer or representatives of the Contracting Officer, the Government's LEED Validation Team Leader, the Contractor's LEED Accredited Professional, the Designer of Record, and the QC System Manager. Representatives of the Director of Public Works or Reserve Component equivalent may also be in attendance. The LEED Implementation Plan shall be reviewed for completeness. Any potential difficulties related to attaining the specified LEED rating shall be identified. The Contractor shall provide the design drawings and specifications.

3.3 LEED Pre-Closeout Meeting

The LEED Pre-Closeout Meeting shall occur 60 days prior to the LEED Validation Meeting. The meeting shall be attended by the Contracting Officer or representatives of the Contracting Officer, the Government's LEED Validation Team Leader, the Contractor's LEED Accredited Professional,

and the QC System Manager. Representatives of the Directorate of Public Works or the Reserve Component equivalent may also be in attendance. The up-to-date LEED Documentation in LEED Online shall be discussed. The LEED rating shall be discussed, and any outstanding issues related to LEED credit or prerequisite requirements shall be identified. A plan for completing any remaining credit and prerequisite requirements and documentation shall be established. The Contractor shall provide hard copies of the up-to-date LEED Documentation from LEED Online and the design drawings and specifications and up-to-date as-built documents.

3.4 LEED Rating Validation Meeting

A LEED Rating Validation meeting shall occur 15 days prior to Contract Completion. The meeting shall be attended by the Contracting Officer or representatives of the Contracting Officer, the Government's LEED Validation Team Leader, the Contractor's LEED Accredited Professional, the Designer of Record, and the QC System Manager. Representatives of the Director of Public Works or Reserve Component equivalent may also be in attendance. The LEED rating and any LEED related activities or problems that have occurred since the LEED Precloseout Meeting shall be discussed. The Contractor shall provide hard copies of the up-to-date LEED Documentation from LEED Online and the design drawings and specifications and as-built documents.

The Government shall validate all of the attempted credits and prerequisites for the project and a LEED rating shall be determined.

-- End of Section --

SECTION 01 35 29.00 06

SAFETY AND OCCUPATIONAL HEALTH REQUIREMENTS

11/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- ANSI A10.32 (2004) Personal Fall Protection - Safety Requirements for Construction and Demolition Operations
- ANSI/ASSE A10.34 (2001; R 2005) Protection of the Public on or Adjacent to Construction Sites
- ANSI Z359.1 (1992; R 1999) Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components

ASME INTERNATIONAL (ASME)

- ASME B30.3 (2004) Construction Tower Cranes
- ASME B30.22 (2005) Articulating Boom Cranes
- ASME B30.5 (2004) Mobile and Locomotive Cranes
- ASME B30.8 (2004) Floating Cranes and Floating Derricks

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 10 (2006; Errata 2006) Standard for Portable Fire Extinguishers
- NFPA 241 (2004) Safeguarding Construction, Alteration, and Demolition Operations
- NFPA 51B (2003) Fire Prevention During Welding, Cutting, and Other Hot Work
- NFPA 70 (2005; TIA 2005) National Electrical Code
- NFPA 70E (2004; AMD 2004) Electrical Safety in the Workplace

U.S. ARMY CORPS OF ENGINEERS (USACE)

- EM 385-1-1 Safety -- Safety and Health Requirements

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.146	Permit-required Confined Spaces
29 CFR 1915	Confined and Enclosed Spaces and Other Dangerous Atmospheres in Shipyard Employment
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.500	Fall Protection

1.2 SUBMITTALS

Government approval/acceptance is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval, or for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Accident Prevention Plan (APP); G

Activity Hazard Analysis (AHA); G

Site Safety & Health Officer Qualifications(SSHO); G

Proof of qualification for Crane Operators; G

Crane Critical Lift Plan; G

SD-06 Test Reports

Reports

Submit reports as their incidence occurs, in accordance with the requirements of the paragraph entitled, "Reports."

Accident Reports

Monthly Exposure Reports

Crane Reports

Regulatory Citations and Violations

SD-07 Certificates

Confined Space Entry Permit

Hot work permit

Submit one copy of each permit/certificate attached to each daily

Quality Control Report.

1.3 DEFINITIONS

- a. Site Safety and Health Officer (SSHO). The qualified or competent person who is responsible for the on-site safety and health management required for the contract project work.
- b. Competent Person for Fall Protection. A person who is capable of identifying hazardous or dangerous conditions in the personal fall arrest system or any component thereof, as well as their application and use with related equipment, and has the authority to take prompt corrective measures to eliminate the hazards of falling.
- c. High Visibility Accident. Any mishap which may generate publicity and/or high visibility.
- d. Medical Treatment. Treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even through provided by a physician or registered personnel.
- e. Qualified Person for Fall Protection. A person with a recognized degree or professional certificate, and with extensive knowledge, training and experience in the field of fall protection; who is capable of performing design, analysis, and evaluation of fall protection systems and equipment.
- f. Recordable Injuries or Illnesses. Any work-related injury or illness that results in:
- (1) Death, regardless of the time between the injury and death, or the length of the illness;
 - (2) Days away from work (any time lost after day of injury/illness onset);
 - (3) Restricted work;
 - (4) Transfer to another job;
 - (5) Medical treatment beyond first aid;
 - (6) Loss of consciousness; or
 - (7) A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (6) above.
- g. "USACE" property and equipment specified in USACE EM 385-1-1 should be interpreted as Government property and equipment.
- h. Weight Handling Equipment (WHE) Accident. A WHE accident occurs when any one or more of the six elements in the operating envelope fails to perform correctly during operation, including operation during maintenance or testing resulting in personnel injury or death; material or equipment damage; dropped load; derailment; two-blocking; overload;

and/or collision, including unplanned contact between the load, crane, and/or other objects. A dropped load, derailment, two-blocking, overload and collision are considered accidents even though no material damage or injury occurs. A component failure (e.g., motor burnout, gear tooth failure, bearing failure) is not considered an accident solely due to material or equipment damage unless the component failure results in damage to other components (e.g., dropped boom, dropped load, roll over, etc.).

i. Low-slope roof. A roof having a slope less than or equal to 4 in 12 (vertical to horizontal).

j. Steep roof. A roof having a slope greater than 4 in 12 (vertical to horizontal).

k. Certified Construction Health & Safety Technician (CHST). An individual who is currently certified by the Board of Certified Safety Professionals.

l. Certified Industrial Hygienist (CIH). An individual who is currently certified by the American Board of Industrial Hygiene.

m. Certified Safety Professional (CSP). An individual who is currently certified by the Board of Certified Safety Professionals.

n. Certified Safety Trained Supervisor (STS). An individual who is currently certified by the Board of Certified Safety Professionals.

o. Associate Safety Professional (ASP). An individual who is currently certified by the Board of Certified Safety Professionals.

1.4 NOT USED

1.5 REGULATORY REQUIREMENTS

In addition to the detailed requirements included in the provisions of this contract, work performed shall comply with USACE EM 385-1-1, and the following federal, state, and local, laws, ordinances, criteria, rules and regulations. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements shall apply.

1.6 SITE QUALIFICATIONS, DUTIES AND MEETINGS

1.6.1 Personnel Qualifications

1.6.1.1 Site Safety and Health Officer (SSHO)

a.) A Site Safety and Health Officer (SSHO) shall be provided at the work site at all times and shall be a member of the onsite work organization and be responsible for overall management of the safety and occupational health program. The SSHO shall have the authority to act in all safety matters for the Contractor at all times to perform safety and occupational health management, surveillance, inspections, and safety enforcement for the Contractor. The SSHO shall be employed by the prime contractor.

The SSHO shall be:

assigned no other duties except being the SSHO, shall not be the CQC System Manager or Superintendent.

.

The SSHO qualifications in resume form shall be submitted per requirements of Section 01 45 04.10 06.

b.) The SSHO shall have a competency experience Level as follows and the Contractor must show evidence that this individual has met these requirements and has completed OSHA training, is trained in First Aid, and CPR. When an alternate is required for the project, the alternate shall have the same the same competency experience level and other qualifications as the SSHO.

Competency Experience Levels:

Level 4:

A minimum of 10 years safety work of a progressive nature with at least 5 years of experience on similar projects.

30-hour OSHA construction safety class or equivalent within the last 5 years.

An average of at least 24 hours of formal safety training each year for the past 5 years with training for competent person status for at least the following areas of competency: Excavation; Scaffolding; Fall protection; Hazardous energy; ; Health hazard recognition, evaluation and control of chemical, physical and biological agents; ; .

c.) Either the CQC system manager or the superintendent shall be equally qualified as the SSHO and shall be capable of performing the full duties of the SSHO during any very brief period of work when the SSHO is absent. To insure that safety and health conditions are maintained/enforced at all times, and a SSHO is present at all times, the Contractor shall designate an alternate to perform the safety and health requirements stated herein to cover any extended period when the SSHO can not be present, such as during absences for vacations/extended sickness, or when there are multiple shifts that requires additional coverage. The alternate shall have the same qualifications/training/ education requirements as the SSHO.

d.) The Contractor shall identify a SSHO for this project and shall submit qualifications to the Government for acceptance. A copy of the letter to the SSHO signed by an authorized official of the firm describing responsibilities and delegating authority to stop work when safety or occupational health of workers is compromised must be provided to the Government. Additionally, the SSHO shall an individual having 10 years of similar previous {heavy}, {housing}, {marine} construction safety experience.

e.) Acceptance of the Contractor's SSHO is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during construction. The Government reserves the right to require the Contractor to make changes to operations including

removal of personnel, as necessary, to obtain a safe work site. At no time will the job be permitted to operate without a SSHO on duty at the work site.

f.) Duties of the SSHO shall include, as a minimum, the following in addition to the duties now listed per other paragraphs of this Section:

Prepare the Contractor's Safety Plan, and Activity Hazard Analysis for each definable feature of work;

Provide safety indoctrination to all construction site visitors;

Ensure the Contractor's accepted Accident Prevention Plan is carried out;

Ensure that all Contractor/subcontractor employees have all HTRW, asbestos, and lead paint training, and their personnel protection equipment meets applicable OSHA/EPA requirements;

Conducts daily walkthrough of the site ensuring work is being accomplished safely and occupational health is not compromised;

Attend and participate in all preparatory and initial quality control phase meetings;

Conduct weekly safety meetings for all workers;

Conduct monthly supervisory safety meetings;

Provide accident reports;

Produce a Daily Safety Report of activities performed and attach this report to the Contractor's Quality Control Report.

Minutes shall be provided of weekly and monthly safety meetings with the Daily Safety Report.

g.) The SSHO shall appoint, in writing, individuals and indicate their duties/responsibilities for the employee who will be in charge of the second and third shifts. These people shall report their activities to the SSHO on a daily basis. Their reports shall be included in the Daily Safety Report. The qualifications for these individuals shall be the same as for the SSHO.

1.6.1.2 Crane Operators

Crane operators shall meet the requirements in USACE EM 385-1-1, Section 16 and Appendix G. In addition, for mobile cranes with Original Equipment Manufacturer (OEM) rated capacities of 50,000 pounds or greater, crane operators shall be designated as qualified by a source that qualifies crane operators (i.e., union, a government agency, or an organization that tests and qualifies crane operators). Proof of current qualification shall be provided.

1.6.2 Personnel Duties

1.6.2.1 Site Safety and Health Officer (SSHO)

a. Conduct daily safety and health inspections and maintain a written

log which includes area/operation inspected, date of inspection, identified hazards, recommended corrective actions, estimated and actual dates of corrections. Safety inspection logs shall be attached to the Contractors' daily quality control report.

b. Conduct mishap investigations and complete required reports. Maintain the OSHA Form 300 for prime and sub-contractors.

c. Maintain applicable safety reference material on the job site.

d. Attend the pre-construction conference, pre-work safety conference, pre-work meetings including preparatory inspection meeting, and periodic in-progress meetings.

e. Implement and enforce accepted APPS and AHAs.

f. Maintain a safety and health deficiency tracking system that monitors outstanding deficiencies until resolution. A list of unresolved safety and health deficiencies shall be posted on the safety bulletin board.

g. Ensure sub-contractor compliance with safety and health requirements.

h. Other duties as identified per Specification Section 01 45 04.10 06.

Failure to perform the above duties shall result in dismissal of the SSHO, and/or CQC System Manager, and/or superintendent and a project work stoppage. The project work stoppage will remain in effect pending approval of a suitable replacement.

1.6.3 Meetings

1.6.3.1 Pework Safety Conference

a. Contractor representatives who have a responsibility or significant role in accident prevention on the project shall attend the prework safety conference. The purpose of the prework safety conference is for the Contractor and the Contracting Officer's representatives to become acquainted and explain the functions and operating procedures of their respective organizations and to reach mutual understanding relative to the administration of the overall project's APP before the initiation of work. This includes the project superintendent, site safety and health officer, quality control system manager, or any other assigned safety and health professionals who participated in the development of the APP (including the Activity Hazard Analyses (AHAs) and special plans, program and procedures associated with it).

b. The Contractor shall discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting Officer's representative as to which phases will require an analysis. In addition, a schedule for the preparation, submittal, review, and acceptance of AHAs shall be established to preclude project delays.

c. Deficiencies in the submitted APP will be brought to the attention of the Contractor at the prework safety conference, and the Contractor shall

revise the plan to correct deficiencies and re-submit it for acceptance. Work shall not begin until there is an accepted APP.

d. The functions of a prework safety conference, may take place at the Post-Award Kickoff meeting for Design Build Contracts.

1.6.3.2 Weekly Safety Meetings

Shall be conducted and documented as required by EM 385-1-1. Minutes showing contract title, signatures of attendees and a list of topics discussed shall be attached to the Contractors' daily quality control report.

1.6.3.3 Work Phase Meetings

The appropriate AHA shall be reviewed and attendance documented by the Contractor at the preparatory, initial, and follow-up control phases of quality control inspection in accordance with Section 01 45 04.10 06 CONTRACTOR QUALITY CONTROL. The analysis should be used during daily inspections to ensure the implementation and effectiveness of safety and health controls; and the results reported on the daily QC Report.

1.7 TRAINING

1.7.1 New Employee Indoctrination

New employees (prime and sub-contractor) will be informed of specific site hazards before they begin work. Documentation of this orientation shall be kept on file at the project site.

1.7.2 Periodic Training

Provide Safety and Health Training in accordance with USACE EM 385-1-1 and the accepted APP. Ensure all required training has been accomplished for all onsite employees.

1.7.3 Training on Activity Hazard Analysis (AHA)

Prior to beginning a new control phase, training will be provided to all affected employees to include a review of the AHA to be implemented.

1.8 ACCIDENT PREVENTION PLAN (APP)

a. The Contractor shall use a qualified person to prepare the written site-specific APP. Prepare the APP in accordance with the format and requirements of USACE EM 385-1-1 and as supplemented herein. Cover all paragraph and subparagraph elements in USACE EM 385-1-1, Appendix A, "Minimum Basic Outline for Accident Prevention Plan". Specific requirements for some of the APP elements are described below. The APP shall be job-specific and shall address any unusual or unique aspects of the project or activity for which it is written. The APP shall interface with the Contractor's overall safety and health program. Any portions of the Contractor's overall safety and health program referenced in the APP shall be included in the applicable APP element and made site-specific. The Government considers the Prime Contractor to be the "controlling authority" for all work site safety and health of the subcontractors. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or

creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out. The APP shall be signed by the person and firm (senior person) preparing the APP, the Contractor, the designated site safety and health officer, the CQC system manager, the contractor's on-site superintendent, and any designated CSP and/or CIH.

b. Submit the APP to the Contracting Officer 15 calendar days prior to the date of the prework safety conference for acceptance. Work cannot proceed without an accepted APP. The Contracting Officer reviews and comments on the Contractor's submitted APP and accepts it when it meets the requirements of the contract provisions.

c. Acceptance is conditional and will be predicated on satisfactory performance during the construction. Once accepted by the Contracting Officer, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified.

d. Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the Contracting Officer, project superintendent, SSHO and quality control manager. Should any hazard become evident, stop work in the area, and secure the area. The project superintendent shall inform/notify the Contracting Officer within 24 hours of discovery, both verbally and in writing, and develop a plan for resolution as soon as possible to eliminate/ remove the hazard. In the interim, all necessary action shall be taken to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ANSI/ASSE A10.34,) and the environment.

e. Copies of the accepted plan will be maintained at the Contracting Officer's office and at the contractor's job site office.

f. The APP shall be continuously reviewed and amended, as necessary, throughout the life of the contract. Unusual or high-hazard activities not identified in the original APP shall be incorporated in the plan as they are discovered.

1.8.1 EM 385-1-1 Contents

In addition to the requirements outlines in Appendix A of USACE EM 385-1-1, the following is required:

a. Names and qualifications (resumes including education, training, experience and certifications) of all site safety and health personnel designated to perform work on this project to include the designated site safety and health officer and other competent and qualified personnel to be used such as CSPs, CIHs, STSs, CHSTs. The duties of each position shall be specified.

b. Qualifications of competent and of qualified persons. As a minimum, competent persons shall be designated and qualifications submitted for each of the following major areas: excavation; scaffolding; fall protection; hazardous energy; confined space; health hazard recognition, evaluation and control of chemical, physical and

biological agents; personal protective equipment and clothing to include selection, use and maintenance.

c. **Confined Space Entry Plan.** Develop a confined space entry plan in accordance with USACE EM 385-1-1, applicable OSHA standards 29 CFR 1910, 29 CFR 1915, and 29 CFR 1926, and any other federal, state and local regulatory requirements identified in this contract. Identify the qualified person's name and qualifications, training, and experience. Delineate the qualified person's authority to direct work stoppage in the event of hazardous conditions. Include procedure for rescue by contractor personnel and the coordination with emergency responders. (If there is no confined space work, include a statement that no confined space work exists and none will be created.)

d. **Crane Critical Lift Plan.** Prepare and sign weight handling critical lift plans for lifts over 75 percent of the capacity of the crane or hoist (or lifts over 50 percent of the capacity of a barge mounted mobile crane's hoists) at any radius of lift; lifts involving more than one crane or hoist; lifts of personnel; and lifts involving non-routine rigging or operation, sensitive equipment, or unusual safety risks. The plan shall be submitted 15 calendar days prior to on-site work and include the requirements of USACE EM 385-1-1, paragraph 16.C.18. and the following:

(1) For lifts of personnel, the plan shall demonstrate compliance with the requirements of 29 CFR 1926.550(g).

(2) For barge mounted mobile cranes, barge stability calculations identifying barge list and trim based on anticipated loading; and load charts based on calculated list and trim. The amount of list and trim shall be within the crane manufacturer's requirements.

e. **Fall Protection and Prevention (FP&P) Plan.** The plan shall be site specific and address all fall hazards in the work place and during different phases of construction. It shall address how to protect and prevent workers from falling to lower levels when they are exposed to fall hazards above (6 feet). A qualified person for fall protection shall prepare and sign the plan. The plan shall include fall protection and prevention systems, equipment and methods employed for every phase of work, responsibilities, assisted rescue, self-rescue and evacuation procedures, training requirements, and monitoring methods. Fall Protection and Prevention Plan shall be revised every six months for lengthy projects, reflecting any changes during the course of construction due to changes in personnel, equipment, systems or work habits. The accepted Fall Protection and Prevention Plan shall be kept and maintained at the job site for the duration of the project. The Fall Protection and Prevention Plan shall be included in the Accident Prevention Plan (APP).

f. **Site Safety and Health, and Emergency Response Plan.** The safety and health aspects prepared in accordance with Section 01 35 30 SAFETY HEALTH AND EMERGENCY RESPONSE (HTRW/UST).

g. **PCB Plan.** The safety and health aspects of Polychlorinated

Biphenyls work, prepared in accordance with Sections 02 84 33 REMOVAL AND DISPOSAL OF POLYCHLORINATED BIPHENALS and 02 61 23 REMOVAL AND DISPOSAL OF PCB CONTAMINATED SOILS.

h. Site Demolition Plan. The safety and health aspects prepared in accordance with Section 02 41 00.00 06 DEMOLITION and referenced sources. Include engineering survey as applicable.

i. Excavation Plan. The safety and health aspects prepared in accordance with Section 31 00 00 EARTHWORK..

j. Training Records and Requirements. List of mandatory training and certifications which are applicable to this project (e.g. explosive actuated tools, confined space entry, fall protection, crane operation, vehicle operator, forklift operators, personal protective equipment); list of requirements for periodic retraining/certification; outline requirements for supervisory and employee safety meetings.

1.9 ACTIVITY HAZARD ANALYSIS (AHA)

a) The Activity Hazard Analysis (AHA) format shall be in accordance with USACE EM 385-1-1 as modified by the Louisville District, using CELRL Form 1259, 01 November 2001, the Form is attached at the end of this section. Submit the AHA for review at least 15 calendar days prior to the start of each phase. Format subsequent AHAs as amendments to the APP.

b) An AHA will be developed by the Contractor for every operation involving a type of work presenting hazards not experienced in previous project operations or where a new work crew or subcontractor is to perform work. The analysis must identify and evaluate hazards and outline the proposed methods and techniques for the safe completion of each phase of work. At a minimum, define activity being performed, sequence of work, specific safety and health hazards anticipated, control measures (to include personal protective equipment) to eliminate or reduce each hazard to acceptable levels, equipment to be used, inspection requirements, training requirements for all involved, and the competent person in charge of that phase of work. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls. For work with fall hazards, including fall hazards associated with scaffold erection and removal, identify the appropriate fall arrest systems. For work with materials handling equipment, address safeguarding measures related to materials handling equipment. For work requiring excavations, include requirements for safeguarding excavations.

c. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.

d. The AHA list will be reviewed periodically (at least monthly) at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change.

e. Activity hazard analyses shall be updated as necessary to provide an effective response to changing work conditions and activities. The on-site superintendent, site safety and health officer and competent persons used to develop the AHAs, including updates, shall sign and date the AHAs before they are implemented.

f. The activity hazard analyses shall be developed using the project schedule as the basis for the activities performed. Any activities listed on the project schedule will require an AHA. The AHAs will be developed by the contractor, supplier or subcontractor and provided to the prime contractor for submittal to the Contracting Officer.

1.10 DISPLAY OF SAFETY INFORMATION

Within 1 calendar days after commencement of work, erect a safety bulletin board at the job site. The safety bulletin board shall include information and be maintained as required by EM 385-1-1, section 01.A.06. Additional items required to be posted include:

- a. Confined space entry permit.
- b. Hot work permit.

1.11 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in the article "References." Maintain applicable equipment manufacturer's manuals.

1.12 EMERGENCY MEDICAL TREATMENT

Contractors will arrange for their own emergency medical treatment. Government has no responsibility to provide emergency medical treatment.

1.13 REPORTS

1.13.1 Accident Reports

- a. For recordable injuries and illnesses, and property damage accidents resulting in at least \$2,000 in damages, the Prime Contractor shall conduct an accident investigation to establish the root cause(s) of the accident, complete the USACE Accident Report Form 3394 and provide the report to the Contracting Officer within 5 calendar day(s) of the accident. The Contracting Officer will provide copies of any required or special forms.
- b. For any weight handling equipment accident (including rigging gear accidents) the Prime Contractor shall conduct an accident investigation to establish the root cause(s) of the accident, complete the WHE Accident Report (Crane and Rigging Gear) form and provide the report to the Contracting Officer within 30 calendar days of the accident. Crane operations shall not proceed until cause is determined and corrective actions have been implemented to the satisfaction of the contracting officer. The Contracting Officer will provide a blank copy of the accident report form.

1.13.2 Accident Notification

Notify the Contracting Officer as soon as practical, but not later than four hours, after any accident meeting the definition of Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than \$2,000, or any weight handling equipment accident. Information shall include contractor name; contract title; type of contract; name of activity, installation or location where accident

occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the accident site until the Government investigation team arrives on-site and Government investigation is conducted.

1.13.3 Monthly Exposure Reports

Monthly exposure reporting to the Contracting Officer is required to be attached to the monthly billing request. This report is a compilation of employee-hours worked each month for all site workers, both prime and subcontractor. The Contracting Officer will provide copies of any special forms.

1.13.4 Regulatory Citations and Violations

Contact the Contracting Officer immediately of any OSHA or other regulatory agency inspection or visit, and provide the Contracting Officer with a copy of each citation, report, and contractor response. Correct violations and citations promptly and provide written corrective actions to the Contracting Officer.

1.13.4 Crane Reports

Submit crane inspection reports required in accordance with USACE EM 385-1-1, Appendix H and as specified herein with Daily Reports of Inspections.

1.13.5 Certificate of Compliance

The Contractor shall provide a Certificate of Compliance for each crane entering an activity under this contract (see Contracting Officer for a blank certificate). Certificate shall state that the crane and rigging gear meet applicable OSHA regulations (with the Contractor citing which OSHA regulations are applicable, e.g., cranes used in construction, demolition, or maintenance shall comply with 29 CFR 1926 and USACE EM 385-1-1 section 16 and Appendix H. Certify on the Certificate of Compliance that the crane operator(s) is qualified and trained in the operation of the crane to be used. The Contractor shall also certify that all of its crane operators working on the DOD activity have been trained in the proper use of all safety devices (e.g., anti-two block devices). These certifications shall be posted on the crane.

1.14 HOT WORK

Prior to performing "Hot Work" (welding, cutting, etc.) or operating other flame-producing/spark producing devices, a written permit shall be requested from the Fire Division having jurisdiction. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED. The Contractor will provide at least two (2) twenty (20) pound 4A:20 BC rated extinguishers for normal "Hot Work". All extinguishers shall be current inspection tagged, approved safety pin and tamper resistant seal. It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity. The Fire Watch shall be trained in accordance with NFPA 51B and remain on-site for a minimum of 30 minutes after completion of the task or as specified on the hot work permit.

When starting work in the facility, Contractors shall require their personnel to familiarize themselves with the location of the nearest fire

alarm boxes and place in memory the emergency Fire Division having jurisdiction phone number. ANY FIRE, NO MATTER HOW SMALL, SHALL BE REPORTED TO THE RESPONSIBLE FIRE DIVISION having jurisdiction IMMEDIATELY.

Obtain services from a NFPA Certified Marine Chemist for "HOT WORK" within or around flammable materials (such as fuel systems, welding/cutting on fuel pipes) or confined spaces (such as sewer wet wells, manholes, vaults, etc.) that have the potential for flammable or explosive atmospheres.

PART 2 PRODUCTS

2.1 FALL PROTECTION ANCHORAGE

Fall protection anchorage, conforming to ANSI Z359.1, installed under the supervision of a qualified person in fall protection, shall be left in place for continued customer use and so identified by signage stating the capacity of the anchorage (strength and number of persons who may be tied-off to it at any one time).

PART 3 EXECUTION

3.1 CONSTRUCTION AND/OR OTHER WORK

The Contractor shall comply with USACE EM 385-1-1, NFPA 241, the APP, the AHA, Federal and/or State OSHA regulations, and other related submittals and activity fire and safety regulations. The most stringent standard shall prevail.

3.1.1 Hazardous Material Use

Each hazardous material must receive approval prior to being brought onto the job site or prior to any other use in connection with this contract. Allow a minimum of 10 working days for processing of the request for use of a hazardous material.

3.1.2 Hazardous Material Exclusions

Notwithstanding any other hazardous material used in this contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation (with the exception of radioactive material and devices used in accordance with USACE EM 385-1-1 such as nuclear density meters for compaction testing and laboratory equipment with radioactive sources) as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocyanates, lead-based paint are prohibited. The Contracting Officer, upon written request by the Contractor, may consider exceptions to the use of any of the above excluded materials.

3.1.3 Unforeseen Hazardous Material

The design should have identified materials such as PCB, lead paint, and friable and non-friable asbestos. If additional material, not indicated, that may be hazardous to human health upon disturbance during construction operations is encountered, stop that portion of work and notify the Contracting Officer immediately. Within 14 calendar days the Government will determine if the material is hazardous. If material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification

pursuant to "FAR 52.243-4, Changes" and "FAR 52.236-2, Differing Site Conditions."

3.2 PRE-OUTAGE COORDINATION MEETING

Contractors are required to apply for utility outages at least 15 days in advance. As a minimum, the request should include the location of the outage, utilities being affected, duration of outage and any necessary sketches. Special requirements for electrical outage requests are contained elsewhere in this specification section. Once approved, and prior to beginning work on the utility system requiring shut down, the Contractor shall attend a pre-outage coordination meeting with the Contracting Officer and the Installation representative to review the scope of work and the lock-out/tag-out procedures for worker protection. No work will be performed on energized electrical circuits unless proof is provided that no other means exist.

3.3 FALL HAZARD PROTECTION AND PREVENTION PROGRAM

The Contractor shall establish a fall protection and prevention program, for the protection of all employees exposed to fall hazards. The program shall include company policy, identify responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection, storage, care and maintenance of fall protection equipment and rescue and evacuation procedures.

3.3.1 Training

The Contractor shall institute a fall protection training program. As part of the Fall Hazard Protection and Prevention Program, the Contractor shall provide training for each employee who might be exposed to fall hazards. A competent person for fall protection shall provide the training. Training requirements shall be in accordance with USACE EM 385-1-1, section 21.A.16.

3.3.2 Fall Protection Equipment and Systems

The Contractor shall enforce use of the fall protection equipment and systems designated for each specific work activity in the Fall Protection and Prevention Plan and/or AHA at all times when an employee is exposed to a fall hazard or on a surface 6 feet or more above lower levels. Fall protection systems such as guardrails/toeboards, personnel fall arrest system, safety nets, etc., are required when working within 6 feet of any leading edge and employees shall be protected from fall hazards as specified in EM 385-1-1, section 21. In addition to the required fall protection systems, safety skiff, personal floatation devices, life rings etc., are required when working above or next to water in accordance with USACE EM 385-1-1, paragraphs 05.H. and 05.I. Personal fall arrest systems are required when working from an articulating or extendible boom, swing stages, or suspended platform. In addition, personal fall arrest systems are required when operating other equipment such as scissor lifts if the work platform is capable of being positioned outside the wheelbase. The need for tying-off in such equipment is to prevent ejection of the employee from the equipment during raising, lowering, or travel. Fall protection must comply with 29 CFR 1926.500, Subpart M, USACE EM 385-1-1 and ANSI A10.32.

3.3.2.1 Personal Fall Arrest Equipment

Personal fall arrest equipment, systems, subsystems, and components shall

meet ANSI Z359.1. Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support device. Body belts may only be used as a positioning device system (for uses such as steel reinforcing assembly and in addition to an approved fall arrest system). Harnesses shall have a fall arrest attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for attachment to the rest of the system. Only locking snap hooks and carabiners shall be used. Webbing, straps, and ropes shall be made of synthetic fiber. The maximum free fall distance when using fall arrest equipment shall not exceed (6 feet). The total fall distance and any swinging of the worker (pendulum-like motion) that can occur during a fall shall always be taken into consideration when attaching a person to a fall arrest system.

3.3.3 Fall Protection for Roofing Work

Fall protection controls shall be implemented based on the type of roof being constructed and work being performed. The roof area to be accessed shall be evaluated for its structural integrity including weight-bearing capabilities for the projected loading.

a. Low Sloped Roofs:

(1) For work within (6 feet) of an edge, on low-slope roofs, personnel shall be protected from falling by use of personal fall arrest systems, guardrails, or safety nets.

(2) For work greater than (6 feet) from an edge, warning lines shall be erected and installed in accordance with 29 CFR 1926.500 and USACE EM 385-1-1.

b. Steep-Sloped Roofs: Work on steep-sloped roofs requires a personal fall arrest system, guardrails with toe-boards, or safety nets. This requirement also includes residential or housing type construction.

3.3.4 Existing Anchorage

Existing anchorages, to be used for attachment of personal fall arrest equipment, shall be certified (or re-certified) by a qualified person for fall protection in accordance with ANSI Z359.1. Existing horizontal lifeline anchorages shall be certified (or re-certified) by a registered professional engineer with experience in designing horizontal lifeline systems.

3.3.5 Horizontal Lifelines

Horizontal lifelines shall be designed, installed, certified and used under the supervision of a qualified person for fall protection as part of a complete fall arrest system which maintains a safety factor of 2 (29 CFR 1926.500).

3.3.6 Guardrails and Safety Nets

Guardrails and safety nets shall be designed, installed and used in accordance with EM 385-1-1 and 29 CFR 1926 Subpart M.

3.3.7 Rescue and Evacuation Procedures

When personal fall arrest systems are used, the contractor must ensure that

the mishap victim can self-rescue or can be rescued promptly should a fall occur. A Rescue and Evacuation Plan shall be prepared by the contractor and include a detailed discussion of the following: methods of rescue; methods of self-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility. The Rescue and Evacuation Plan shall be included in the Activity Hazard Analysis (AHA) for the phase of work, in the Fall Protection and Prevention (FP&P) Plan, and the Accident Prevention Plan (APP).

3.4 SCAFFOLDING

Employees shall be provided with a safe means of access to the work area on the scaffold. Climbing of any scaffold braces or supports not specifically designed for access is prohibited. Access to scaffold platforms greater than 6 (six) feet in height shall be accessed by use of a scaffold stair system. Vertical ladders commonly provided by scaffold system/tower manufacturers shall not be used for accessing scaffold platforms greater than 6 (six) feet in height. The use of an adequate gate is required. Contractor shall ensure that employees are qualified to perform scaffold erection and dismantling. Do not use scaffold without the capability of supporting at least four times the maximum intended load or without appropriate fall protection as delineated in the accepted fall protection and prevention plan. Stationary scaffolds must be attached to structural building components to safeguard against tipping forward or backward. Special care shall be given to ensure scaffold systems are not overloaded. Side brackets used to extend scaffold platforms on self-supported scaffold systems for the storage of material is prohibited. The first tie-in shall be at the height equal to 4 times the width of the smallest dimension of the scaffold base. Work platforms shall be placed on mud sills. Scaffold or work platform erectors shall have fall protection during the erection and dismantling of scaffolding or work platforms that are more than 6 (six) feet. Delineate fall protection requirements when working above 6 (six) feet or above dangerous operations in the Fall Protection and Prevention (FP&P) Plan and Activity Hazard Analysis (AHA) for the phase of work. For additional requirements, see Section 00 80 00.00 06, paragraph 1.43.

3.4.1 Stilts

The use of stilts in conjunction with scaffolds is prohibited. Stilts shall not be used for gaining additional height for construction, renovation, repair or maintenance work; see EM385-1-1 for types of scaffolds where this requirement applies.

3.5 EQUIPMENT

3.5.1 Material Handling Equipment

- a. Material handling equipment such as forklifts shall not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturer's printed operating instructions.
- b. The use of hooks on equipment for lifting of material must be in accordance with manufacturer's printed instructions.
- c. Operators of forklifts or power industrial trucks shall be licensed in accordance with OSHA.

3.5.2 Weight Handling Equipment

- a. Cranes and derricks shall be equipped as specified in [EM 385-1-1](#), section 16.
- b. The Contractor shall notify the Contracting Officer 15 days in advance of any cranes entering the activity so that necessary quality assurance spot checks can be coordinated. Contractor's operator shall remain with the crane during the spot check.
- c. The Contractor shall comply with the crane manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work. Erection shall be performed under the supervision of a designated person (as defined in [ASME B30.5](#)). All testing shall be performed in accordance with the manufacturer's recommended procedures.
- d. The Contractor shall comply with [ASME B30.5](#) for mobile and locomotive cranes, [ASME B30.22](#) for articulating boom cranes, [ASME B30.3](#) for construction tower cranes, and [ASME B30.8](#) for floating cranes and floating derricks.
- e. Under no circumstance shall a Contractor make a lift at or above 90% of the cranes rated capacity in any configuration.
- f. When operating in the vicinity of overhead transmission lines, operators and riggers shall be alert to this special hazard and shall follow the requirements of USACE [EM 385-1-1](#) section 11 and [ASME B30.5](#) or [ASME B30.22](#) as applicable.
- g. Crane suspended personnel work platforms (baskets) shall not be used unless the Contractor proves that using any other access to the work location would provide a greater hazard to the workers or is impossible. Personnel shall not be lifted with a line hoist or friction crane.
- h. Portable fire extinguishers shall be inspected, maintained, and recharged as specified in [NFPA 10](#), Standard for Portable Fire Extinguishers.
- i. All employees shall be kept clear of loads about to be lifted and of suspended loads.
- j. The Contractor shall use cribbing when performing lifts on outriggers.
- k. The crane hook/block must be positioned directly over the load. Side loading of the crane is prohibited.
- l. A physical barricade must be positioned to prevent personnel from entering the counterweight swing (tail swing) area of the crane.
- m. Certification records which include the date of inspection, signature of the person performing the inspection, and the serial number or other identifier of the crane that was inspected shall always be available for review by Contracting Officer personnel.
- n. Written reports listing the load test procedures used along with any repairs or alterations performed on the crane shall be available

for review by Contracting Officer personnel.

o. Certify that all crane operators have been trained in proper use of all safety devices (e.g. anti-two block devices).

p. The presence of Government personnel does not relieve the Contractor of an obligation to comply with all applicable safety regulations. The Government will investigate all complaints of unsafe or unhealthful working conditions received in writing from contractor employees, federal civilian employees, or military personnel.

q. Each load shall be rigged/attached independently to the hook/master-link in such a fashion that the load cannot slide or otherwise become detached. Christmas-tree lifting (multiple rigged materials) is not allowed.

3.6 EXCAVATIONS

The competent person shall perform soil classification in accordance with [29 CFR 1926](#).

3.6.1 Utility Locations

Prior to digging, the appropriate digging permit must be obtained. All underground utilities in the work area must be positively identified by a private utility locating service in addition to any station locating service and coordinated with the station utility department. Any markings made during the utility investigation must be maintained throughout the contract.

3.6.2 Utility Location Verification

The Contractor must physically verify underground utility locations by hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within three feet of the underground system. Digging within 2 feet of a known utility must not be performed by means of mechanical equipment; hand digging shall be used. If construction is parallel to an existing utility the utility shall be exposed by hand digging every 100 feet if parallel within 5 feet of the excavation.

3.6.3 Shoring Systems

Trench and shoring systems must be identified in the accepted safety plan and AHA. Manufacturer tabulated data and specifications or registered engineer tabulated data for shoring or benching systems shall be readily available on-site for review. Job-made shoring or shielding shall have the registered professional engineer stamp, specifications, and tabulated data. Extreme care must be used when excavating near direct burial electric underground cables.

3.6.4 Trenching Machinery

Trenching machines with digging chain drives shall be operated only when the spotters/laborers are in plain view of the operator. Operator and spotters/laborers shall be provided training on the hazards of the digging chain drives with emphasis on the distance that needs to be maintained when the digging chain is operating. Documentation of the training shall be kept on file at the project site.

3.7 UTILITIES WITHIN CONCRETE SLABS

Utilities located within concrete slabs or pier structures, bridges, and the like, are extremely difficult to identify due to the reinforcing steel used in the construction of these structures. Whenever contract work involves concrete chipping, saw cutting, or core drilling, the existing utility location must be coordinated with station utility departments in addition to a private locating service. Outages to isolate utility systems shall be used in circumstances where utilities are unable to be positively identified. The use of historical drawings does not alleviate the contractor from meeting this requirement.

3.8 ELECTRICAL

3.8.1 Conduct of Electrical Work

Underground electrical spaces must be certified safe for entry before entering to conduct work. Cables that will be cut must be positively identified and de-energized prior to performing each cut. Positive cable identification must be made prior to submitting any outage request for electrical systems. Arrangements are to be coordinated with the Contracting Officer and Station Utilities for identification. The Contracting Officer will not accept an outage request until the Contractor satisfactorily documents that the circuits have been clearly identified. Perform all high voltage cable cutting remotely using hydraulic cutting tool. When racking in or live switching of circuit breakers, no additional person other than the switch operator will be allowed in the space during the actual operation. Plan so that work near energized parts is minimized to the fullest extent possible. Use of electrical outages clear of any energized electrical sources is the preferred method. When working in energized substations, only qualified electrical workers shall be permitted to enter. When work requires Contractor to work near energized circuits as defined by the NFPA 70, high voltage personnel must use personal protective equipment that includes, as a minimum, electrical hard hat, safety shoes, insulating gloves with leather protective sleeves, fire retarding shirts, coveralls, face shields, and safety glasses. In addition, provide electrical arc flash protection for personnel as required by NFPA 70E. Insulating blankets, hearing protection, and switching suits may also be required, depending on the specific job and as delineated in the Contractor's AHA.

3.8.2 Portable Extension Cords

Portable extension cords shall be sized in accordance with manufacturer ratings for the tool to be powered and protected from damage. All damaged extension cords shall be immediately removed from service. Portable extension cords shall meet the requirements of NFPA 70.

3.9 WORK IN CONFINED SPACES

The Contractor shall comply with the requirements in Section 06.I of USACE EM 385-1-1, OSHA 29 CFR 1910.146 and OSHA 29 CFR 1926.21(b)(6). Any potential for a hazard in the confined space requires a permit system to be used.

- a. Entry Procedures. Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential

hazards are controlled or eliminated and documented. (See Section 06.I.06 of USACE EM 385-1-1 for entry procedures.) All hazards pertaining to the space shall be reviewed with each employee during review of the AHA.

b. Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained to ensure exposure to any hazardous atmosphere is kept below its' action level.

c. Sewer wet wells require continuous atmosphere monitoring with audible alarm for toxic gas detection.

-- End of Section --

SECTION 01 42 00

SOURCES FOR REFERENCE PUBLICATIONS

08/10

PART 1 GENERAL

1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization, (e.g. ASTM B 564 Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided. Documents listed in the specifications with numbers which were not assigned by the standards producing organization should be ordered from the source by title rather than by number.

ACI INTERNATIONAL (ACI)
38800 Country Club Drive
Farmington Hills, MI 48331
Ph: 248-848-3700
Fax: 248-848-3701
E-mail: bkstore@concrete.org
Internet: <http://www.concrete.org>

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)
30 West University Drive
Arlington Heights, IL 60004-1893
Ph: 847-394-0150
Fax: 847-253-0088
E-mail: amca@amca.org
Internet: <http://www.amca.org>

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)
2111 Wilson Blvd, Suite 500
Arlington, VA 22201
Ph: 703-524-8800
Fax: 703-528-3816
E-mail: fdietz@ahrinet.org
Internet: <http://www.ahrinet.org>

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)
1200 G Street, NW, Suite 500
Washington, D.C. 20005
Ph: 202-628-6380
Fax: 202-393-5453
E-mail: doccenter@atis.org

Internet: <http://www.atis.org>

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

444 North Capital Street, NW, Suite 249

Washington, DC 20001

Ph: 202-624-5800

Fax: 202-624-5806

E-Mail: info@aaashto.org

Internet: <http://www.aashto.org>

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

1303 W. Walnut Hill Lane, Suite 305

Irving, TX 75038-3008

Ph: 972-506-7216

Fax: 972-506-7682

E-mail: info@concrete-pipe.org

Internet: <http://www.concrete-pipe.org>

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

1819 L Street, NW, 6th Floor

Washington, DC 20036

Ph: 202-293-8020

Fax: 202-293-9287

E-mail: info@ansi.org

Internet: <http://www.ansi.org/>

AMERICAN PETROLEUM INSTITUTE (API)

1220 L Street, NW

Washington, DC 20005-4070

Ph: 303-397-7993

Fax: 303-397-2740

E-mail: greg.kallio@ihs.com

Internet: <http://www.api.org>

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION
(AREMA)

10003 Derekwood Lane, Suite 210

Lanham, MD 20706

Ph: 301-459-3200

Fax: 301-459-8077

Internet: <http://www.arema.org>

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

1800 East Oakton Street

Des Plaines, IL 60018-2187

Ph: 847-699-2929

Fax: 847-768-3434

E-mail: customerservice@asse.org

Internet: <http://www.asse.org>

AMERICAN WATER WORKS ASSOCIATION (AWWA)

6666 West Quincy Avenue

Denver, CO 80235

Ph: 800-926-7337

Fax: 303-347-0804

E-mail: smorrison@awwa.org

Internet: <http://www.awwa.org>

AMERICAN WELDING SOCIETY (AWS)
550 N.W. LeJeune Road
Miami, FL 33126
Ph: 800-443-9353 - 305-443-9353
Fax: 305-443-7559
E-mail: info@aws.org or customerservice@awspubs.com
Internet: <http://www.aws.org>

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)
P.O. Box 361784
Birmingham, AL 35236-1784
Ph: 205-733-4077
Fax: 205-733-4075
E-mail: email@awpa.com
Internet: <http://www.awpa.com>

ASME INTERNATIONAL (ASME)
Three Park Avenue, M/S 10E
New York, NY 10016-5990
Ph: 800-854-7179 or 800-843-2763
Fax: 212-591-7674
E-mail: infocentral@asme.org
Internet: <http://www.asme.org>

ASPHALT INSTITUTE (AI)
Research Park Drive
P.O. Box 14052
Lexington, KY 40512-4052
Ph: 859-288-4960
Fax: 859-288-4999
E-mail: info@asphaltinstitute.org
Internet: <http://www.asphaltinstitute.org>

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)
600 North 18th Street
P.O. Box 2641
Birmingham, AL 35291
Ph: 205-257-2530
Fax: 205-257-2540
E-Mail: aeicdir@bellsouth.net
Internet: <http://www.aeic.org>

ASTM INTERNATIONAL (ASTM)
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA 19428-2959
Ph: 610-832-9585
Fax: 610-832-9555
E-mail: service@astm.org
Internet: <http://www.astm.org>

CARPET AND RUG INSTITUTE (CRI)
P.O. Box 2048
Dalton, GA 30722-2048
Ph: 800-882-8846 or 706-278-3176
Fax: 706-278-8835
Internet: <http://www.carpet-rug.com>

ELECTRONIC COMPONENTS ASSOCIATION (ECA)
2500 Wilson Blvd.

Suite 310
Arlington, VA 22201
Ph: 703-907-8024
E-mail: emikoski@ecaus.org
Internet: <http://www.ecaus.org>

FM GLOBAL (FM)
270 Central Avenue
P.O. Box 7500
Johnston, RI 02919
Ph: 401-275-3000 ext. 1945
Fax: 401-275-3029
E-mail: servicedesk.myrisk@fmglobal.com
Internet: <http://www.fmglobal.com>

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH
(FCCCHR)
University of South California
Kaprielian Hall 200
Los Angeles, CA 90089-2531
Ph: 213-740-2032 or 866-545-6340
Fax: 213-740-8399
E-mail: fccchr@usc.edu
Internet: <http://www.usc.edu/dept/fccchr>

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)
120 Wall Street, 17th Floor
New York, NY 10005
Ph: 212-248-5000
Fax: 212-248-5018
E-mail: iesna@iesna.org
Internet: <http://www.iesna.org>

INNOVATIVE PAVEMENT RESEARCH FOUNDATION (IPRF)
Att: Mr. Gerald Voigt
5420 Old Orchard Rd, Suite A-100
Skokie, IL 60077-1059
Internet: www.iprf.org

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
445 Hoes Lane or 2001 L Street, NW. Suite 700
Piscataway, NJ 08855-1331 or Washington, DC 20036-4910 USA
Ph: 732-981-0060 or 800-701-4333
Fax: 732-562-6380
E-mail: onlinesupport@ieee.org or ieeeusa@ieee.org
Internet: <http://www.ieee.org>

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)
P.O. Box 1568
Carrollton, GA 30112
Ph: 1 800 447 3352
Fax: 1 303 397 2599
E-mail: global@ihs.com
Internet: <http://www.icea.net>

INTERNATIONAL CODE COUNCIL (ICC)
5360 Workman Mill Road
Whittier, CA 90601
Ph: 1-888-422-7233

Fax: 562-908-5524
E-mail: webmaster@iccsafe.org
Internet: www.iccsafe.org

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

3050 Centre Ave. Suite 102
Portage, MI 49024
Ph: 269-488-6382
Fax: 269-488-6383
E-mail: neta@netaworld.org
Internet: <http://www.netaworld.org>

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

127 Park Street, NE
Vienna, VA 22180
Ph: 703-281-6613
Fax: 703-281-6671
E-mail: info@mss-hq.com
Internet: <http://www.mss-hq.com>

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

Superintendent of Documents at
U.S. Government Printing Office
732 North Capitol Street, NW
Washington, DC 20401-0001
Ph: 202-783-3238
Fax: 202-512-1800
E-mail: ContactCenter@gpo.gov
Internet: <http://www.gpoaccess.gov/help>

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

1300 North 17th Street, Suite 1752
Rosslyn, VA 22209
Ph: 703-841-3200
Fax: 703-841-5900
Internet: <http://www.nema.org/>

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

1 Batterymarch Park
Quincy, MA 02169-7471
Ph: 617-770-3000 or 800-344-3555
Fax: 617-770-0700
E-mail: webmaster@nfpa.org
Internet: <http://www.nfpa.org>

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

100 Bureau Drive
Stop 1070
Gaithersburg, MD 20899-1070
Ph: 301-975-NIST (6478)
E-mail: inquiries@nist.gov
Internet: <http://www.nist.gov>

NATIONAL READY MIXED CONCRETE ASSOCIATION (NRMCA)

900 Spring Street

Silver Spring, MD 20910
Ph: 240-485-1165
E-mail: jjenkins@nrmca.org (jacques jenkins)
Internet: <http://www.nrmca.org>

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION
(SMACNA)
4201 Lafayette Center Drive
Chantilly, VA 20151-1219
Ph: 703-803-2980
Fax: 703-803-3732
E-mail: info@smacna.org
Internet: <http://www.smacna.org>

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)
400 Commonwealth Drive
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PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not used

-- End of Section --

SECTION 01 46 00.00 06

COMMISSIONING OF BUILDING ENERGY SYSTEMS
09/08

PART 1 GENERAL

Commissioning of the HVAC[, Lighting Control, Domestic Hot Water, Renewable Energy, and On-Site Power] systems is the responsibility of the Contractor. The Contractor shall employ the services of an independent Commissioning Agent. The Commissioning Agent shall coordinate all aspects of the commissioning process. Commissioning procedures shall conform to the procedures outlined in this specification.

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-05 Design Data;

Design Review Report; G, ED.

Completed report individually listing each deficiency and the corresponding proposed corrective action shall be submitted [no later than 14 calendar days after approval of the Commissioning Agent.][concurrent with the submission of the final design.]

Commissioning Plan; G, ED.

Outline of the overall commissioning process; the schedule for Pre-Commissioning Checks, Functional Performance Tests, Training, Turn-Over Instruction, and Building Operation Review as applicable; list of team members who will represent the Contractor during Pre-Commissioning Checks and Functional Performance Tests; Pre-Commissioning Check lists and Functional Performance Tests lists for each building, each system, and each component; shall be submitted at least 14 calendar days prior to start of pre-commissioning checks.

SD-06 Test Reports

Final Commissioning Report Reports; G, ED.

Completed pre-commissioning checklists and functional performance test checklists organized by system and by subsystem and submitted

as one package. The results of failed tests shall be included along with a description of the corrective action taken. The report shall include an executive summary of the commissioning process and results and include any seasonal testing scheduled for a later date. [The report shall indicate whether systems meet the requirements of the Owner's Project Requirements and the Basis of Design.]The training video shall be included. The report shall be submitted no later than 14 calendar days after completion of Functional Performance Testing.

SD-07 Certificates

Commissioning Agent; G, ED

The Commissioning Agent shall be a NEBB qualified Systems Commissioning Administrator (SCA) employed by a NEBB certified firm with a minimum of three years of HVAC commissioning experience and at least two projects of similar size and scope; or an AABC Certified Commissioning Agent (CCA) employed by an AABC certified firm with a minimum of three years of HVAC commissioning experience and at least two projects of similar size and scope; or a Professional Engineer (P.E.) with a minimum of five years of HVAC design experience who is not associated with the design of this project, is licensed in the state where this project is located, and has a minimum of three years of HVAC commissioning experience and at least two projects of similar size and scope. The Commissioning Agent's certification of qualifications including the Commissioning Agent's name and firm shall be submitted no later than 30 calendar days after Notice to Proceed. [The Commissioning Agent's contract including the Scope of Work for Building Operation Review shall be submitted with the Commissioning Agent's qualifications]

Certificate of Readiness; G, RE.

Statement issued by the Contractor and signed by the Contractor, the Commissioning Agent, and all other Contractor's Representatives on the Commissioning Team certifying that all equipment, systems, and controls are complete and ready for Functional Performance Tests. Includes start-up reports, completed Pre-Commissioning Checklists, Performance Verification Test Report, and the TAB Report. Submit no later than 14 calendar days prior to Functional Performance Tests.

[SD-10 Operation and Maintenance Data]

[Systems Manual; G, ED.]

[Completed manual including the Basis of Design and, for all commissioned systems, the single line diagrams, the as-built sequences of operation, the control drawings, original setpoints, operating instructions, recommended schedule of maintenance if not in the O&M manual, and the recommended schedule for calibrating sensors and actuators. The Systems Manual shall be submitted no later than 14 calendar days after completion of Functional Performance Testing.]

1.2 Certificate of Readiness

The Contractor shall issue a Certificate of Readiness certifying that the building energy systems are ready for Functional Performance Testing. The Certificate of Readiness shall include all equipment and system start-up reports, Performance Verification Test Reports, Pre-Commissioning Checklists, TAB Report, and the Building Air Tightness Test Report. The Contractor, the Commissioning Agent, and the Contractor's Quality Control, Mechanical, Electrical, Controls, and Testing, Adjusting, and Balancing Representatives shall sign and date the Certificate of Readiness.

1.3 COMMISSIONING ACTIVITIES

The Contractor shall be responsible for the following procedures described in this specification:

a. Preconstruction Commissioning Meeting - The Commissioning Agent, the Contractor, the Contractor's Quality Control Representative, and the Government shall meet and discuss the commissioning process to include all requirements and submittals as specified in this section no later than 14 days after approval of the Commissioning Agent.

[b. Design Review (Design-Build) - The Commissioning Agent shall review the Design Plans and Specifications, the Basis of Design, and the Owner's Project Requirements prior to 60% completion of the design. The Commissioning Agent shall assess the completeness and clarity of the Owner's Project Requirements, verify that the requirements stated in the Owner's Project Requirements are addressed in the Basis of Design, and verify that the Design Plans and Specifications are prepared in accordance with the Basis of Design and the Owner's Project Requirements. The Commissioning Agent shall backcheck the reviewed documents at 95% completion of the design. The Commissioning Agent shall provide a Design Review Report which shall identify any discrepancies between the reviewed documents, deviations in the design from the Basis of Design or Owner's Project Requirements, or deficiencies that would prevent the building energy systems from operating effectively in accordance with the sequence of operation. The Design Review Report shall individually list each deficiency and the corresponding proposed corrective action necessary for proper system operation. The report shall be submitted with the final design submission to the Government. The Contracting Officer's Representative, the Commissioning Agent, and the Designers shall meet, discuss, and resolve any items contained in the report no later than 14 calendar days after submission of the report.]

[b. Design Review (Design-Bid-Build) - The Commissioning Agent shall review the Contract Plans and Specifications and advise the Contracting Officer's Representative of any deficiencies that would prevent the building energy systems from operating effectively in accordance with the sequence of operation specified. [The Commissioning Agent shall review the Basis of Design and Owner's Project Requirements. The Basis of Design is shown in Appendix C. The Owner's Project Requirements is shown in Appendix D. The Commissioning Agent shall compare the Basis of Design and the Owner's Project Requirements against the Contract Plans and Specifications and advise the Contracting Officer of any discrepancies. The Design Review shall be performed before the first submission of building energy system related submittals.]The Commissioning Agent shall provide a Design Review

Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation. The report shall be submitted to the Contracting Officer no later than 14 days after approval of the Commissioning Agent. The Contracting Officer, the Commissioning Agent, and the Designer shall meet and discuss any items contained in the report no later than 7 calendar days after submission of the report. All items will be resolved at that meeting.]

c. Commissioning Plan - The Commissioning Agent shall prepare the Commissioning Plan. The Commissioning Plan shall outline the overall commissioning process, the commissioning schedule, the commissioning team members and responsibilities, and documentation requirements. The commissioning schedule shall include Pre-Commissioning Checks, Functional Performance Tests, Training, Turn-Over Instruction, and Building Operation Review as applicable. The Commissioning Agent shall prepare the Pre-Commissioning Checklists for each building, for each system, and for each component before the start of the checks. Appendix A provides examples of the minimum detail required for Pre-Commissioning Checklists. The Commissioning Agent shall prepare the Functional Performance Test lists for each building, for each system, and for each component before the start of the tests. Appendix B provides examples of the minimum detail required for Functional Performance Test Lists.

d. Construction - The Commissioning Agent shall review all building energy system related shop drawings and submittals and verify the submitted equipment complies with the contract requirements[and the requirements of the Basis of Design and the Owner's Project Requirements]. The Commissioning Agent shall review the status of the Pre-Commissioning Checklists, and shall verify the items on the checklists conform to the submittals, are installed in accordance with the manufacturer's recommendations, and are installed in compliance with the contract requirements[and the requirements of the Basis of Design and the Owner's Project Requirements]. The Commissioning Agent shall perform an onsite review and shall verify that the systems are in compliance with all specifications prior to the Functional Performance Tests.

e. Pre-Commissioning Checks - The Commissioning Agent, Contractor's Quality Control Representative, and the Government shall perform pre-commissioning checks and complete the Pre-Commissioning Checklists. Each applicable item in the checklist for each item of equipment shall be inspected and the checklist shall be initialed by the Commissioning Team. The Commissioning Team shall only initial items on the checklist that are complete and witnessed.

e. Testing, Adjusting, and Balancing (TAB) Verification Testing - After the TAB process is performed and the balance report is submitted, the Commissioning Agent shall perform a verification test. The extent of verification shall be to the discretion of the commissioning agent; however a minimum of 15% of all readings shall be verified. If readings deviate more than + or - 10% from the report the TAB contractor shall be directed to re-balance the system and submit new reports.

f. Pre-Functional Performance Test Meeting - The Commissioning Agent, the Contractor, the Contractor's Quality Control Representative, and the Government shall meet prior to Functional Performance Tests to determine if all Functional Performance Test Prerequisites have been completed and to discuss the reports submitted with the Certificate of Readiness and the Functional Performance Test procedures

g. Functional Performance Tests - The Commissioning Agent shall lead the Functional Performance Tests in accordance with the Commissioning Plan.

[h. Systems Manual - The Commissioning Agent shall develop a system manual. The systems manual shall be a separate document from the Operating and Maintenance Manuals required by related sections. The system manual shall include the Basis of Design and, for all commissioned systems, the single line diagrams, the as-built sequences of operation, the control drawings, original setpoints, operating instructions, recommended schedule of maintenance if not in the O&M manual, and the recommended schedule for calibrating sensors and actuators.]

i. Training - The Commissioning Agent shall schedule, supervise and video all training of the owner's maintenance staff on all building energy equipment and systems. The video shall be turned over to the COR as part of the final commissioning report for future reference. The Commissioning agent shall provide the video on the appropriate media as directed by the Contracting Officer's Representative.

j. Operating and Maintenance Manuals Turn-over - The Commissioning Agent shall assist and schedule the submission of all O&M Manuals and Warranties.

k. Turn-over Instruction - When the building energy systems are ready to be turned-over to the owner, the Commissioning Agent shall schedule a final session for operation and maintenance personnel instruction. The system design engineers, installing contractors, major equipment suppliers and any other interested parties should be in attendance. This instruction shall include a review of all systems and equipment operations, additional hands-on instruction where required and a question and answer period.

l. Final Commissioning Report - The Commissioning Agent shall prepare a Final Commissioning Report as required. The report shall include an executive summary of the commissioning process and results and include any seasonal testing scheduled for a later date. [The report shall indicate whether systems meet the requirements of the Owner's Project Requirements and the Basis of Design.]The report shall detail any deficiencies found during the testing and the corrective actions taken. The report shall include all Pre-Commissioning Checklists and Functional Performance Test Checklists, and any substantiating information.

[m. Building Operation Review - The Commissioning Agent shall visit the building and review building energy system operation with operating staff and users 8 to 10 months after substantial completion. The Commissioning Agent shall advise the Contracting Officer's Representative of any outstanding construction deficiencies. The Systems Manual shall be updated with the list of deficiencies that will not be corrected. The updated Systems Manual shall be submitted no later than 14 calendar days after completion of Building Operation Review.]

1.4 SEQUENCING AND SCHEDULING

The Functional Performance Tests described in this Section shall begin only after all work and testing required in related Sections, including Section 23 09 23 DIRECT DIGITAL CONTROL FOR HVAC AND OTHER LOCAL BUILDING SYSTEMS, LRL Section 07 25 00.00 06 BUILDING AIR BARRIER SYSTEM, and Section 23 05 93.00 10 TESTING, ADJUSTING AND BALANCING FOR HVAC, have been successfully completed, and after all test and inspection reports and operation and maintenance manuals required in these Sections have been submitted and approved.

The following shall be completed prior to Functional Performance Tests:

- a. All equipment and systems have been completed, calibrated, and operate in accordance with contract documents.
- b. Performance Verification Tests have been completed and the Performance Verification Test Report has been submitted. Performance Verifications Tests shall [be as specified in Section 23 09 23.][demonstrate that all physical and functional requirements of the contract have been met. The Contractor shall demonstrate that the control systems perform in accordance with the sequence of operations.]
- c. Testing, Adjusting, and Balancing has been completed and the TAB Report has been submitted.
- d. The Building Air Tightness Tests have been completed and the Building Air Tightness Test Reports have been submitted.
- e. The Pre-Commissioning Checklists have been completed and submitted.
- f. The Certificate of Readiness has been submitted.
- g. The Pre-Functional Performance Test Meeting has occurred.

1.5 COMMUNICATION WITH THE GOVERNMENT

The Commissioning Agent shall submit all plans, schedules, reports, and documentation directly to the Contracting Officer's Representative concurrent with submission to the CQC System Manager. The Commissioning Agent shall have direct communication with the Contracting Officer's Representative regarding all elements of the commissioning process.

PART 2 PRODUCTS(NOT APPLICABLE)

PART 3 EXECUTION

3.1 COMMISSIONING TEAM AND CHECKLISTS

The Contractor shall designate team members to participate in the pre-commissioning checks and the functional performance testing specified herein.

The team members for pre-commissioning checks shall be as follows:

Designation	Function
QA	Contracting Officer's Quality Assurance Representative
QC	Contractor's Quality Control Representative
CA	Commissioning Agent

The team members for functional performance testing shall be as follows:

Contracting Officer's Quality Assurance Representative
 Contractor's Quality Control Representative
 Commissioning Agent
 Contractor's Controls Representative
 Contractor's Testing, Adjusting, and Balancing Representative
 Design Agent's Representative

The following may be required to participate as team members during Pre-Commissioning Checks and Functional Performance Testing at the request

of the Commissioning Agent:

Contractor's Mechanical Representative
Contractor's Electrical Representative
Using Agent's Representative

The commissioning team shall complete the Pre-Commissioning Check Lists and the Functional Performance Tests lists prepared by the Commissioning Agent. Acceptance by each commissioning team member of each pre-commissioning checklist item shall be indicated by initials and date. Acceptance by each commissioning team member of each functional performance test checklist shall be indicated by signature and date.

3.2 TESTS

The pre-commissioning checks and functional performance tests shall be performed in a manner which essentially duplicates the checking, testing, and inspection methods established in the related Sections. Where checking, testing, and inspection methods are not specified in other Sections, methods shall be established to verify that the system is installed and performs in accordance with contract documents. Testing and verification shall demonstrate that all HVAC components have been installed, that each control device and item of equipment operates, and that the system operates in accordance with contract documents. Requirements in related Sections are independent from the requirements of this Section and shall not be used to satisfy any of the requirements specified in this Section. The Contractor shall provide all materials, services, and labor required to perform the pre-commissioning checks and functional performance tests. A pre-commissioning check or functional performance test shall be aborted if any system deficiency prevents the successful completion of the test or if any participating non-Government commissioning team member of which participation is specified is not present for the test. The Contractor shall reimburse the Government for all costs associated with effort lost due to tests that are aborted. These costs shall include salary, travel costs and per diem (where applicable) for Government commissioning team members.

3.2.1 Pre-Commissioning Checks

Pre-commissioning checks shall be performed for ductwork, piping, each major item of equipment, and the control systems. Deficiencies discovered during these checks shall be corrected and retested in accordance with the applicable contract requirements.

3.2.2 Functional Performance Tests

Functional performance tests shall be performed for each major item of equipment, each HVAC system, and the HVAC control systems. Functional performance tests shall verify all control responses, safeties, interlocks, operating modes, capacities, and all other relevant contract requirements comply with contract documents. Functional performance tests shall begin only after all pre-commissioning checks have been successfully completed, the Certificate of Readiness has been submitted, and the Pre-Functional Performance Test Meeting has occurred. Tests shall prove all modes of the sequences of operation, and shall verify all other relevant contract requirements. Tests shall begin with equipment or components and shall progress through subsystems to complete systems. Upon failure of any functional performance test checklist item, the Contractor shall correct all deficiencies in accordance with the applicable contract requirements.

The checklist shall then be repeated until it has been completed with no errors. If TAB Verification has not been completed prior to Functional Performance Testing, it shall be verified during Functional Performance Testing.

3.3 Building Operation Review

The Commissioning Agent shall visit the building site, inspect building energy system equipment, review building operation with the building operating/maintenance staff and/or users, and analyze control point trends. The operating staff shall have the responsibility for providing control point trends relevant to identified operating issues to the Commissioning Agent. The Commissioning Agent shall identify any deficiency of the building energy systems to operate in accordance with the Contract Plans and Specifications, the Basis of Design, and the Owner's Project Requirements. The Commissioning Agent shall advise the Contracting Officer's Representative of any identified deficiencies and the proposed corrective action. Any deficiency that will not be corrected, shall be documented. Documentation shall be provided to the Contracting Officer's Representative as an update to the Systems Manual.

APPENDIX A
PRE-COMMISSIONING CHECKLISTS

Pre-commissioning checklist - Piping

For [_____] Piping System

Checklist Item	QA	QC	CA
Installation			
a. Piping complete.	___	___	___
b. As-built shop drawings submitted.	___	___	___
c. Piping flushed and cleaned.	___	___	___
d. Strainers cleaned.	___	___	___
e. Valves installed as required.	___	___	___
f. Piping insulated as required.	___	___	___
g. Thermometers and gauges installed as required.	___	___	___
h. Verify operation of valves.	___	___	___
i. Air vents installed as specified.	___	___	___
j. Flexible connectors installed as specified	___	___	___
k. Verify that piping has been labeled and valves identified as specified.	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. Hydrostatic test complete.	___	___	___
b. TAB operation complete.	___	___	___

Pre-commissioning Checklist - Ductwork

For Air Handler: [____]

Checklist Item	QA	QC	CA
Installation			
a. Ductwork complete.	___	___	___
b. As-built shop drawings submitted.	___	___	___
c. Ductwork leak test complete.	___	___	___

NOTE: The first bracketed item will be used for Army projects, the second for Air Force projects.

[d. Fire dampers, smoke dampers, and access doors installed as required.	___	___	___]
[d. Fire dampers, smoke dampers, and access doors installed as required with installation of each verified by the specified team members initialing each location on a copy of the as-built drawings.	___	___	___]
e. Ductwork insulated as required.	___	___	___
f. Thermometers and gauges installed as required.	___	___	___
g. Verify open/closed status of dampers.	___	___	___
h. Verify smoke dampers operation.	___	___	___
i. Flexible connectors installed as specified	___	___	___

Testing, Adjusting, and Balancing (TAB)

a. TAB operation complete.	___	___	___
----------------------------	-----	-----	-----

Pre-commissioning Checklist - Multizone Air Handling Unit

For Air Handling Unit: [_____]

Checklist Item	QA	QC	CA
Installation			
a. Vibration isolation devices installed [and freed to float with adequate movement and seismic restraint] as specified.	___	___	___
b. Inspection and access doors are operable and sealed.	___	___	___
c. Casing undamaged.	___	___	___
d. Insulation undamaged.	___	___	___
e. Condensate drainage is unobstructed. (Visually verify pan drains completely by pouring a cup of water into drain pan.)	___	___	___
f. Fan belt adjusted.	___	___	___
g. Manufacturer's required maintenance clearance provided.	___	___	___
Electrical			
a. Power available to unit disconnect.	___	___	___
b. Power available to unit control panel.	___	___	___
c. Proper motor rotation verified.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
[e. Power available to electric heating coil.	___	___	___]
Coils			
[a. Chilled water piping properly connected.	___	___	___]
[a. Refrigerant piping properly connected.	___	___	___]
[b. Chilled water piping pressure tested.	___	___	___]
[b. Refrigerant piping pressure tested.	___	___	___]
[c. Hot water piping properly connected.	___	___	___]
[c. Steam and condensate piping properly connected.	___	___	___]
[d. Hot water piping pressure tested.	___	___	___]
[d. Steam and condensate piping pressure tested.	___	___	___]
e. Air vents installed on water coils [with			

shutoff valves] as specified.

___ ___ ___

f. Any damage to coil fins has been repaired

___ ___ ___

Controls

a. Control valves/actuators properly installed.

___ ___ ___

b. Control valves/actuators operable.

___ ___ ___

c. O.A. dampers/actuators properly installed.

___ ___ ___

d. O.A. dampers/actuators operable.

___ ___ ___

e. Zone dampers/actuators properly installed.

___ ___ ___

f. Zone dampers/actuators operable.

___ ___ ___

Testing, Adjusting, and Balancing (TAB)

a. Construction filters removed and replaced.

___ ___ ___

b. TAB report submitted.

___ ___ ___

c. TAB results within +10%/-0% of L/s
cfm shown on drawings

___ ___ ___

d. TAB results for outside air intake within
+10%/-0% of L/s CFM shown on drawings.

___ ___ ___

Pre-commissioning Checklist - Variable Volume Air Handling Unit

For Air Handling Unit: [_____]

Checklist Item	QA	QC	CA
Installation			
a. Vibration isolation devices installed.	___	___	___
b. Inspection and access doors are operable and sealed.	___	___	___
c. Casing undamaged.	___	___	___
d. Insulation undamaged.	___	___	___
e. Condensate drainage is unobstructed. (Visually verify drainage by pouring a cup of water into drain pan.)	___	___	___
f. Fan belt adjusted.	___	___	___
g. Manufacturer's required maintenance clearance provided.	___	___	___
Electrical			
a. Power available to unit disconnect.	___	___	___
b. Power available to unit control panel.	___	___	___
c. Proper motor rotation verified.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
[e. Power available to electric heating coil.	___	___	___]
Coils			
[a. Chilled water piping properly connected.	___	___	___]
[a. Refrigerant piping properly connected.	___	___	___]
[b. Chilled water piping pressure tested.	___	___	___]
[b. Refrigerant piping pressure tested.	___	___	___]
[c. Hot water piping properly connected.	___	___	___]
[c. Steam and condensate piping properly connected.	___	___	___]
[d. Hot water piping pressure tested.	___	___	___]
[d. Steam and condensate piping pressure tested.	___	___	___]
[e. Air vents installed on water coils [with shutoff valves] as specified.	___	___	___]
f. Any damage to coil fins has been repaired.	___	___	___]

Controls

- a. Control valves/actuators properly installed. _____
- b. Control valves/actuators operable. _____
- c. Dampers/actuators properly installed. _____
- d. Dampers/actuators operable. _____
- e. Verify proper location, installation and calibration of duct static pressure sensor. _____
- f. Fan air volume controller operable. _____
- g. Air handler controls system operational. _____

Testing, Adjusting, and Balancing (TAB)

- a. Construction filters removed and replaced. _____
- b. TAB report submitted. _____
- c. TAB results within +10%/-0% of L/s cfm shown on drawings _____
- d. TAB results for outside air intake within +10%/-0% of both the minimum and maximum L/s cfms shown on drawings. _____

Pre-commissioning Checklist - VAV Terminal

For VAV Terminal: [_____]]

Checklist Item	QA	QC	CA
Installation			
a. VAV terminal in place.	___	___	___
b. VAV terminal ducted.	___	___	___
c. VAV terminal connected to controls.	___	___	___
[d. Reheat coil connected to hot water pipe.	___	___	___]
[e. Electric reheat coil connected to local disconnect.	___	___	___]
f. Manufacturer's required maintenance clearance provided.	___	___	___
Controls			
a. Cooling only VAV terminal controls set.	___	___	___
b. Cooling only VAV controls verified.	___	___	___
c. Reheat VAV terminal controls set.	___	___	___
d. Reheat terminal/coil controls verified.	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. Verify terminal maximum air flow set.	___	___	___
b. Verify terminal minimum air flow set.	___	___	___
c. TAB operation complete.	___	___	___

Pre-commissioning Checklist - DX Air Cooled Condensing Unit

For Condensing Unit: [_____]

Checklist Item	QA	QC	CA
Installation	___	___	___
b. Refrigerant pipe leak tested.	___	___	___
c. Refrigerant pipe evacuated and charged in accordance with manufacturer's instructions.	___	___	___
d. Check condenser fans for proper rotation.	___	___	___
e. Any damage to coil fins has been repaired.	___	___	___
f. Manufacturer's required maintenance/operational clearance provided.	___	___	___
Electrical			
a. Power available to unit disconnect.	___	___	___
b. Power available to unit control panel.	___	___	___
c. Verify that power disconnect is located within sight of the unit it controls	___	___	___
Controls			
a. Unit safety/protection devices tested.	___	___	___
b. Control system and interlocks installed.	___	___	___
c. Control system and interlocks operational.	___	___	___

Pre-commissioning Checklist - Pumps

For Pump: [____]

Checklist Item	QA	QC	CA
Installation			
a. Pumps grouted in place.	___	___	___
b. Pump vibration isolation devices functional.	___	___	___
c. Pump/motor coupling alignment verified.	___	___	___
d. Piping system installed.	___	___	___
e. Piping system pressure tested.	___	___	___
f. Pump not leaking.	___	___	___
g. Field assembled couplings aligned to meet manufacturer's prescribed tolerances.	___	___	___
Electrical			
a. Power available to pump disconnect.	___	___	___
b. Pump rotation verified.	___	___	___
c. Control system interlocks functional.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. Pressure/temperature gauges installed.	___	___	___
b. Piping system cleaned.	___	___	___
c. Chemical water treatment complete.	___	___	___
d. Water balance complete.	___	___	___
e. Water balance with design maximum flow.	___	___	___
f. TAB Report submitted.	___	___	___

Pre-commissioning Checklist - Packaged Air Cooled Chiller

For Chiller: [_____]

Checklist Item	QA	QC	CA
Installation			
a. Chiller properly piped.	___	___	___
b. Chilled water pipe leak tested.	___	___	___
c. Verify that refrigerant used complies with specified requirements.	___	___	___
d. Any damage to coil fins has been repaired.	___	___	___
e. Manufacturer's required maintenance clearance provided.	___	___	___
Electrical			
a. Power available to unit disconnect.	___	___	___
b. Power available to unit control panel.	___	___	___
c. Separate power is supplied to electric heating tape.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
Controls			
a. Factory startup and checkout complete.	___	___	___
b. Chiller safety/protection devices tested.	___	___	___
c. Chilled water flow switch installed.	___	___	___
d. Chilled water flow switch tested.	___	___	___
e. Chilled water pump interlock installed.	___	___	___
f. Chilled water pump interlock tested.	___	___	___

Pre-commissioning Checklist - Centrifugal Chiller

For Chiller: [_____]

Checklist Item	QA	QC	CA
Installation			
a. Chilled water connections properly piped.	___	___	___
b. Condenser water connections properly piped.	___	___	___
c. Chilled water pipe leak tested.	___	___	___
d. Condenser water pipe leak tested.	___	___	___
e. High efficiency purge unit installed and operating as specified.	___	___	___
f. Refrigerant leak detector installed.	___	___	___
g. Oxygen sensor installed and tested.	___	___	___
h. Mechanical room ventilation installed as specified.	___	___	___
i. Manufacturer's required maintenance clearance provided.	___	___	___
j. Field assembled couplings aligned to meet manufacturer's prescribed tolerances.	___	___	___
Electrical			
a. Power available to unit starter.	___	___	___
b. Power available to unit control panel.	___	___	___
c. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
Controls			
a. Factory startup and checkout complete.	___	___	___
b. Chiller safety/protection devices tested.	___	___	___
c. Chilled water flow switch installed.	___	___	___
d. Chilled water flow switch tested.	___	___	___
e. Chilled water pump interlock installed.	___	___	___
f. Chilled water pump interlock tested.	___	___	___
g. Condenser water flow switch installed.	___	___	___
h. Condenser water flow switch tested.	___	___	___
i. Condenser water pump interlock installed.	___	___	___

j. Condenser water pump interlock tested.

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Pre-commissioning Checklist - Cooling Tower

For Cooling Tower: [____]

Checklist Item	QA	QC	CA
Installation			
a. Cooling tower in place.	___	___	___
b. Cooling tower piped.	___	___	___
c. Cooling tower fan drive adjusted.	___	___	___
d. Cooling tower makeup water supply piped.	___	___	___
e. Verify makeup control valve shutoff.	___	___	___
f. Fan lubricated and blade pitch adjusted.	___	___	___
g. Manufacturer's required maintenance/ operational clearance provided.	___	___	___
h. Cooling tower drain and overflow is piped.	___	___	___
Electrical			
a. Power available to tower disconnect.	___	___	___
b. Power available to electric sump heater.	___	___	___
c. Control system interlocks functional.	___	___	___
d. Motor and fan rotation checked.	___	___	___
e. Verify that power disconnect is located within sight of the unit is controls.	___	___	___
Piping			
a. Tower basin is clean and filled.	___	___	___
b. Condenser water treatment functional.	___	___	___
c. Water balance with design flow verified.	___	___	___
d. Water distribution headers balanced.	___	___	___

Pre-commissioning Checklist - Hot Water Boiler

For Boiler: [____]

Checklist Item	QA	QC	CA
Installation			
a. Boiler flue installed.	___	___	___
b. Boiler hot water piping installed.	___	___	___
c. Boiler hot water piping tested.	___	___	___
d. Boiler makeup water piping installed.	___	___	___
e. Boiler fuel oil piping installed.	___	___	___
f. Boiler fuel oil piping tested.	___	___	___
g. Boiler gas piping installed.	___	___	___
h. Boiler gas piping tested.	___	___	___
i. Manufacturer's required maintenance clearance provided.	___	___	___
Startup			
a. Boiler system cleaned and filled with treated water.	___	___	___
b. Boiler safety/protection devices, including high temperature burner shut-off, low water cutoff, flame failure, pre and post purge, have been tested.	___	___	___
c. Verify that PRV rating conforms to boiler rating.	___	___	___
d. Boiler water treatment system functional.	___	___	___
e. Boiler startup and checkout complete.	___	___	___
f. Combustion efficiency demonstrated.	___	___	___
Electrical			
a. Verify that power disconnect is located within sight of the unit served.	___	___	___
Controls			
a. Hot water pump interlock installed.	___	___	___
b. Hot water pump interlock tested.	___	___	___
c. Hot water heating system balanced.	___	___	___
d. Hot water heating controls operational.	___	___	___

Pre-commissioning Checklist - Steam Boiler

For Boiler: [____]

Checklist Item	QA	QC	CA
Installation			
a. Boiler flue installed.	___	___	___
b. Boiler steam piping installed.	___	___	___
c. Boiler steam piping tested.	___	___	___
d. Boiler makeup water piping installed.	___	___	___
e. Boiler makeup water piping tested.	___	___	___
f. Boiler fuel oil piping installed.	___	___	___
g. Boiler fuel oil piping tested.	___	___	___
h. Boiler gas piping installed.	___	___	___
i. Boiler gas piping tested.	___	___	___
j. Manufacturer's required maintenance clearance provided.	___	___	___
Startup			
a. Boiler system cleaned and filled with treated water.	___	___	___
b. Boiler safety/protection devices, including high temperature burner shut-off, low water cutoff, flame failure, pre and post purge, have been tested.	___	___	___
c. Verify that PRV rating conforms to boiler rating.	___	___	___
d. Boiler feed water system operational.	___	___	___
e. Boiler water treatment system functional.	___	___	___
f. Boiler startup and checkout complete.	___	___	___
g. All steam traps operational.	___	___	___
h. All condensate return pumps operational.	___	___	___
i. Combustion efficiency demonstrated.	___	___	___
Electrical			
a. Verify that power disconnect is located within sight of the unit served.	___	___	___

Pre-commissioning Checklist - Steam/Hot Water Converter

For Converter: [____]

Checklist Item	QA	QC	CA
Installation			
a. Converter steam piping installed.	___	___	___
b. Converter steam piping tested.	___	___	___
c. Hot water piping installed.	___	___	___
d. Hot water piping tested.	___	___	___
e. Makeup water piping installed.	___	___	___
f. Vacuum breaker installed on shell of shell and tube unit.	___	___	___
g. Air vent installed as specified.	___	___	___
h. Manufacturer's required maintenance clearance provided.	___	___	___
Startup			
a. Hot water system cleaned and filled.	___	___	___
b. All steam traps operational.	___	___	___
c. All condensate return pumps operational.	___	___	___
d. Converter safety/protection devices tested.	___	___	___
e. Converter startup and checkout complete.	___	___	___
Controls			
a. Control valves/actuators properly installed.	___	___	___
b. Control valves/actuators operable.	___	___	___

Pre-commissioning Checklist - Fan Coil Unit

For Fan Coil Unit: [_____]]

Checklist Item	QA	QC	CA
Installation			
a. Vibration isolation devices installed.	___	___	___
b. Access doors/removable panels are operable and sealed.	___	___	___
c. Casing undamaged.	___	___	___
d. Insulation undamaged.	___	___	___
e. Condensate drainage is unobstructed.	___	___	___
f. Fan belt adjusted.	___	___	___
g. Any damage to coil fins has been repaired.	___	___	___
h. Manufacturer's required maintenance clearance provided.	___	___	___
Electrical			
a. Power available to unit disconnect.	___	___	___
b. Power available to unit control panel.	___	___	___
c. Proper motor rotation verified.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
[e. Power available to electric heating coil.	___	___	___]
Coils			
[a. Dual temperature piping properly connected.	___	___	___]
[a. Chilled water piping properly connected.	___	___	___]
[b. Dual temperature piping pressure tested.	___	___	___]
[b. Chilled water piping pressure tested.	___	___	___]
[c. Hot water piping properly connected.	___	___	___]
[d. Hot water piping pressure tested.	___	___	___]
Controls			
a. Control valves/actuators properly installed.	___	___	___
b. Control valves/actuators operable.	___	___	___
c. Verify proper location and installation of thermostat.	___	___	___

Pre-commissioning Checklist - Unit Heater

For Electric Cabinet or Unit Heater: [_____]

Checklist Item	QA	QC	CA
Installation			
[a. Hot water piping properly connected.	___	___	___]
[a. Steam and condensate piping properly connected.	___	___	___]
[b. Hot water piping pressure tested.	___	___	___]
[b. Steam and condensate piping pressure tested.	___	___	___]
c. Air vent installed on hot water coil with shutoff valve as specified.	___	___	___
d. Any damage to coil fins has been repaired.	___	___	___
e. Manufacturer's required maintenance/ operational clearance provided.	___	___	___
Electrical			
a. Power available to unit disconnect.	___	___	___
b. Proper motor rotation verified.	___	___	___
c. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
d. Power available to electric heating coil.	___	___	___
Controls			
a. Control valves properly installed.	___	___	___
b. Control valves operable.	___	___	___
c. Verify proper location and installation of thermostat.	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. TAB Report submitted.	___	___	___

Pre-commissioning Checklist - Exhaust Fan

For Exhaust Fan: [_____]

Checklist Item	QA	QC	CA
Installation			
a. Fan belt adjusted.	___	___	___
Electrical			
a. Power available to fan disconnect.	___	___	___
b. Proper motor rotation verified.	___	___	___
c. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
Controls			
a. Control interlocks properly installed.	___	___	___
b. Control interlocks operable.	___	___	___
c. Dampers/actuators properly installed.	___	___	___
d. Dampers/actuators operable.	___	___	___
e. Verify proper location and installation of thermostat.	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. TAB results +10%/-0% to L/s (cfm) shown on drawings	___	___	___
b. TAB Report submitted.	___	___	___

Pre-commissioning Checklist - Computer Room Unit

For Computer Room Unit: [_____]]

Checklist Item	QA	QC	CA
Installation			
a. Unit properly supported.	___	___	___
b. Access doors are operable and sealed.	___	___	___
c. Casing undamaged.	___	___	___
d. Insulation undamaged.	___	___	___
e. Condensate drainage is unobstructed and routed to floor drain.	___	___	___
f. Fan belt adjusted.	___	___	___
g. Manufacturer's required maintenance operational clearance provided.	___	___	___
Electrical			
a. Power available to unit disconnect.	___	___	___
b. Proper motor rotation verified.	___	___	___
c. Proper motor rotation verified.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
[e. Power available to reheat coils.	___	___	___]
Coils/Humidifier			
[a. Chilled water piping properly connected.	___	___	___]
[a. Refrigerant piping properly connected.	___	___	___]
[b. Chilled water piping pressure tested.	___	___	___]
[b. Refrigerant piping pressure tested.	___	___	___]
[c. Hot water piping properly connected.	___	___	___]
[c. Steam piping properly connected.	___	___	___]
[d. Hot water piping pressure tested.	___	___	___]
[d. Steam piping pressure tested.	___	___	___]
e. Humidifier makeup water connected.	___	___	___
Controls			

a. Control valves operable. _____

b. Unit control system operable and verified. _____

c. Verify proper location and installation of thermostat. _____

Testing, Adjusting, and Balancing (TAB)

a. Construction filters removed and replaced. _____

b. TAB results +10%/-0% L/s (cfm) shown on drawings. _____

c. TAB Report submitted. _____

Pre-commissioning Checklist - HVAC System Controls
For HVAC SystemControl Including the Central Equipment

Checklist Item	QA	QC	CA
Installation			
a. As-built shop drawings submitted.	___	___	___
b. Layout of control panel matches drawings.	___	___	___
c. Framed instructions mounted in or near control panel.	___	___	___
d. Components properly labeled (on inside and outside of panel).	___	___	___
e. Control components piped and/or wired to each labeled terminal strip.	___	___	___
f. EMCS connection made to each labeled terminal strip as shown.	___	___	___
g. Control wiring and tubing labeled at all terminations, splices, and junctions.	___	___	___
h. Shielded wiring used on electronic sensors.	___	___	___
i. Air dryer installed as specified.	___	___	___
j. Water drain installed as specified.	___	___	___
Main Power and Control Air			
a. 110 volt AC power available to panel.	___	___	___
b. 138 kPa gauge (20 psig) 20 psig compressed air available to panel.	___	___	___
Testing, Commissioning, and Balancing			
a. Testing, Commissioning, and Balancing Report submitted.	___	___	___

Pre-commissioning Checklist - Single Zone or Outdoor Air Handling Unit

For Air Handling Unit: [____]

Checklist Item	QA	QC	CA
Installation			
a. Vibration isolation devices installed.	___	___	___
b. Inspection and access doors are operable and sealed.	___	___	___
c. Casing undamaged.	___	___	___
d. Insulation undamaged.	___	___	___
e. Condensate drainage is unobstructed and trap is installed in accordance with the details.	___	___	___
f. Fan belt adjusted.	___	___	___
g. Any damage to coil fins has been repaired.	___	___	___
h. Manufacturer's required maintenance clearance provided.	___	___	___
Electrical			
a. Power available to unit disconnect.	___	___	___
b. Power available to unit control panel.	___	___	___
c. Proper motor rotation verified.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
e. Power available to electric heating coil.	___	___	___
Coils			
[a. Chilled water piping properly connected.	___	___	___]
[a. Refrigerant piping properly connected.	___	___	___]
[b. Chilled water piping pressure tested.	___	___	___]
[b. Refrigerant piping pressure tested.	___	___	___]
[c. Hot water piping properly connected.	___	___	___]
[c. Steam and condensate piping properly connected.	___	___	___]
[d. Hot water piping pressure tested.	___	___	___]
[d. Steam and condensate piping pressure tested.	___	___	___]
[e. Air vents installed on water coils [with			

shutoff valves] as specified.

___ ___ ___]

f. Any damage to coil fins has been repaired.

___ ___ ___

Controls

a. Control valves/actuators properly installed.

___ ___ ___

b. Control valves/actuators operable.

___ ___ ___

c. Dampers/actuators properly installed.

___ ___ ___

d. Dampers/actuators operable.

___ ___ ___

e. Verify proper location and installation of thermostat.

___ ___ ___

Testing, Adjusting, and Balancing (TAB)

a. Construction filters removed and replaced.

___ ___ ___

b. TAB results +10%/-0% L/s (cfm) shown on drawings.

___ ___ ___

c. TAB Report submitted.

___ ___ ___

Pre-commissioning Checklist - Energy Recovery System

For Energy Recovery System: [____]

Checklist Item	QA	QC	CA
Installation			
a. Recovery system piping installed.	___	___	___
b. Recovery system piping tested.	___	___	___
c. Air vent installed as specified.	___	___	___
d. Manufacturer's required maintenance clearance provided.	___	___	___
Startup			
a. Recovery system piping cleaned and filled.	___	___	___
b. Converter startup and checkout complete.	___	___	___
Controls			
a. Control valves/actuators properly installed.	___	___	___
b. Control valves/actuators operable.	___	___	___

Pre-commissioning Checklist - Geothermal Well Field

Checklist Item	QA	QC	CA
Installation			
a. Vault inspection and access doors are operable.	___	___	___
c. All vault supply and return valves operate full open and full closed.	___	___	___
d. The vault contains no water and has no leaks.	___	___	___
e. TAB report submitted.	___	___	___
f. TAB results within +10%/-0% of the flow shown on drawings	___	___	___
g. Verify the flow.			

Pre-commissioning Checklist - Heat Exchanger

For Heat Exchanger: [____]

Checklist Item	QA	QC	CA
Installation			
a. Piping installed and connections are per manufacturers diagrams.	___	___	___
b. Piping tested.	___	___	___
c. Makeup water piping installed.	___	___	___
d. Air vent installed as specified.	___	___	___
e. Manufacturer's required maintenance clearance provided.	___	___	___
Startup			
a. System cleaned and filled.	___	___	___
b. Strainer is clean.	___	___	___

Pre-commissioning Checklist - Heat Pump Unit

For Heat Pump Unit: _____

Checklist Item	QA	QC	CA
Installation			
a. Unit properly supported.	___	___	___
b. Access doors are operable and sealed.	___	___	___
c. Casing undamaged.	___	___	___
d. Insulation undamaged.	___	___	___
e. Condensate drainage is unobstructed and trap is as detailed.	___	___	___
g. Manufacturer's required maintenance operational clearance provided.	___	___	___
h. Loop water piping connected as detailed.	___	___	___
Electrical			
a. Power available to unit disconnect.	___	___	___
b. Proper fan motor rotation verified.	___	___	___
c. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
Controls			
a. Control valve is operates properly.	___	___	___
b. Unit control system operable and verified.	___	___	___
c. Verify proper location and installation of thermostat.	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. Construction filters removed and replaced.	___	___	___
b. TAB results +10%/-0% L/s (cfm) shown on drawings.	___	___	___
c. TAB Report submitted.	___	___	___

Pre-commissioning Checklist - Domestic Hot Water Heater

For Water Heater: [_____]

Checklist Item	QA	QC	CA
Installation			
a. Water Heater flue installed.	___	___	___
b. Water Heater hot water piping installed.	___	___	___
c. Water Heater hot water piping tested.	___	___	___
d. Water Heater makeup water piping installed.	___	___	___
e. Water Heater fuel oil piping installed.	___	___	___
f. Water Heater fuel oil piping tested.	___	___	___
g. Water Heater gas piping installed.	___	___	___
h. Water Heater gas piping tested.	___	___	___
i. Water Heater insulation installed as required	___	___	___
j. Manufacturer's required maintenance clearance provided.	___	___	___
Startup			
a. Domestic water system cleaned, flushed, and filled with water.	___	___	___
b. Water Heater safety/protection devices, including high temperature burner shut-off, low water cutoff, flame failure, have been tested.	___	___	___
c. Water Heater startup and checkout complete.	___	___	___
f. Combustion efficiency demonstrated.	___	___	___
Electrical			
a. Verify that power disconnect is located within sight of the unit served.	___	___	___
Controls			
a. Domestic water heating controls operational.	___	___	___

Pre-commissioning Checklist - Steam/Domestic Hot Water Heat Exchanger

For Heat Exchanger: [_____]

Checklist Item	QA	QC	CA
Installation			
a. Heat Exchanger steam piping installed.	___	___	___
b. Heat Exchanger steam piping tested.	___	___	___
c. Domestic hot water piping installed.	___	___	___
d. Domestic hot water piping tested.	___	___	___
e. Makeup cold water piping installed.	___	___	___
f. Vacuum breaker installed on shell of shell and tube unit.	___	___	___
g. Air vent installed as specified.	___	___	___
h. Insulation installed as required.	___	___	___
h. Manufacturer's required maintenance clearance provided.	___	___	___
Startup			
a. Hot water system cleaned, flushed, and filled.	___	___	___
b. All steam traps operational.	___	___	___
c. All condensate return pumps operational.	___	___	___
d. Heat Exchanger safety/protection devices tested.	___	___	___
e. Heat Exchanger startup and checkout complete.	___	___	___
Controls			
a. Control valves/actuators properly installed.	___	___	___
b. Control valves/actuators operable.	___	___	___

Pre-commissioning Checklist - Lighting System

For Lighting System: [_____]

Checklist Item	QA	QC	CA
Installation			
a. Light fixtures installed and .	___	___	___
Electrical			
a. Power available to light fixtures.	___	___	___
b. Power available to light sensors.	___	___	___
c. Power available to occupancy sensors.	___	___	___
Controls			
a. Controls operable.	___	___	___
c. Verify proper location and installation of light sensors.	___	___	___
d. Verify proper location and installation of occupancy sensors.	___	___	___

APPENDIX B
FUNCTIONAL PERFORMANCE TESTS CHECKLISTS

Functional Performance Test Checklist - Pumps

For Pump: [_____]

Prior to performing this checklist, ensure that for closed loop systems, system is pressurized and the make-up water system is operational or, for open loop systems, that the sumps are filled to the proper level.

1. Activate pump start using control system commands (all possible combination, on/auto, etc.). ON _____ AUTO _____ OFF _____

a. Verify pressure drop across strainer:

Strainer inlet pressure _____ kPa (_____ psig)
Strainer outlet pressure _____ kPa (_____ psig)
Strainer inlet pressure _____ psig
Strainer outlet pressure _____ psig

b. Verify pump inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report, pump design conditions, and pump manufacturer's performance.

DESIGN TAB ACTUAL
Pump inlet pressure (kPa gauge) _____
Pump outlet pressure (kPa gauge) _____
DESIGN TAB ACTUAL
Pump inlet pressure (psig) _____
Pump outlet pressure (psig) _____

c. Operate pump at shutoff and at 100 percent of designed flow when all components are in full flow. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

SHUTOFF 100 percent
Pump inlet pressure (kPa gauge) _____
Pump outlet pressure _____
Pump flow rate (L/s) _____
SHUTOFF 100 percent
Pump inlet pressure (psig) _____
Pump outlet pressure _____
Pump flow rate (gpm) _____

d. Operate pump at shutoff and at minimum flow or when all components are in full by-pass. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

SHUTOFF 100 percent
Pump inlet pressure (kPa gauge) _____
Pump outlet pressure _____
Pump flow rate (L/s) _____
SHUTOFF 100 percent
Pump inlet pressure (psig) _____
Pump outlet pressure _____

Pump flow rate (gpm) _____

2. Verify motor amperage each phase and voltage phase to phase and phase to ground for both the full flow and the minimum flow conditions.

a. Full flow:

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	_____
Voltage	_____	_____	_____
Voltage to ground	_____	_____	_____

b. Minimum flow:

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	_____
Voltage	_____	_____	_____
Voltage to ground	_____	_____	_____

3. Unusual vibration, noise, etc.

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

- Contractor's Quality Control Representative _____
- Contractor's Mechanical Representative _____
- Contractor's Electrical Representative _____
- Contractor's Testing, Adjusting and Balancing Representative _____
- Contractor's Controls Representative _____
- Government Representative _____
- Using Agency's Representative _____
- Design Agency's Representative _____
- Commissioning Agent _____

Functional Performance Test Checklist - Centrifugal Chiller

For Chiller: [_____]

1. Functional Performance Test: Contractor shall demonstrate operation of chilled water system as per specifications including the following: Start building air handler to provide load for chiller. Activate controls system chiller start sequence as follows:

- a. Time of day startup program initiates chiller start: _____
- b. Start condenser water pump and establish condenser water flow. Verify chiller condenser water proof-of-flow switch operation. _____
- c. Start chilled water pump and establish chilled water flow. Verify chiller chilled water proof-of-flow switch operation. _____
- d. Verify control system energizes chiller start sequence. _____
- e. Verify chiller senses chilled water temperature above set point and control system activates chiller start. _____
- f. Verify functioning of "soft start" sequence. _____
- g. Shut off air handling equipment to remove load on chilled water system. Verify chiller shutdown sequence is initiated and accomplished after load is removed. _____
- h. Restart air handling equipment one minute after chiller shut down. Verify condenser water pump, cooling tower, and chiller restart sequence. _____

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

- Contractor's Quality Control Representative _____
- Contractor's Mechanical Representative _____
- Contractor's Electrical Representative _____
- Contractor's Testing, Adjusting and Balancing Representative _____
- Contractor's Controls Representative _____
- Government Representative _____
- Using Agency's Representative _____
- Design Agency's Representative _____
- Commissioning Agent _____

Functional Performance Test Checklist - Cooling Tower

For Cooling Tower: [_____]

1. Functional Performance Test: Contractor shall demonstrate operation of the cooling tower as per specification and the following:

a. Activate cooling tower fan start using control system command. This should first start [condenser][tower] water pump, establish flow, delay fan start, as specified, to equalize flow in distribution basin and sump. Verify fan start after timed delay.

b. After chiller startup, control system should modulate [bypass valve and two-speed fan motor][fan speed] to maintain [condenser][loop] water set point. Verify function of bypass valve under varying loads.

c. Verify cooling tower operates in accordance with the sequence of control.

d. Verify makeup water [float][fill] valve is functioning:

e. Verify bleed valve is functioning:

Activate chemical treatment feed valve, verify makeup of chemical treatment system, pump, and controls:

e. Entering water temperature [_____] degrees C
Leaving water temperature: [_____] degrees C
Air volume measured: [_____] L/s
Air volume calculated: [_____] L/s
Entering wet bulb temperature: [_____] degrees C
Measured water flow: [_____] L/s

e. Entering water temperature [_____] degrees F
Leaving water temperature: [_____] degrees F
Air volume measured: [_____] cfm
Air volume calculated: [_____] cfm
Entering wet bulb temperature: [_____] degrees F
Measured water flow: [_____] gpm

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative

Government Representative

Using Agency's Representative

Design Agency's Representative

Commissioning Agent

Functional Performance Test Checklist - VAV Terminals

The Contracting officer will select VAV terminals to be spot-checked during the functional performance test. The number of terminals shall not exceed [2] [10] [10 percent].

1. Functional Performance Test: Contractor shall demonstrate operation of selected VAV boxes as per specifications including the following:

a. Cooling only VAV boxes:

(1) Verify VAV box response to room temperature set point adjustment. Turn thermostat to 5 degrees F above ambient and measure maximum air flow. Turn thermostat to 5 degrees F below ambient and measure minimum air flow.

Maximum flow [_____] L/s
Minimum flow [_____] L/s

Maximum flow [_____] cfm
Minimum flow [_____] cfm

(2) Check damper maximum/minimum flow settings.

Maximum flow setting [_____] L/s
Minimum flow setting [_____] L/s

Maximum flow setting [_____] cfm
Minimum flow setting [_____] cfm

b. Cooling with reheat VAV boxes:

(1) Verify VAV box response to room temperature set point adjustment. Turn thermostat to 3 degrees C 5 degrees F above ambient and measure maximum air flow. Turn thermostat to 3 degrees C 5 degrees F below ambient and measure minimum air flow.

Maximum flow [_____] L/s
Minimum flow [_____] L/s

Maximum flow [_____] cfm
Minimum flow [_____] cfm

(2) Check damper maximum/minimum flow settings.

Maximum flow setting [_____] L/s
Minimum flow setting [_____] L/s

Maximum flow setting [_____] cfm
Minimum flow setting [_____] cfm

Reheat coil operation range (full open to full closed) _____

c. Fan powered VAV boxes:

(1) Verify VAV box response to sensor call for heating via set point adjustment. Changes to be cooling setpoint to heating set point and

return to cooling set point. _____ Verify cooling damper closes to minimum position, blower fan energizes according to sequence of operation, and upon further drop in space temperature, heating coil activation and deactivation. _____

(2) Check primary air damper maximum/minimum flow settings.

Maximum flow setting [_____] L/s
Minimum flow setting [_____] L/s

(3) Check blower fan flow. [_____] L/s

Maximum flow setting [_____] cfm
Minimum flow setting [_____] cfm

(3) Check blower fan flow. [_____] cfm

(4) Verify free operation of fan backdraft damper (insure no primary air is being discharged through the recirculated air register).

(5) Verify that no recirculated air is being induced when box is in full cooling. _____

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Government Representative _____

Using Agency's Representative _____

Design Agency's Representative _____

Commissioning Agent _____

Functional Performance Test Checklist - Variable Volume Air Handling Unit

For Air Handling Unit: [_____]

Ensure that a slight negative pressure exists on inboard side of the outside air dampers throughout the operation of the dampers. Modulate OA, RA, and EA dampers from fully open to fully closed positions.

1. Functional Performance Test: Contractor shall verify operation of air handling unit as per specification including the following:

a. The following shall be verified when the [supply fan operating] [supply and return fans operating] mode is initiated:

(1) All dampers in normal position [and fan inlet vanes modulate to maintain the required static pressure]. _____

(2) All valves in normal position. _____

(3) System safeties allow start if safety conditions are met. _____

(4) VAV fan controller shall "soft-start" fan. _____

(5) Modulate all VAV boxes to minimum air flow and verify that the static pressure does not exceed the design static pressure Class shown.

b. Occupied mode of operation - economizer de-energized.

(1) Outside air damper at minimum position. _____

(2) Return air damper open. _____

(3) Relief air damper [at minimum position] [closed]. _____

(4) Chilled water control valve modulating to maintain leaving air temperature set point. _____

(5) Fan VAV controller receiving signal from duct static pressure sensor and modulating fan to maintain supply duct static pressure set point.

c. Occupied mode of operation - economizer energized.

(1) Outside air damper modulated to maintain mixed air temperature set point. _____

(2) Relief air damper modulates with outside air damper according to sequence of operation. _____

(3) Chilled water control valve modulating to maintain leaving air temperature set point. _____

(4) Hot water control valve modulating to maintain leaving air temperature set point. _____

(5) Fan VAV controller receiving signal from duct static pressure sensor and modulating fan to maintain supply duct static pressure set point.

d. Unoccupied mode of operation

(1) All dampers in normal position. _____

(2) Verify low limit space temperature is maintained as specified in sequence of operation. _____

e. The following shall be verified when the [supply fan off] [supply and return fans off] mode is initiated:

(1) All dampers in normal position. _____

(2) All valves in normal position. _____

(3) Fan de-energizes. _____

f. Verify the chilled water coil control valve operation by setting all VAV's to maximum and minimum cooling.

	Max cooling	Min cooling
Supply air volume (_____ L/s)	_____	_____

Supply air temp. (_____ degrees C)	_____	_____
------------------------------------	-------	-------

	Max cooling	Min cooling
Supply air volume _____ cfm)	_____	_____

Supply air temp. (_____ degrees F)	_____	_____
------------------------------------	-------	-------

g. Verify safety shut down initiated by smoke detectors. _____

h. Verify safety shut down initiated by low temperature protection thermostat. _____

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Government Representative _____

Using Agency's Representative _____

Design Agency's Representative _____

Commissioning Agent

Functional Performance Test Checklist - Single Zone Air Handling Unit

For Air Handling Unit: [_____]

1. Functional Performance Test: Contractor shall verify operation of air handling unit as per specification including the following:

a. The following shall be verified when the [supply fan operating] [supply and return fans operating] mode is initiated:

(1) All dampers in normal position. _____

(2) All valves in normal position. _____

(3) System safeties allow start if safety conditions are met. _____

b. Occupied mode of operation - economizer de-energized.

(1) Outside air damper at minimum position. _____

(2) Return air damper open. _____

(3) Relief air damper [at minimum position] [closed]. _____

(4) Chilled water control valve modulating to maintain space cooling temperature set point. _____

(5) Hot water control valve modulating to maintain space heating temperature set point input from outside air temperature controller. _____

c. Occupied mode of operation - economizer energized.

(1) Outside air damper modulated to maintain mixed air temperature set point. _____

(2) Relief air damper modulates with outside air damper according to sequence of operation. _____

(3) Chilled water control valve modulating to maintain space cooling temperature set point. _____

d. Unoccupied mode of operation

(1) All dampers in normal position. _____

(2) Verify low limit space temperature is maintained as specified in sequence of operation. _____

e. The following shall be verified when the [supply fan off] [supply and return fans off] mode is initiated:

(1) All dampers in normal position. _____

(2) All valves in normal position. _____

(3) Fan de-energizes. _____

f. Verify cooling coil and heating coil operation by varying thermostat set point from cooling set point to heating set point and

returning to cooling set point. _____

g. Verify safety shut down initiated by smoke detectors. _____

h. Verify safety shut down initiated by low temperature protection thermostat. _____

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Government Representative _____

Using Agency's Representative _____

Design Agency's Representative _____

Commissioning Agent _____

Functional Performance Test Checklist - Single Zone Outdoor Air Handling Unit

For Air Handling Unit: [_____]_____

1. Functional Performance Test: Contractor shall verify operation of air handling unit as per specification including the following:

a. The following shall be verified when the supply fan is commanded off or manually set to OFF:

(1) Outdoor air damper is closed. _____

(2) Automatic Water Valve is closed. Verify no water flow. _____

b. The following shall be verified when the supply fan is commanded on or manually set to ON:

(1) Outside air damper at full open position. _____

(2) Automatic Water Valve is open. Verify full flow. _____

(3) Verify safety shut down initiated by smoke detectors. _____

c. Cooling mode of operation:

(1) Note the outdoor air temperature. _____

(2) Verify that the cooling coil leaving air temperature is as scheduled. _____

(3) Verify that the reheat coil leaving temperature is as scheduled. _____

d. Heating mode of operation:

(1) Verify that the cooling coil leaving air temperature is as scheduled. _____

(2) Verify that the heating section leaving air temperature is as scheduled. _____

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative

Government Representative

Using Agency's Representative

Commissioning Agent

Functional Performance Test Checklist - Multizone Air Handling Unit

For Air Handling Unit: [_____]

Ensure that a slight negative pressure exists on inboard side of the outside air dampers throughout the operation of the dampers. Modulate OA, RA, and EA dampers from fully open to fully closed positions.

1. Functional Performance Test: Contractor shall verify operation of air handling unit as per specification including the following:

a. The following shall be verified when the supply and return fans operating mode is initiated:

(1) All dampers in normal position. _____

(2) All valves in normal position. _____

(3) System safeties allow start if safety conditions are met. _____

b. Occupied mode of operation - economizer de-energized.

(1) Outside air damper at minimum position. _____

(2) Return air damper open. _____

(3) Relief air damper [at minimum position] [closed]. _____

(4) Chilled water control valve modulating to maintain cold deck supply air temperature set point. _____

(5) Hot water control valve modulating to maintain hot deck supply air temperature set point input from outside air temperature controller.

c. Occupied mode of operation - economizer energized.

(1) Outside air damper modulates to maintain mixed air temperature set point. _____

(2) Relief air damper modulates with outside air damper according to sequence of operation. _____

(3) Chilled water control valve modulating to maintain cold deck supply air temperature set point. _____

(4) Hot water control valve modulating to maintain hot deck supply air temperature set point input from outside air temperature controller.

d. Unoccupied mode of operation

(1) All dampers in normal position. _____

(2) Verify low limit space temperature is maintained as specified in sequence of operation. _____

e. The following shall be verified when the supply and return fans off mode is initiated:

- (1) All dampers in normal position. _____
- (2) All valves in normal position. _____
- (3) Fan de-energizes. _____

f. Verify zone damper operation by varying zone thermostat set points from cooling set point to heating set point and returning to cooling set point. _____

g. Verify safety shut down initiated by smoke detectors. _____

h. Verify safety shut down initiated by low temperature protection thermostat. _____

i. Index room thermostats to full cooling then to full heating. Measure and record cold deck, hot deck, and supply air temperatures and determine damper leakage for a minimum of 2 zones.

Cold deck temperature _____ degrees C (_____ degrees F)
 Hot deck temperature _____ degrees C (_____ degrees F)

Cold deck temperature _____ degrees F
 Hot deck temperature _____ degrees F

Zone _____
 Cooling temperature _____ degrees C (_____ degrees F)
 Heating temperature _____ degrees C (_____ degrees F)
 Damper leakage cooling _____ degrees C (_____ degrees F)
 Damper leakage heating _____ degrees C (_____ degrees F)

Zone _____
 Cooling temperature _____ degrees F
 Heating temperature _____ degrees F
 Damper leakage cooling _____ degrees F
 Damper leakage heating _____ degrees

Zone _____
 Cooling temperature _____ degrees C (_____ degrees F)
 Heating temperature _____ degrees C (_____ degrees F)
 Damper leakage cooling _____ degrees C (_____ degrees F)
 Damper leakage heating _____ degrees C (_____ degrees F)

Zone _____
 Cooling temperature _____ degrees F
 Heating temperature _____ degrees F
 Damper leakage cooling _____ degrees F
 Damper leakage heating _____ degrees F

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Government Representative _____

Using Agency's Representative _____

Design Agency's Representative _____

Commissioning Agent _____

Functional Performance Test Checklist - Packaged Air Cooled Chiller

For Chiller: [_____]

1. Functional Performance Test: Contractor shall demonstrate operation of chilled water system as per specifications including the following: Start building air handler to provide load for chiller. Activate controls system chiller start sequence as follows.

- a. Start chilled water pump and establish chilled water flow. Verify chiller-chilled water proof-of-flow switch operation. _____
- b. Verify control system energizes chiller start sequence. _____
- c. Verify chiller senses chilled water temperature above set point and control system activates chiller start. _____
- d. Verify functioning of "soft start" sequence. _____
- e. Shut off air handling equipment to remove load on chilled water system. Verify chiller shutdown sequence is initiated and accomplished after load is removed. _____
- f. Restart air handling equipment one minute after chiller shut down. Verify chiller restart sequence. _____

2. Verify chiller inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report, chiller design conditions, and chiller manufacturer's performance data.

		DESIGN	TAB	ACTUAL
Chiller inlet pressure	(kPa gauge)	_____	_____	_____
Chiller inlet pressure	(psig)	_____	_____	_____
Chiller outlet pressure	(kPa gauge)	_____	_____	_____
Chiller outlet pressure	(psig)	_____	_____	_____

3. Verify chiller amperage each phase and voltage phase-to-phase and phase-to-ground.

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	_____
Voltage	_____	_____	_____
Voltage to ground	_____	_____	_____

4. Record the following information:

Ambient dry bulb temperature _____ degrees C
 Ambient wet bulb temperature _____ degrees C
 Entering chilled water temperature _____ degrees C
 Leaving chilled water temperature _____ degrees C

Ambient dry bulb temperature _____ degrees F
 Ambient wet bulb temperature _____ degrees F
 Entering chilled water temperature _____ degrees F
 Leaving chilled water temperature _____ degrees F

5. Unusual vibration, noise, etc.

6. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Government Representative _____

Using Agency's Representative _____

Design Agency's Representative _____

Commissioning Agent _____

Functional Performance Test Checklist - Air Cooled Condensing Unit

For Condensing Unit: [_____]

1. Functional Performance Test: Contractor shall demonstrate operation of refrigeration system as per specifications including the following: Start building air handler to provide load for condensing unit. Activate controls system start sequence as follows.

a. Start air handling unit. Verify control system energizes condensing unit start sequence. _____

b. Shut off air handling equipment to verify condensing unit de-energizes. _____

c. Restart air handling equipment one minute after condensing unit shut down. Verify condensing unit restart sequence. _____

2. Verify condensing unit amperage each phase and voltage phase to phase and phase to ground.

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	_____
Voltage	_____	_____	_____
Voltage to ground	_____	_____	_____

3. Record the following information:

Ambient dry bulb temperature _____ degrees C
 Ambient wet bulb temperature _____ degrees C
 Suction pressure _____ kPa gauge
 Discharge pressure _____ kPa gauge

Ambient dry bulb temperature _____ degrees F
 Ambient wet bulb temperature _____ degrees F
 Suction pressure _____ psig
 Discharge pressure _____ psig

4. Unusual vibration, noise, etc.

5. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative Representative _____

Contractor's Testing, Adjusting and Balancing _____

Contractor's Controls Representative _____

Government Representative

Using Agency's Representative

Design Agency's Representative

Commissioning Agent

Functional Performance Test Checklist - Hot Water Boiler

For Boiler: [_____]

1. Functional Performance Test: Contractor shall demonstrate operation of hot water system as per specifications including the following: Start building heating equipment to provide load for boiler. Activate controls system boiler start sequence as follows.

a. Start hot water pump and establish hot water flow. Verify boiler hot water proof-of-flow switch operation. _____

b. Verify control system energizes boiler start sequence. _____

c. Verify boiler senses hot water temperature below set point and control system activates boiler start. _____

d. Shut off building heating equipment to remove load on hot water system. Verify boiler shutdown sequence is initiated and accomplished after load is removed. _____

2. Verify boiler inlet/outlet pressure reading, compare to Test and Balance (TAB) Report, boiler design conditions, and boiler manufacturer's performance data.

	DESIGN	TAB	ACTUAL
Boiler inlet pressure (kPa gauge)	_____	_____	_____
Boiler outlet pressure (kPa gauge)	_____	_____	_____
Boiler flow rate (L/s)	_____	_____	_____
Flue-gas temperature at boiler outlet	_____	_____	_____
Percent carbon dioxide in flue-gas	_____	_____	_____
Draft at boiler flue-gas exit	_____	_____	_____
Draft or pressure in furnace	_____	_____	_____
Stack emission pollutants concentration	_____	_____	_____
Fuel type	_____	_____	_____
Combustion efficiency	_____	_____	_____

	DESIGN	TAB	ACTUAL
Boiler inlet pressure (psig)	_____	_____	_____
Boiler outlet pressure (psig)	_____	_____	_____
Boiler flow rate (gpm)	_____	_____	_____
Flue-gas temperature at boiler outlet	_____	_____	_____
Percent carbon dioxide in flue-gas	_____	_____	_____
Draft at boiler flue-gas exit	_____	_____	_____
Draft or pressure in furnace	_____	_____	_____
Stack emission pollutants concentration	_____	_____	_____
Fuel type	_____	_____	_____
Combustion efficiency	_____	_____	_____

3. Record the following information:

Ambient temperature _____ degrees C
 Entering hot water temperature _____ degrees C
 Leaving hot water temperature _____ degrees C

 Ambient temperature _____ degrees F

Entering hot water temperature _____ degrees F
Leaving hot water temperature _____ degrees F

4. Verify temperatures in item 3 are in accordance with the reset schedule. _____

5. Verify proper operation of boiler safeties. _____

6. Unusual vibration, noise, etc. _____

7. Visually check refractory for cracks or spalling and refractory and tubes for flame impingement. _____

8. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Government Representative _____

Using Agency's Representative _____

Design Agency's Representative _____

Commissioning Agent _____

Functional Performance Test Checklist - Steam Boiler

For Boiler: [____]

1. Functional Performance Test: Contractor shall demonstrate operation of steam heating system as per specifications including the following: Start building heating equipment to provide load for boiler. Activate controls system boiler start sequence as follows.

a. Start steam heating system. Verify control system energizes boiler start sequence. _____

b. Verify boiler senses steam pressure below set point and control system activates boiler start. _____

c. Shut off building heating equipment to remove load on steam heating system. Verify boiler shutdown sequence is initiated and accomplished after load is removed. _____

d. Verify that water level and makeup water system are operational.

2. Verify boiler inlet/outlet pressure reading, compare to boiler design conditions and manufacturer's performance data.

	DESIGN	TAB	ACTUAL
Boiler inlet water temp (degrees F)	_____	_____	_____
Boiler outlet pressure (kPa gauge)	_____	_____	_____
Flue-gas temperature at boiler outlet (degrees C)	_____	_____	_____
Percent carbon dioxide in flue-gas	_____	_____	_____
Draft at boiler flue-gas exit	_____	_____	_____
Draft or pressure in furnace	_____	_____	_____
Stack emission pollutants concentration	_____	_____	_____
Fuel type	_____	_____	_____
Combustion efficiency	_____	_____	_____

	DESIGN	TAB	ACTUAL
Boiler inlet water temp (degrees F)	_____	_____	_____
Boiler outlet pressure (psig)	_____	_____	_____
Flue-gas temperature at boiler outlet (degrees F)	_____	_____	_____
Percent carbon dioxide in flue-gas	_____	_____	_____
Draft at boiler flue-gas exit	_____	_____	_____
Draft or pressure in furnace	_____	_____	_____
Stack emission pollutants concentration	_____	_____	_____
Fuel type	_____	_____	_____
Combustion efficiency	_____	_____	_____

3. Record the following information:

Ambient temperature _____ degrees C
 Ambient temperature _____ degrees F

4. Verify proper operation of boiler safeties. _____

5. Unusual vibration, noise, etc.

6. Visually check refractory for cracks or spalling and refractory and tubes for flame impingement. _____

7. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Government Representative _____

Using Agency's Representative _____

Design Agency's Representative _____

Commissioning Agent _____

Functional Performance Test Checklist - Fan Coil Units

The Contracting Officer will select fan coil units to be spot-checked during the functional performance test. The number of terminals shall not exceed [2] [10] [10 percent].

1. Functional Performance Test: Contractor shall demonstrate operation of selected fan coils as per specifications including the following:

a. Cooling only fan coils:

(1) Verify fan coil unit response to room temperature set point adjustment. Changes to be cooling set point to cooling set point minus 10 degrees and return to cooling set point. _____

(2) Check blower fan air flow. _____ L/s
Check blower fan air flow. _____ cfm

(3) Check cooling coil water flow. _____ L/s
Check cooling coil water flow. _____ gpm

(4) Verify proper operation of cooling water control valve. _____

b. Cooling/heating fan coils:

(1) Verify fan coil unit response to room temperature set point adjustment. Changes to be cooling set point to heating set point and return to cooling set point. _____

(2) Check blower fan air flow. _____ L/s
Check blower fan air flow. _____ cfm

(3) Check cooling coil water flow. _____ L/s
Check cooling coil water flow. _____ cfm

(4) Verify proper operation of cooling water control valve. _____

(5) Check cooling mode inlet air temperature. _____ degrees C
Check cooling mode inlet air temperature. _____ degrees F

(6) Check cooling mode outlet air temperature. _____ degrees C
Check cooling mode outlet air temperature. _____ degrees F

(7) Check heating coil water flow. _____ L/s
Check heating coil water flow. _____ gpm

(8) Verify proper operation of heating water control valve. _____

(9) Check heating mode inlet air temperature. _____ degrees C
Check heating mode inlet air temperature. _____ degrees F

(10) Check heating mode outlet air temperature. _____ degrees C
Check heating mode outlet air temperature. _____ degrees F

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Government Representative _____

Using Agency's Representative _____

Design Agency's Representative _____

Commissioning Agent _____

Functional Performance Test Checklist - Unit Heaters

The Contracting Officer will select unit heaters to be spot-checked during the functional performance test. The number of terminals shall not exceed [2] [10] [10 percent].

1. Functional Performance Test: Contractor shall demonstrate operation of selected unit heaters as per specifications including the following:

a. Verify unit heater response to room temperature set point adjustment. Changes to be heating set point to heating set point minus 10 degrees and return to heating set point. _____

b. Check blower fan speed. _____rpm

c. Check heating mode inlet air temperature. _____ degrees C Check heating mode inlet air temperature. _____ degrees F

d. Check heating mode outlet air temperature. _____ degrees C Check heating mode outlet air temperature. _____ degrees F

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Government Representative _____

Using Agency's Representative _____

Design Agency's Representative _____

Commissioning Agent _____

Functional Performance Test Checklist - Heat Exchanger

For Converter: HX-1

1. Functional Performance Test: Contractor shall demonstrate operation of heat exchanger as per specifications including the following:

a. Verify proper flow. _____

b. Verify that the building controls open the valve allowing flow to the heat exchanger according the the sequence of control. _____

c. Shut off building cooling equipment to remove load on system. Verify that the valve allowing flow to the heat exchanger closes. _____

2. Verify converter inlet/outlet pressure reading, compare to converter design conditions and manufacturer's performance data.

	DESIGN	ACTUAL
Hot Side inlet water temp (degrees F)	_____	_____
Hot Side outlet water temp (degrees F)	_____	_____
Cold Side inlet water temp (degrees F)	_____	_____
Cold Side outlet water temp (degrees F)	_____	_____
Hot side inlet pressure (psig)	_____	_____
Hot Side outlet pressure (psig)	_____	_____
Hot Side Water flow rate based on pressure drop.	_____	_____
Hot Side Water flow rate based on flow measuring device.	_____	_____
Cold side inlet pressure (psig)	_____	_____
Cold Side outlet pressure (psig)	_____	_____
Cold Side Water flow rate based on pressure drop.	_____	_____
Cold Side Water flow rate based on flow measuring device.	_____	_____

3. Check and report unusual vibration, noise, etc.

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Government Representative _____

Using Agency's Representative

Commissioning Agent

Functional Performance Test Checklist - Heat Pump Unit

For Heat Pump: _____

1. Functional Performance Test: Contractor shall verify operation of each heat pump as per specification including the following:

a. System safeties allow start if safety conditions are met. _____

b. Verify cooling and heating operation by varying thermostat set point from space set point to space set point plus 10 degrees, space set point minus 10 degrees, and returning to space set point. _____

c. Verify that airflow is within +10/-0 percent of design airflow.

d. Command all units off, then command all the units on. Verify that units start in a staggered manner and that all units do not start at once. _____

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Government Representative _____

Using Agency's Representative _____

Commissioning Agent _____

Functional Performance Test Checklist - Steam/Hot Water Converter

For Converter: [_____]

1. Functional Performance Test: Contractor shall demonstrate operation of heating system as per specifications including the following: Start building heating equipment to provide load for converter.

a. Verify control system energizes. _____

b. Verify converter senses hot water temperature below set point and control system modulates steam valve. _____

c. Shut off building heating equipment to remove load on heating system. Verify converter steam valve closes after load is removed. _____

2. Verify converter inlet/outlet pressure reading, compare to converter design conditions and manufacturer's performance data.

	DESIGN	ACTUAL
Converter inlet water temp (degrees C)	_____	_____
Converter outlet water temp (degrees F)	_____	_____
Converter inlet steam pressure (psig)	_____	_____
Determine water flow rate based on pressure drop through converter	_____	_____
Determine water flow rate with flow measuring device	_____	_____
Verify that temperature of water is in accordance with outdoor air reset schedule	_____	_____

	DESIGN	ACTUAL
Converter inlet water temp (degrees F)	_____	_____
Converter outlet water temp (degrees F)	_____	_____
Converter inlet steam pressure (psig)	_____	_____
Determine water flow rate based on pressure drop through converter	_____	_____
Determine water flow rate with flow measuring device	_____	_____
Verify that temperature of water is in accordance with outdoor air reset schedule	_____	_____

3. Verify proper operation of converter safeties. _____

4. Check and report unusual vibration, noise, etc. _____

5. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Government Representative _____

Using Agency's Representative _____

Design Agency's Representative _____

Commissioning Agent _____

Functional Performance Test Checklist - Computer Room Unit

For Computer Room Unit: [_____]

1. Functional Performance Test: Contractor shall verify operation of computer room unit as per specification including the following:

- a. System safeties allow start if safety conditions are met. _____
- b. Verify cooling and heating operation by varying thermostat set point from space set point to space set point plus 10 degrees, space set point minus 10 degrees, and returning to space set point. _____
- c. Verify humidifier operation by varying humidistat set point from space set point to space set point plus 20 percent RH, and returning to space set point. _____
- d. Verify that airflow is within +10/-0 percent of design airflow. _____
- e. Verify unit shut down during fire event initiated by smoke/heat sensors. _____

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Government Representative _____

Using Agency's Representative _____

Design Agency's Representative _____

Commissioning Agent _____

Functional Performance Test Checklist - Geothermal Well Field

1. Functional Performance Test: Contractor shall demonstrate operation of the system as per specifications including the following: Start equipment to provide energy source for the geothermal well field.

2. Verify the geothermal well field inlet/outlet readings, compare to design conditions and manufacturer's performance data.

	Design	Actual
Loop inlet temp (degrees F)	_____	_____
Loop outlet temp (degrees F)	_____	_____
Loop flow rate	_____	_____
Loop pressure drop	_____	_____
Energy transfered (BTU/hr)	_____	_____

3. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing , Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Government Representative _____

Using Agency's Representative _____

Commissioning Agent _____

Functional Performance Test Checklist - HVAC Controls

For HVAC System: [_____]

The Contracting Officer will select HVAC control systems to undergo functional performance testing. The number of systems shall not exceed [2] [10] [10 percent].

1. Functional Performance Test: Contractor shall verify operation of HVAC controls by performing the following tests:

a. Verify that controllers are maintaining the set points by manually measuring the controlled variables with a thermometer, sling psychrometer, inclined manometer, etc.

b. Verify sensor/controller combination by manually measuring the controlled medium. Take readings from control panel display and compare readings taken manually. Record all readings for all sensors on a separate form.

Sensor - _____
Manual measurement _____
Panel reading value _____

c. Verify system stability by changing the controller set point as follows:

- (1) Air temperature - 10 degrees F
- (2) Water temperature - 10 degrees F
- (3) Static or Differential pressure - 10 percent of set point
- (4) Relative humidity - percent (RH)
- (5) Flow - 10 percent

The control system shall be observed for 10 minutes after the change in set point. Instability or excessive hunting will be unacceptable.

- d. Verify interlock with other HVAC controls.
- e. Verify interlock with fire alarm control panel.
- f. Verify interlock with EMCS.
- g. Verify all points are available at the EMCS..

[h. Change controller set point 10 percent with EMCS and verify correct response.]

2. Verify that operation of control system conforms to that specified in the sequence of operation.

3. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Government Representative _____

Using Agency's Representative _____

Design Agency's Representative _____

Commissioning Agent _____

Functional Performance Test Checklist - Energy Recovery System

For Energy Recovery System: [_____]

1. Functional Performance Test: Contractor shall demonstrate operation of energy recovery system as per specifications including the following: Start equipment to provide energy source for recovery system.

a. Verify energy source is providing recoverable energy. _____

b. Verify recovery system senses available energy and activates. _____

c. Verify that recovery system deactivates when recoverable energy is no longer available. _____

2. Verify recovery system inlet/outlet readings, compare to design conditions and manufacturer's performance data.

	Design	Actual
Primary loop inlet temp (degrees C)	_____	_____
Primary loop outlet temp (degrees F)	_____	_____
Primary loop flow rate	_____	_____
Secondary loop inlet temp (degrees)	_____	_____
Secondary loop outlet temp (degrees C)	_____	_____
Energy recovered (kJ)	_____	_____

	Design	Actual
Primary loop inlet temp (degrees F)	_____	_____
Primary loop outlet temp (degrees F)	_____	_____
Primary loop flow rate	_____	_____
Secondary loop inlet temp (degrees F)	_____	_____
Secondary loop outlet temp (degrees F)	_____	_____
Energy recovered BTU's)	_____	_____

3. Check and report unusual vibration, noise, etc.

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing , Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Government Representative _____

Using Agency's Representative

Design Agency's Representative

Commissioning Agent

Functional Performance Test Checklist - Domestic Hot Water Heater

For Water Heater: [_____]

1. Functional Performance Test: Contractor shall demonstrate operation of domestic hot water system as per specifications including the following:

a. Run domestic hot water at all plumbing fixtures. Determine flow rate of hot water at fixtures. Verify hot water heater burners fire to maintain hot water temperature. _____

b. Shut off domestic hot water at plumbing fixtures. Verify hot water heater burners shut off when load is satisfied.

c. Put building into unoccupied mode and verify that domestic hot water recirculating pump shuts off and hot water heater controls are disabled. _____

d. Put building into occupied mode and verify that domestic hot water recirculating pump starts and hot water heater controls are enabled.

2. Record the following information:

Entering hot water temperature	_____	degrees C
Leaving hot water temperature	_____	degrees C
Domestic hot water flow rate	_____	L/s
Entering hot water temperature	_____	degrees F
Leaving hot water temperature	_____	degrees F
Domestic hot water flow rate	_____	gpm

3. Verify capacity of water heater from data in item 2.

4. Verify proper operation of water heater safeties.

5. Unusual vibration, noise, etc.

6. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative

Government Representative

Using Agency's Representative

Design Agency's Representative

Commissioning Agent

Functional Performance Test Checklist - Steam/Domestic Hot Water Heat Exchanger

For Heat Exchanger: [_____]

1. Functional Performance Test: Contractor shall demonstrate operation of the domestic hot water system as per specifications including the following:

a. Run domestic hot water at all plumbing fixtures. Determine flow rate of hot water at fixtures. _____

b. Verify heat exchanger senses hot water temperature below set point and control system modulates steam valve.

c. Shut off domestic hot water at plumbing fixtures. Verify heat exchanger steam valve closes after load is removed.

d. Put building into unoccupied mode and verify that domestic hot water recirculating pump shuts off and heat exchanger controls are disabled.

e. Put building into occupied mode and verify that domestic hot water recirculating pump starts and heat exchanger controls are enabled.

2. Verify heat exchanger inlet/outlet temperature readings and pressures and compare to heat exchanger design conditions and manufacturer's performance data.

	DESIGN	ACTUAL
Converter inlet water temp (degrees C)	_____	_____
Converter outlet water temp (degrees F)	_____	_____
Converter inlet steam pressure (psig)	_____	_____
Determine water flow rate based on pressure drop through heat exchanger	_____	_____
Determine water flow rate with flow measuring device or from plumbing fixture flow rate	_____	_____
	DESIGN	ACTUAL
Converter inlet water temp (degrees F)	_____	_____
Converter outlet water temp (degrees F)	_____	_____
Converter inlet steam pressure (psig)	_____	_____
Determine water flow rate based on pressure drop through converter	_____	_____
Determine water flow rate with flow measuring device or from plumbing fixture flow rate	_____	_____

3. Verify proper operation of heat exchanger safeties.

4. Check and report unusual vibration, noise, etc.

5. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Contractor's Quality Control Representative	_____
Contractor's Mechanical Representative	_____
Contractor's Electrical Representative	_____
Contractor's Testing, Adjusting and Balancing Representative	_____
Contractor's Controls Representative	_____
Government Representative	_____
Using Agency's Representative	_____
Design Agency's Representative	_____
Commissioning Agent	_____

Functional Performance Test Checklist - Electric Instantaneous Point-of-Use Water Heaters

1. Functional Performance Test: Contractor shall demonstrate operation of electric instantaneous point-of-use water heaters as per specifications including the following:

a. Run domestic hot water at all connected plumbing fixtures. Determine flow rate of hot water at fixtures. _____

b. Check water heater inlet water temperature. _____ degrees C
_____ degrees F

c. Check water heater outlet water temperature. _____ degrees C
_____ degrees F

2. Verify capacity of water heater from data in item 1.

3. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Government Representative _____

Using Agency's Representative _____

Design Agency's Representative _____

Commissioning Agent _____

Functional Performance Test Checklist - Lighting System

1. Functional Performance Test: Contractor shall demonstrate operation of lighting system for 10% of sensors, devices, or spaces as applicable including the following:

a. Occupancy Sensors - Enter room to turn on lights and leave room. Record time to lights off. _____

b. Occupancy Sensors - Verify manual switch operation. _____

c. Night Shutoff - Verify lighting system shuts off at specified time. _____

d. Night Shutoff - Verify occupancy sensors override night shutoff. _____

e. Automatic Lighting Dimmers - Verify light dimmers increase light output from fixtures by blocking daylight from windows. _____

f. Automatic Lighting Dimmers - Verify light dimmers decrease light output from fixtures by allowing daylight into space. _____

2. Record illumination level in footcandles at 30 inches above the floor at 10 ft intervals for all spaces with automatic lighting dimmers. _____

3. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Government Representative _____

Using Agency's Representative _____

Design Agency's Representative _____

Commissioning Agent _____

APPENDIX C
BASIS OF DESIGN

BASIS OF DESIGN DOCUMENT FOR LEED FUNDAMENTAL COMMISSIONING

Project: Project, Location, PN #####

Approved:

Name Design Agent's Representative Date

Instructions: Each bullet point describes information that should be inputted. Replace the explanation of the bullet point with the appropriate information. Add fields or additional spaces as necessary to provide all pertinent information to the commissioning of the building energy-related systems. Matrices may be provided to describe Primary Design Assumptions for redundant space types rather than listing per the outline.

BASIS OF DESIGN DOCUMENT FOR LEED FUNDAMENTAL COMMISSIONING

Contents

1. Primary Design Assumptions
 - a. Climatic Design Conditions
 - b. Space Type 1
 - i. Space Use
 - ii. Redundancy
 - iii. Diversity
 - iv. Space Zoning
 - v. Occupancy
 - vi. Operations
 - vii. Space Environmental Requirements
 - c. Space Type 2
 - i. Space Use
 - ii. Redundancy
 - iii. Diversity
 - iv. Space Zoning
 - v. Occupancy
 - vi. Operations
 - vii. Space Environmental Requirements
 - d. Space Type 3
 - i. Space Use
 - ii. Redundancy
 - iii. Diversity
 - iv. Space Zoning
 - v. Occupancy
 - vi. Operations
 - vii. Space Environmental Requirements
2. Applicable Standards
3. System Narratives
 - a. HVAC&R Systems
 - i. System 1
 - ii. System 2
 - iii. System 3
 - b. Lighting Systems
 - i. System 1
 - ii. System 2
 - iii. System 3
 - c. Domestic Hot Water Systems
 - i. System 1
 - ii. System 2
 - iii. System 3
 - d. On-site Power Systems
 - i. System 1
 - ii. System 2
 - iii. System 3
 - e. Other Systems
 - i. System 1
 - ii. System 2
 - iii. System 3

1. Primary Design Assumptions

a. Climatic Design Conditions

Identify Source of Design Condition Data. (Example: Design Criteria Data is obtained from the Air Force Combat Climatology Center in accordance with UFC 3-400-02, Design: Engineering Weather Data.)

Location Information. (Example: Ft. Drum, NY; Latitude 44.05 N, Longitude 75.73 W, Elevation 679 ft)

Summer Hot Design Condition

(Example: 1.0% Dry Bulb Temperature Occurrence
84 deg F / 70 deg F mean coincident wet bulb temperature)

Winter Design Condition

(Example: 99.6% Dry Bulb Temperature Occurrence
-11 deg F/ -11 deg F mean coincident wet bulb temperature)

Summer Humid Design Condition

(Example: 1.0% Wet Bulb Temperature Occurrence
73 deg F/ 79 deg F mean coincident dry bulb temperature)

Cooling and Heating Degree Days and Base Temperature

(Example: Cooling Degree Days 584
Heating Degree Days 6901 Base 65 deg F)

b. Space Type 1

Space Use: Explain how the space(s) will be used (Example: Classroom occasionally used as conference room).

Redundancy: Identify whether and why the systems serving the space(s) require redundancy. (Example: Systems serving spaces will use hydronic heating system with two boilers minimum.)

Diversity: Identify whether and why diversity may be applied to the determination of block cooling/heating loads, ventilation rates, lighting, electrical circuit capacity, etc. (Example: Applied population diversity to ventilation system in accordance with ASHRAE 62.1-2004. Applied diversity to VAV system by setting airflow at value needed to satisfy total block load.)

Space Zoning: Describe how spaces will be zoned. (Example: No more than 3 private offices will be grouped together on one VAV box and thermostat. Commander offices will have its own VAV box and thermostat.) (Example: External open office spaces [within 15 ft of wall] will be separately zoned from interior open office spaces.) (Example: Each office is its own zone.)

Occupancy: Describe the occupancy including number of people at various times (i.e. drill weekend-maximum capacity, weekdays-20%; or 0700-0900 - none, 0900-1400 - 30 people, 1400-1600 - none; 1 person per 100 sqft.).

Operations: Describe how space(s) are operated. (Example: Building is operated 24 hrs 7 days a week; Building systems are controlled from DDC

system to switch modes based on occupancy schedule or sensor input.)
(Example: The classroom is used occasionally as a conference room.)

Space Environmental Requirements: Describe the environmental requirements of the space(s). Include description of temperatures, humidity levels, ventilation rates, air quality, lighting levels, or any other specific parameters (i.e. 75 deg F, 50% rh, 30 fc, etc.).

c. Space Type 2

2. Applicable Standards

List standards, codes, design guides, and other references used for the design and installation of the building energy systems.

(Example:

ASHRAE Standard 90.1-2004 Energy Standard for Buildings Except Low-Rise Residential

ASHRAE Standard 62.1-2004 Ventilation for Acceptable Indoor Air Quality

ASHRAE Standard 52.2-1999 Method of Testing General Ventilation

Air-Cleaning Devices for Removal Efficiency by Particle Size

LEED-NC Green Building Rating System for New Construction & Major Renovations v2.2

LEED for New Construction & Major Renovation v 2.2 Reference Guide

International Mechanical Code

International Plumbing Code

NFPA 54 National Fuel Gas Code

NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems

NFPA 90B Standard for the Installation of Warm Air Heating and Air-Conditioning Systems

UFC 4-171-05 Design: Guide for Army Reserve Facilities

UFC 3-400-01 Energy Conservation

UFC 3-400-02 Design: Engineering Weather Data

UFC 3-410-01 Heating, Ventilating, and Air Conditioning)

3. System Narratives

a. HVAC&R Systems

- i. System 1 (Examples: Office Area VAV Air Distribution System, Hydronic Heating System, Geothermal Systems, Control Systems, Unit Heating)

Insert narrative of system.

- ii. System 2

Insert narrative of system.

b. Lighting Systems

- i. System 1 (Examples: High-efficiency fluorescent lamps with high-efficiency ballasts. A daylight harvesting system with automatic dimming of the fluorescent fixtures based on the amount of natural sunlight in the area will be specified in the open office areas.)

Insert narrative of system.

- ii. System 2

Insert narrative of system.

c. Domestic Hot Water Systems

- i. System 1 (Examples: Gas-fire Water Heater with External Storage Tank, Recirculation Loop, Instantaneous Electric Water Heaters)

Insert narrative of system.

- ii. System 2

Insert narrative of system.

d. On-site Power Systems

- i. System 1 (Examples: Hydro-power Units, etc.)

Insert narrative of system.

- ii. System 2

Insert narrative of system.

e. Other Systems

- i. System 1

Insert narrative of system.

- ii. System 2

Insert narrative of system.

APPENDIX D

OWNER'S PROJECT REQUIREMENTS

OWNER'S PROJECT REQUIREMENTS DOCUMENT FOR LEED FUNDAMENTAL COMMISSIONING

Project: Project, Location, PN #####

Approved:

Name Design Agent's Representative Date

Name Owner's Representative Date

Instructions: Each bullet point describes information that should be inputted. Replace the explanation of the bullet point with the appropriate information. Add fields or additional spaces as necessary to provide all pertinent information to the commissioning of the building energy-related systems. Matrices may be provided to describe Indoor Environmental Quality Requirements rather than listing per the outline.

OWNER'S PROJECT REQUIREMENTS DOCUMENT FOR LEED FUNDAMENTAL COMMISSIONING

Contents

1. Owner and User Requirements
 - a. Primary Purpose, Program, and Use
 - b. Project History
 - c. Broad Goals
 - i. Future Expansion
 - ii. Flexibility
 - iii. Quality of Materials
 - iv. Construction Costs
 - v. Operational Costs
2. Environmental and Sustainability Goals
 - a. LEED Goal
 - b. Other
3. Energy Efficiency Goals
 - a. Compliance with Energy Policy Act of 2005
 - b. Envelope or Site Feature Energy Impact
4. Indoor Environmental Quality Requirements
 - a. Space Type 1
 - i. Intended Use
 - ii. Occupancy Schedule
 - iii. Environmental Requirements
 - iv. Occupant System Control Ability
 - v. Type of Lighting
 - vi. After-hour Use Accommodation
 - b. Space Type 2
 - i. Intended Use
 - ii. Occupancy Schedule
 - iii. Environmental Requirements
 - iv. Occupant System Control Ability
 - v. Type of Lighting
 - vi. After-hour Use Accommodation
5. Equipment and System Expectations
 - a. HVAC Systems
 - i. Quality and Reliability
 - ii. Type
 - iii. Automation
 - iv. Flexibility
 - v. Maintenance Requirements
 - b. Lighting Systems
 - i. Quality and Reliability
 - ii. Type
 - iii. Automation
 - iv. Flexibility
 - v. Maintenance Requirements
 - c. Domestic Hot Water Systems
 - i. Quality and Reliability
 - ii. Type
 - iii. Automation
 - iv. Flexibility
 - v. Maintenance Requirements

Contents (continued)

- d. On-site Power Systems
 - i. Quality and Reliability
 - ii. Type
 - iii. Automation
 - iv. Flexibility
 - v. Maintenance Requirements
- e. Other Systems
 - i. Quality and Reliability
 - ii. Type
 - iii. Automation
 - iv. Flexibility
 - v. Maintenance Requirements
- 6. Building Occupant and O&M Personnel Requirements
 - a. Facility Operation
 - b. UMCS (EMCS or FMCS)
 - c. Occupant Training and Orientation
 - d. O&M Staff Training and Orientation

1. Owner and User Requirements

a. Primary Purpose, Program, and Use

Explain the purpose, program, and use of the facility. (i.e. Army Reserve Center used for training reserve units. Training includes weapons, medical, vehicle repair, cooking, etc.)

b. Project History

Explain the history of the project related to design/construction (i.e. D/B/B, D/B, IDIQ, JOC, COE in-house, A/E, etc.). Explain any additional project background that would impact energy/sustainability goals.

c. Broad Goals

- i. Future Expansion: Explain goals related to potential future expansion.
- ii. Flexibility: Explain goals related to flexibility for layout and use of the building. (i.e. high rate of office churn, expected frequency of renovation, etc.)
- iii. Quality of Materials: Explain goals related to quality of materials. (i.e. highest quality materials, 50 yr life, 25 yr life, highest quality within budget, etc.)
- iv. Construction Costs: Explain goals related to construction costs. (i.e. how low can you go, set project amount, select simplest systems for low cost, etc.)
- v. Operational Costs: Explain goals related to operational costs. (i.e. low utilities based on water and energy conservation, trade-off allowable on maintenance costs to reduce utility cost, utility cost unimportant compared to construction cost, etc.)

2. Environmental and Sustainability Goals

a. LEED Goal

Set LEED goal and explain sustainable features permissible or preferred to be incorporated. Explain relative importance of LEED goal within project scope.

Set LEED goal. Indicate requirement by Army Sustained Design and Development Policy.

b. Other

Explain any special sustainability or environmental goals associated with the project. Identify specific sustainability features that may be required or desired. (i.e. hydro-power, solar power, on-site water treatment, on-site water infiltration, impervious cover reduction, parking capacity, etc.)

3. Energy Efficiency Goals

a. Compliance with the Energy Policy Act of 2005

It is mandatory that all federal buildings designed after January 2007 meet the requirements of the Energy Policy Act of 2005. This act requires that the building energy consumption level be reduced by 30% compared to the baseline building performance per ASHRAE Standard 90.1-2004, Appendix G if Life Cycle Cost Effective. If 30% reduction is not life-cycle cost effective, the most energy efficient design that is life cycle cost effective must be evaluated. Federal agencies are required to specify FEMP-designated or ENERGY STAR equipment, including building mechanical and lighting equipment and builder-supplied appliances.

b. Envelope or Site Feature Energy Impact

Identify and explain envelope or site features that will be incorporated to maximize energy efficiency. Identify features that must be incorporated that will reduce or limit energy efficiency.

4. Indoor Environmental Quality Requirements

a. Space Type 1

- i. Intended Use: Explain how the space will be used (i.e. classroom occasionally used as conference room).
- ii. Occupancy Schedule: Describe the occupancy including number of people at various times (i.e. drill weekend-maximum capacity, weekdays-20%; or 0700-0900 - none, 0900-1400 - 30 people, 1400-1600 - none).
- iii. Environmental Requirements: Describe the environmental requirements of the space. Include description of temperatures, humidity levels, ventilation rates, air quality, lighting levels, or any other specific parameters desired (i.e. 75 deg F, 50% rh, 30 fc, etc.).
- iv. Occupant System Control Ability: Describe the desired level of control the occupants will have over the thermal comfort and lighting systems. (i.e. adjustable thermostat for every person, adjustable thermostat in all private offices, no adjustable thermostats, adjustable thermostat in senior rank also controlling other offices, occupancy sensors for lighting, adjustable dimming, etc.)
- v. Type of Lighting: Describe the type of lighting desired (i.e. task lighting with minimal overhead, maximize daylight with dimming on overhead, accent lighting, particular fixtures, etc.).
- vi. After-hour Use Accommodations: Describe whether and how often the space may be used after hours. Describe the systems that activate when an occupant uses the building after-hours. Describe the level of control of after-hour use HVAC. (Example: Space is rarely used after-hours by few occupants. HVAC and lighting system should activate. The HVAC operation will be limited to that required to provide heating, A/C, and ventilation to the occupied space alone.) (Example: Space is rarely used after-hours by few occupants. Lighting and heating systems should activate. Ventilation and cooling should remain in normal after-hour operation.)

b. Space Type 2

5. Equipment and System Expectations

a. HVAC Systems

- i. **Quality and Reliability:** Explain the level of quality and reliability required of the HVAC systems. (Example: Equipment efficiency should meet ASHRAE and EPACT requirements. Due to critical nature of facility, additional redundancy in the cooling and heating systems is required, i.e. multiple chillers, boilers, and pumps.) (Example: No specific quality or reliability requirements specified. Equipment should remain serviceable over life of building or to the extent typical of the type of equipment.)
- ii. **Type:** Explain the type of equipment desired. (Example: Boilers and water heaters should be XXXX manufacturer. Boilers should be condensing type. Use hydronic heating and cooling. Use self-contained A/C units in computer rooms.)
- iii. **Automation:** Explain the level of automation in the HVAC System desired. (Example: Single loop HVAC systems permissible. Use packaged controls only.) (Example: Control HVAC systems from DDC system connected to the base UMCS.) (Example: Boilers should have packaged controls connected to the DDC system.)
- iv. **Flexibility:** Describe the desired level of flexibility of the HVAC system. (Example: System should accommodate frequent office layout changes including private office wall movement.) (Example: Layout will remain mostly unchanged; no flexibility required.) (Example: Accommodate potential for conference and classrooms to change to offices.)
- v. **Maintenance Requirements:** Describe the level of maintenance available or the requirements of the equipment regarding maintainability. (Example: Equipment should be located to allow easy maintenance access. Equipment vendors or repair service should be able to respond within 24 hrs.)

b. Lighting Systems

- i. **Quality and Reliability:** Explain the level of quality and reliability required of the lighting system controls. (Example: The building lighting system should meet ASHRAE/IESNA Standard 90.1 requirements.)
- ii. **Type:** Explain the type of lighting or control equipment desired. (Example: High-efficiency fluorescent lamps with high-efficiency ballasts will be specified. Indirect lighting will be used in all office and classroom spaces. Foot-candle levels may be reduced to 45 in lieu of the typical 50 foot-candles when indirect lighting is used.)
- iii. **Automation:** Explain the level of automation in the lighting control system desired. (Example: Provide occupancy sensors in restrooms, corridors, and storage areas.)
- iv. **Flexibility:** Describe the desired level of flexibility of the lighting system and control systems. (Example: Provide dual level switching in classrooms and conference rooms.)
- v. **Maintenance Requirements:** Describe the level of maintenance available or the requirements of the equipment regarding maintainability. (Example:)

c. Domestic Hot Water Systems

- i. **Quality and Reliability:** Explain the level of quality and reliability required of the domestic hot water systems. (Example:

- Equipment efficiency should meet ASHRAE and EPACT requirements. Due to critical nature of facility, additional redundancy in the water heating systems is required, i.e. multiple hot water heaters and circulation pumps.) (Example: No specific quality or reliability requirements specified. Equipment should remain serviceable over life of building or to the extent typical of the type of equipment.)
- ii. Type: Explain the type of equipment desired. (Example: Gas-fired storage tank water heater with mixing valve for temperature control.) (Example: Instantaneous electric water heater at lavatories.) (Example: Instantaneous electric water heater with integral control system for eyewash/showers.)
 - iii. Automation: Explain the level of automation in the domestic hot water control system desired. (Example: Occupancy schedule control for recirculation loop and gas burner. Connect package controls to DDC system.)
 - iv. Flexibility: Describe the desired level of flexibility of the domestic hot water systems. (Example: No anticipated changes to restroom layout; no additional flexibility required.)
 - v. Maintenance Requirements: Describe the level of maintenance available or the requirements of the equipment regarding maintainability. (Example: Equipment should be located to allow easy maintenance access. Equipment vendors or repair service should be able to respond within 24 hrs.)
- d. On-site Power Systems
- i. Quality and Reliability: Explain the level of quality and reliability required of the on-site power system.
 - ii. Type: Explain the type of on-site power system desired.
 - iii. Automation: Explain the level of automation in the on-site power system desired.
 - iv. Flexibility: Describe the desired level of flexibility of the on-site power system.
 - v. Maintenance Requirements: Describe the level of maintenance available or the requirements of the on-site power system regarding maintainability.
- e. Other Systems
- i. Quality and Reliability: Explain the level of quality and reliability required of the system.
 - ii. Type: Explain the type of system desired.
 - iii. Automation: Explain the level of automation in the system desired.
 - iv. Flexibility: Describe the desired level of flexibility of the system.
 - v. Maintenance Requirements: Describe the level of maintenance available or the requirements of the system regarding maintainability.

6. Building Occupant and O&M Personnel Requirements

a. Facility Operation

Describe how the facility will be operated. Who operates the facility? Who maintains the facility? Who pays the utility bills?

b. UMCS (EMCS or FMCS)

Will the building be tied to an EMCS? What system will be connected to? Provide information regarding connection requirements, protocols, and control, scheduling and monitoring points.

c. Occupant Training and Orientation

How much training and orientation is desired for building occupants? Will training need to be provided for all systems? To what extent do the occupants need to understand and use the systems?

d. O&M Staff Training and Orientation

How much training and orientation is desired for building occupants? Will training need to be provided for all systems? To what extent do the occupants need to understand and use the systems?

-- End of Section --

SECTION 01 50 00

TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS
08/09

PART 1 GENERAL

1.1 SUMMARY

Requirements of this Section apply to, and are a component of, each section of the specifications.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH
(FCCCHR)

FCCCHR List (continuously updated) List of Approved
Backflow Prevention Assemblies

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 241 (2009) Standard for Safeguarding
Construction, Alteration, and Demolition
Operations

NFPA 70 (2011) National Electrical Code

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1 (2007; Rev K) Obstruction Marking and
Lighting

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

MUTCD (2009) Manual of Uniform Traffic Control
Devices

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submitted the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Construction site plan; G
Traffic control plan; G

SD-06 Test Reports

Backflow Preventer Tests; G

SD-07 Certificates

Backflow Tester Certification; G

Backflow Preventers Certificate of Full Approval

1.4 CONSTRUCTION SITE PLAN

Prior to the start of work, submit a site plan showing the locations and dimensions of temporary facilities (including layouts and details, equipment and material storage area (onsite and offsite), and access and haul routes, avenues of ingress/egress to the fenced area and details of the fence installation. Identify any areas which may have to be graveled to prevent the tracking of mud. Indicate if the use of a supplemental or other staging area is desired. Show locations of safety and construction fences, site trailers, construction entrances, trash dumpsters, temporary sanitary facilities, and worker parking areas.

1.5 BACKFLOW PREVENTERS CERTIFICATE

Certificate of Full Approval from FCCCHR List, University of Southern California, attesting that the design, size and make of each backflow preventer has satisfactorily passed the complete sequence of performance testing and evaluation for the respective level of approval. Certificate of Provisional Approval will not be acceptable.

1.5.1 Backflow Tester Certificate

Prior to testing, submit to the Contracting Officer certification issued by the State or local regulatory agency attesting that the backflow tester has successfully completed a certification course sponsored by the regulatory agency. Tester must not be affiliated with any company participating in any other phase of this Contract.

1.5.2 Backflow Prevention Training Certificate

Submit a certificate recognized by the State or local authority that states the Contractor has completed at least 10 hours of training in backflow preventer installations. The certificate must be current.

PART 2 PRODUCTS

2.1 TEMPORARY SIGNAGE

2.1.1 Bulletin Board

Immediately upon beginning of work, provide a weatherproof glass-covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract, Wage Rate Information poster, and other information approved by the Contracting Officer. Locate the bulletin board at the project site in a conspicuous place easily accessible to all employees, as approved by the Contracting Officer.

2.1.2 Project and Safety Signs

The requirements for the signs, their content, and location are as specified elsewhere. Erect signs within 15 days after receipt of the notice to proceed. Correct the data required by the safety sign daily, with light colored metallic or non-metallic numerals.

2.2 TEMPORARY TRAFFIC CONTROL

2.2.1 Haul Roads

At contractors expense construct access and haul roads necessary for proper prosecution of the work under this contract. Construct with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic are to be avoided. Provide necessary lighting, signs, barricades, and distinctive markings for the safe movement of traffic. The method of dust control, although optional, must be adequate to ensure safe operation at all times. Location, grade, width, and alignment of construction and hauling roads are subject to approval by the Contracting Officer. Lighting must be adequate to assure full and clear visibility for full width of haul road and work areas during any night work operations.

2.2.2 Barricades

Erect and maintain temporary barricades to limit public access to hazardous areas. Whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic barricades will be required. Securely place barricades clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

2.2.3 Fencing

- a. Provide fencing along the construction site at all open excavations and tunnels to control access by unauthorized people. Fencing must be installed to be able to restrain a force of at least 250 pounds against it.

2.2.4 Temporary Wiring

Provide temporary wiring in accordance with NFPA 241 and NFPA 70, Article 305-6(b), Assured Equipment Grounding Conductor Program. Include frequent inspection of all equipment and apparatus.

PART 3 EXECUTION

3.1 EMPLOYEE PARKING

Contractor employees will park privately owned vehicles in an area designated by the Contracting Officer. This area will be within reasonable walking distance of the construction site. Contractor employee parking must not interfere with existing and established parking requirements of the government installation.

3.2 AVAILABILITY AND USE OF UTILITY SERVICES

3.2.1 Temporary Utilities

Provide temporary utilities required for construction. Materials may be new or used, must be adequate for the required usage, not create unsafe conditions, and not violate applicable codes and standards.

3.2.2 Payment for Utility Services

- a. The Government will make all reasonably required utilities available to the Contractor from existing outlets and supplies, as specified in the contract. Unless otherwise provided in the contract, the amount of each utility service consumed will be charged to or paid for by the Contractor at prevailing rates charged to the Government or, where the utility is produced by the Government, at reasonable rates determined by the Contracting Officer. Carefully conserve any utilities furnished without charge.
- b. Reasonable amounts of the following utilities will be made available to the Contractor as indicated elsewhere.
- c. The point at which the Government will deliver such utilities or services and the quantity available is as indicated. Pay all costs incurred in connecting, converting, and transferring the utilities to the work. Make connections, including providing backflow-preventing devices on connections to domestic water lines; and providing transformers; and make disconnections.

3.2.3 Meters and Temporary Connections

At the Contractors expense and in a manner satisfactory to the Contracting Officer, provide and maintain necessary temporary connections, distribution lines, and meter bases (Government will provide meters) required to measure the amount of each utility used for the purpose of determining charges. Notify the Contracting Officer, in writing, 5 working days before final electrical connection is desired so that a utilities contract can be established. The Government will provide a meter and make the final hot connection after inspection and approval of the Contractor's temporary wiring installation. The Contractor will not make the final electrical connection.

3.2.4 Advance Deposit

An advance deposit for utilities consisting of an estimated month's usage or a minimum of \$50.00 will be required. The last monthly bills for the fiscal year will normally be offset by the deposit and adjustments will be billed or returned as appropriate. Services to be rendered for the next fiscal year, beginning 1 October, will require a new deposit. Notification of the due date for this deposit will be mailed to the Contractor prior to the end of the current fiscal year.

3.2.5 Final Meter Reading

Before completion of the work and final acceptance of the work by the Government, notify the Contracting Officer, in writing, 5 working days before termination is desired. The Government will take a final meter reading, disconnect service, and remove the meters. Then remove all the temporary distribution lines, meter bases, and associated paraphernalia.

Pay all outstanding utility bills before final acceptance of the work by the Government.

3.2.6 Sanitation

a. Provide and maintain within the construction area minimum field-type sanitary facilities approved by the Contracting Officer and periodically empty wastes into a municipal, district, or station sanitary sewage system, or remove waste to a commercial facility. Obtain approval from the system owner prior to discharge into any municipal, district, or commercial sanitary sewer system. Any penalties and / or fines associated with improper discharge will be the responsibility of the Contractor. Coordinate with the Contracting Officer and follow station regulations and procedures when discharging into the station sanitary sewer system. Maintain these conveniences at all times without nuisance. Include provisions for pest control and elimination of odors. Government toilet facilities will not be available to Contractor's personnel.

3.2.7 Telephone

Make arrangements and pay all costs for telephone facilities desired.

3.2.8 Obstruction Lighting of Cranes

Provide a minimum of 2 aviation red or high intensity white obstruction lights on temporary structures (including cranes) over 100 feet above ground level. Light construction and installation must comply with FAA AC 70/7460-1. Lights must be operational during periods of reduced visibility, darkness, and as directed by the Contracting Officer.

3.2.9 Fire Protection

Provide temporary fire protection equipment for the protection of personnel and property during construction. Remove debris and flammable materials daily to minimize potential hazards.

3.3 TRAFFIC PROVISIONS

3.3.1 Maintenance of Traffic

- a. Conduct operations in a manner that will not close any thoroughfare or interfere in any way with traffic on railways or highways except with written permission of the Contracting Officer at least 15 calendar days prior to the proposed modification date, and provide a Traffic Control Plan detailing the proposed controls to traffic movement for approval. The plan must be in accordance with State and local regulations and the MUTCD, Part VI. Contractor may move oversized and slow-moving vehicles to the worksite provided requirements of the highway authority have been met.
- b. Conduct work so as to minimize obstruction of traffic, and maintain traffic on at least half of the roadway width at all times. Obtain approval from the Contracting Officer prior to starting any activity that will obstruct traffic.
- c. Provide, erect, and maintain, at contractors expense, lights, barriers, signals, passageways, detours, and other items, that may be required by

the Life Safety Signage, overhead protection authority having jurisdiction.

3.3.2 Protection of Traffic

Maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment the work, and the erection and maintenance of adequate warning, danger, and direction signs, will be as required by the State and local authorities having jurisdiction. Protect the traveling public from damage to person and property. Minimize the interference with public traffic on roads selected for hauling material to and from the site. Investigate the adequacy of existing roads and their allowable load limit. Contractor is responsible for the repair of any damage to roads caused by construction operations.

3.3.3 Rush Hour Restrictions

Do not interfere with the peak traffic flows preceding and during normal operations for Ft. Campbell without notification to and approval by the Contracting Officer.

3.3.4 Dust Control

Dust control methods and procedures must be approved by the Contracting Officer. Treat dust abatement on access roads with applications of calcium chloride, water sprinklers, or similar methods or treatment.

3.4 CONTRACTOR'S TEMPORARY FACILITIES

Contractor-owned or -leased trailers must be identified by Government assigned numbers. Size and location of the number will comply with requirements identified elsewhere. Apply the number to the trailer within 14 calendar days of notification, or sooner, if directed by the Government.

3.4.1 Safety

Protect the integrity of any installed safety systems or personnel safety devices. If entrance into systems serving safety devices is required, the Contractor must obtain prior approval from the Contracting Officer. If it is temporarily necessary to remove or disable personnel safety devices in order to accomplish contract requirements, provide alternative means of protection prior to removing or disabling any permanently installed safety devices or equipment and obtain approval from the Contracting Officer.

3.4.2 Administrative Field Offices

Provide and maintain administrative field office facilities within the construction area at the designated site. Government office and warehouse facilities will not be available to the Contractor's personnel.

3.4.3 Storage Area

Construct a temporary 6 foot high chain link fence around trailers and materials. Include plastic strip inserts, colored green, so that visibility through the fence is obstructed. Fence posts may be driven, in lieu of concrete bases, where soil conditions permit. Do not place or

store Trailers, materials, or equipment outside the fenced area unless such trailers, materials, or equipment are assigned a separate and distinct storage area by the Contracting Officer away from the vicinity of the construction site but within the installation boundaries. Trailers, equipment, or materials must not be open to public view with the exception of those items which are in support of ongoing work on any given day. Do not stockpile materials outside the fence in preparation for the next day's work. Park mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, and like equipment within the fenced area at the end of each work day.

3.4.4 Supplemental Storage Area

Upon Contractor's request, the Contracting Officer will designate another or supplemental area for the Contractor's use and storage of trailers, equipment, and materials. This area may not be in close proximity of the construction site but will be within the installation boundaries. Fencing of materials or equipment will not be required at this site; however, the Contractor is responsible for cleanliness and orderliness of the area used and for the security of any material or equipment stored in this area. Utilities will not be provided to this area by the Government.

3.4.5 Appearance of Trailers

- a. Trailers utilized by the Contractor for administrative or material storage purposes must present a clean and neat exterior appearance and be in a state of good repair. Trailers which, in the opinion of the Contracting Officer, require exterior painting or maintenance will not be allowed on installation property.
- b. Paint using suitable paint and maintain the temporary facilities. Failure to do so will be sufficient reason to require their removal.

3.4.6 Maintenance of Storage Area

- a. Keep fencing in a state of good repair and proper alignment. Grassed or unpaved areas, which are not established roadways, will be covered with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways, should the Contractor elect to traverse them with construction equipment or other vehicles; gravel gradation will be at the Contractor's discretion. Mow and maintain grass located within the boundaries of the construction site for the duration of the project. Grass and vegetation along fences, buildings, under trailers, and in areas not accessible to mowers will be edged or trimmed neatly.

3.4.7 Security Provisions

Provide adequate outside security lighting at the Contractor's temporary facilities. The Contractor will be responsible for the security of its own equipment; in addition, the Contractor will notify the appropriate law enforcement agency requesting periodic security checks of the temporary project field office.

3.4.8 Weather Protection of Temporary Facilities and Stored Materials

Take necessary precautions to ensure that roof openings and other critical openings in the building are monitored carefully. Take immediate actions required to seal off such openings when rain or other detrimental weather

is imminent, and at the end of each workday. Ensure that the openings are completely sealed off to protect materials and equipment in the building from damage.

3.4.8.1 Building and Site Storm Protection

When a warning of gale force winds is issued, take precautions to minimize danger to persons, and protect the work and nearby Government property. Precautions must include, but are not limited to, closing openings; removing loose materials, tools and equipment from exposed locations; and removing or securing scaffolding and other temporary work. Close openings in the work when storms of lesser intensity pose a threat to the work or any nearby Government property.

3.5 GOVERNMENT FIELD OFFICE

3.5.1 Resident Engineer's Office

Provide the Government Resident Engineer with an office, located where directed and providing space heat, electric light and power, and toilet facilities consisting of one lavatory and one water closet complete with connections to water and sewer mains. Provide a mail slot in the door or a lockable mail box mounted on the surface of the door. Include a 4 by 8 foot plan table, computer work space a standard size office desk and chair, and telephone. At completion of the project, the office will remain the property of the Contractor and be removed from the site. Utilities will be connected and disconnected in accordance with local codes and to the satisfaction of the Contracting Officer.

3.5.2 Quality Control Manager Records and Field Office

Provide on the jobsite an office with approximately 200 square feet of useful floor area for the exclusive use of the QC Manager. Provide a weathertight structure with adequate heating and cooling, toilet facilities, lighting, ventilation, a 4 by 8 foot plan table, a standard size office desk and chair, computer station, and working communications facilities. Provide a door with a cylinder lock and windows with locking hardware. Make utility connections. Locate as directed. File quality control records in the office and make available at all times to the Government. After completion of the work, remove the entire structure from the site.

3.5.3 Trailer-Type Mobile Office

The Contractor may, at its option, furnish and maintain a trailer-type mobile office acceptable to the Contracting Officer and providing as a minimum the facilities specified above. Securely anchor the trailer to the ground at all four corners to guard against movement during high winds.

3.6 PLANT COMMUNICATION

Whenever the Contractor has the individual elements of its plant so located that operation by normal voice between these elements is not satisfactory, the Contractor must install a satisfactory means of communication, such as telephone or other suitable devices and made available for use by Government personnel.

3.7 TEMPORARY PROJECT SAFETY FENCING

As soon as practicable, but not later than 15 days after the date established for commencement of work, furnish and erect temporary project safety fencing at the work site. The safety fencing must be a high visibility orange colored, high density polyethylene grid or approved equal, a minimum of 42 inches high, supported and tightly secured to steel posts located on maximum 10 foot centers, constructed at the approved location. Maintain the safety fencing during the life of the contract and, upon completion and acceptance of the work, will become the property of the Contractor and be removed from the work site.

3.8 CLEANUP

Remove construction debris, waste materials, packaging material and the like from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways must be cleaned away. Store within the fenced area described above or at the supplemental storage area any materials resulting from demolition activities which are salvageable. Neatly stacked stored materials not in trailers, whether new or salvaged.

3.9 RESTORATION OF STORAGE AREA

Upon completion of the project remove the bulletinboard, signs, barricades, haulroads, and any other temporary products from the site. After removal of trailers, materials, and equipment from within the fenced area, remove the fence that will become the property of the Contractor. Restore to the original or better condition, areas used by the Contractor for the storage of equipment or material, or other use. Gravel used to traverse grassed areas must be removed and the area restored to its original condition, including top soil and seeding as necessary.

-- End of Section --

SECTION 01 57 23

TEMPORARY STORM WATER POLLUTION CONTROL
04/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 4439	(2004) Geosynthetics
ASTM D 4491	(1999a; R 2009) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(2004; R 2009) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(2008) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(2004) Determining Apparent Opening Size of a Geotextile
ASTM D 4873	(2002; R 2009) Identification, Storage, and Handling of Geosynthetic Rolls and Samples

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 832-R-92-005	(1992) Storm Water Management for Construction Activities Developing Pollution Preventions and Plans and Best Management Practices
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U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 122.26	Storm Water Discharges (Applicable to State NPDES Programs, see section 123.25)
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1.2 SYSTEM DESCRIPTION

The work consists of implementing the storm water pollution prevention measures to prevent sediment from entering streams or water bodies as specified in this Section in conformance with the requirements of Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION, and the requirements of the National Pollution Discharge Elimination System (NPDES) permit attached to that Section.

1.3 EROSION AND SEDIMENT CONTROLS

The controls and measures required of the Contractor are described below.

1.3.1 Stabilization Practices

The stabilization practices to be implemented include temporary seeding, mulching, geotextiles, sod stabilization, etc. On the daily CQC Report, record the dates when the major grading activities occur, (e.g., clearing and grubbing, excavation, embankment, and grading); when construction activities temporarily or permanently cease on a portion of the site; and when stabilization practices are initiated. Except as provided in paragraphs UNSUITABLE CONDITIONS and NO ACTIVITY FOR LESS THAN 21 DAYS, initiate stabilization practices as soon as practicable, but no more than 14 days, in any portion of the site where construction activities have temporarily or permanently ceased.

1.3.1.1 Unsuitable Conditions

Where the initiation of stabilization measures by the fourteenth day after construction activity temporarily or permanently ceases or is precluded by unsuitable conditions caused by the weather, initiate stabilization practices as soon as practicable after conditions become suitable.

1.3.1.2 No Activity for Less Than 21 Days

When the total time period in which construction activity is temporarily ceased on a portion of the site is 21 days minimum, stabilization practices do not have to be initiated on that portion of the site until 14 days have elapsed after construction activity temporarily ceased.

1.3.1.3 Burnoff

Burnoff of the ground cover is not permitted.

1.3.1.4 Protection of Erodible Soils

Immediately finish the earthwork brought to a final grade, as indicated or specified, and protect the side slopes and back slopes upon completion of rough grading. Plan and conduct earthwork to minimize the duration of exposure of unprotected soils.

1.3.2 Erosion, Sediment and Stormwater Control

a. Submit "Erosion and Sediment Controls" (E&S) (form provided at the pre-construction conference) and [Storm Water Inspection Reports for General Permit](#) to the Contracting Officer once every 7 calendar days and within 24 hours of a storm event that produces 0.5 inch or more of rain.

b. Storm Water Notice of Intent for Construction Activities

c. Submit a [Storm Water Notice of Intent](#) for NPDES coverage under the general permit for construction activities and a [Storm Water Pollution Prevention Plan](#) (SWPPP) for the project to the Contracting Officer prior to the commencement of work. The SWPPP shall meet the requirements of the State of Kentucky general permit for storm water discharges from construction sites. Submit the SWPPP along with any required Notice of Intents, Notice of Termination, and appropriate permit fees, via the Contracting Officer, to the appropriate State agency for approval, a minimum of 14 calendar days prior to the start of any land disturbing activities. Maintain an approved copy of the

SWPPP at the construction on-site office, and continually update as regulations require, to reflect current site conditions. Include within the SWPPP:

(1) Identify potential sources of pollution which may be reasonably expected to affect the quality of storm water discharge from the site.

(2) Describe and ensure implementation of practices which will be used to reduce the pollutants in storm water discharge from the site.

(3) Ensure compliance with terms of the Kentucky general permit for storm water discharge.

(4) Select applicable best management practices from EPA 832-R-92-005.

(5) Include a completed copy of the Registration Statement, BMP Inspection Report Template and Notice of Termination except for the effective date.

(6) Storm Water Pollution Prevention Measures and Notice of Intent [40 CFR 122.26](#), [EPA 832-R-92-005](#). Provide a "Storm Water Pollution Prevention Plan" (SWPPP) for the project. The SWPPP will meet the requirements of the Kentucky general permit for storm water discharges from construction sites. Submit the SWPPP along with any required Notice of Intent, Notice of Termination, and appropriate permit fees, via the Contracting Officer, to the appropriate State agency for approval, a minimum of 14 calendar days prior to the start of construction. A copy of the approved SWPPP will be kept at the construction on-site office, and continually updated as regulations require to reflect current site conditions.

(8) Following SWPPP approval, submit Registration Statement and appropriate permit fees to the Virginia Department of Conservation and Recreation (DCR) before any land disturbing activities begin. Coverage under the permit begins on the day the Registration Statement and fee are: (1) post marked by mail, (2) registered online at the DCR's website, or (3) hand delivered to the DCR office. The Contractor is responsible for all associated fees; contact DCR to determine applicable fees.

(9) Install, inspect, and maintain best management practices (BMPs) as required by the general permit. Prepare and submit to DCR, BMP Inspection Reports as required by the general permit.

(10) Once construction is complete and the site has been stabilized with a final, sustainable cover, submit the Notice of Termination to DCR within 30 days after all land disturbing activities end.

(12) Information on the permit application, SWPPP requirements, Registration Statement, BMP Inspection Reports, and Notice of Termination can be found in the Virginia Permit Regulation 9 VAC 25-180. The Registration Statement, Notice of Termination, and permit fee forms can be found on the DCR website <http://www.dcr.state.va.us/sw/vsmp.htm>. This website also

contains the permit regulations and information on how to obtain coverage online.

(13) Once construction is complete and the site has been stabilized with a final, sustainable cover, submit the Notice of Termination to DCR within 30 days after all land disturbing activities end.

1.3.3 Structural Practices

Implement structural practices to divert flows from exposed soils, temporarily store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. Implement structural practices in a timely manner, during the construction process, to minimize erosion and sediment runoff. Include the following devices;

1.3.3.1 Silt Fences

Provide silt fences as a temporary structural practice to minimize erosion and sediment runoff. Properly install silt fences to effectively retain sediment immediately after completing each phase of work where erosion would occur in the form of sheet and rill erosion (e.g. clearing and grubbing, excavation, embankment, and grading). Install silt fences in the locations indicated on the drawings. Obtain approval from the Contracting Officer prior to final removal of silt fence barriers.

1.3.3.2 Straw Bales

Provide bales of straw as a temporary structural practice to minimize erosion and sediment runoff. If bales are used, properly place the bales to effectively retain sediment immediately after completing each phase of work (e.g., clearing and grubbing, excavation, embankment, and grading) in each independent runoff area (e.g., after clearing and grubbing in a area between a ridge and drain, place the bales as work progresses, remove/replace/relocate the bales as needed for work to progress in the drainage area). Show on the drawings areas where straw bales are to be used. The Contracting Officer will approve the final removal of straw bale barriers. Provide rows of bales of straw as follows:

- a. Along the downhill perimeter edge of all areas disturbed.
- b. Along the top of the slope or top bank of drainage ditches, channels, swales, etc. that traverse disturbed areas.
- c. Along the toe of all cut slopes and fill slopes of the construction areas.
- d. Perpendicular to the flow in the bottom of existing drainage ditches, channels, swales, etc. that traverse disturbed areas or carry runoff from disturbed areas. Space the rows a maximum of 100 feet apart .
- e. Perpendicular to the flow in the bottom of new drainage ditches, channels, and swales. Space the rows a maximum of 100 feet apart .
- f. At the entrance to culverts that receive runoff from disturbed areas.

1.3.4 Sediment Basins

Trap sediment in temporary sediment basins. Select a basin size to accommodate the runoff of a local 2-year storm. Pump dry and remove the accumulated sediment, after each storm. Use a paved weir or vertical overflow pipe for overflow. Remove collected sediment from the site. Institute effluent quality monitoring programs. Install, inspect, and maintain best management practices (BMPs) as required by the general permit. Prepare BMP Inspection Reports as required by the general permit. If required by the permit, include those inspection reports.

1.3.5 Vegetation and Mulch

a. Provide temporary protection on sides and back slopes as soon as rough grading is completed or sufficient soil is exposed to require erosion protection. Protect slopes by accelerated growth of permanent vegetation, temporary vegetation, mulching, or netting. Stabilize slopes by hydroseeding, anchoring mulch in place, covering with anchored netting, sodding, or such combination of these and other methods necessary for effective erosion control.

b. Seeding: Provide new seeding where ground is disturbed. Include topsoil or nutriment during the seeding operation necessary to establish a suitable stand of grass. The seeding operation will be as specified in Section 32 92 19 SEEDING.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Storm Water Pollution Prevention Plan
Storm Water Notice of Intent

Pollution prevention plan and Notice of intent for NPDES coverage under the general permit for construction activities

SD-06 Test Reports

Storm Water Inspection Reports for General Permit
Erosion and Sediment Controls

SD-07 Certificates

Mill Certificate or Affidavit

Certificate attesting that the Contractor has met all specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

Identify, store and handle filter fabric in accordance with ASTM D 4873.

PART 2 PRODUCTS

2.1 COMPONENTS FOR SILT FENCES

2.1.1 Filter Fabric

Provide geotextile that complies with the requirements of [ASTM D 4439](#), and consists of polymeric filaments which are formed into a stable network such that filaments retain their relative positions. The filament shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of ester, propylene, or amide, and contains stabilizers and/or inhibitors added to the base plastic to make the filaments resistant to deterioration due to ultraviolet and heat exposure. Provide synthetic filter fabric that contains ultraviolet ray inhibitors and stabilizers to assure a minimum of six months of expected usable construction life at a temperature range of 0 to 120 degrees F. The filter fabric shall meet the following requirements:

FILTER FABRIC FOR SILT SCREEN FENCE

PHYSICAL PROPERTY	TEST PROCEDURE	STRENGTH REQUIREMENT
Grab Tensile	ASTM D 4632	100 lbs. min.
Elongation (percent)		30 percent max.
Trapezoid Tear	ASTM D 4533	55 lbs. min.
Permittivity	ASTM D 4491	0.2 sec-1
AOS (U.S. Std Sieve)	ASTM D 4751	20-100

2.1.2 Silt Fence Stakes and Posts

Use either wooden stakes or steel posts for fence construction. Wooden stakes utilized for silt fence construction, shall have a minimum cross section of 2 by 2 inches when oak is used and 4 by 4 inches when pine is used, and have a minimum length of 5 feet. Steel posts (standard "U" or "T" section) utilized for silt fence construction, shall have a minimum weight of 1.33 pounds/linear foot and a minimum length of 5 feet.

2.1.3 Mill Certificate or Affidavit

Provide a mill certificate or affidavit attesting that the fabric and factory seams meet chemical, physical, and manufacturing requirements specified above. Specify in the mill certificate or affidavit the actual Minimum Average Roll Values and identify the fabric supplied by roll identification numbers. Submit a mill certificate or affidavit signed by a legally authorized official from the company manufacturing the filter fabric.

2.2 COMPONENTS FOR STRAW BALES

The straw in the bales shall be stalks from oats, wheat, rye, barley, rice, or from grasses such as byhalia, bermuda, etc., furnished in air dry condition. Provide bales with a standard cross section of 14 by 18 inches. Wire-bound or string-tie all bales. Use either wooden stakes or steel posts to secure the straw bales to the ground. Wooden stakes utilized for this purpose, shall have a minimum dimensions of 2 by 2 inches in cross section and have a minimum length of 3 feet. Steel posts (standard "U" or "T" section) utilized for securing straw bales, shall have a minimum weight

of 1.33 pounds/linear foot and a minimum length of 3 feet.

PART 3 EXECUTION

3.1 INSTALLATION OF SILT FENCES

Extend silt fences a minimum of 16 inches above the ground surface without exceeding 34 inches above the ground surface. Provide filter fabric from a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are unavoidable, splice together filter fabric at a support post, with a minimum 6 inch overlap, and securely sealed. Excavate trench approximately 4 inches wide and 4 inches deep on the upslope side of the location of the silt fence. The 4 by 4 inch trench shall be backfilled and the soil compacted over the filter fabric. Remove silt fences upon approval by the Contracting Officer.

3.2 INSTALLATION OF STRAW BALES

Place the straw bales in a single row, lengthwise on the contour, with ends of adjacent bales tightly abutting one another. Install straw bales so that bindings are oriented around the sides rather than along the tops and bottoms of the bales in order to prevent deterioration of the bindings. Entrench and backfill the barrier. Excavate a trench the width of a bale and the length of the proposed barrier to a minimum depth of 4 inches. After the bales are staked and chinked (gaps filled by wedging with straw), backfill the excavated soil against the barrier. Conform the backfill soil with the ground level on the downhill side and build up to 4 inches against the uphill side of the barrier. Scatter loose straw over the area immediately uphill from a straw bale barrier to increase barrier efficiency. Securely anchor each bale by at least two stakes driven through the bale. Drive the first stake or steel post in each bale toward the previously laid bale to force the bales together. Drive stakes or steel pickets a minimum 18 inches deep into the ground to securely anchor the bales.

3.3 FIELD QUALITY CONTROL

Maintain the temporary and permanent vegetation, erosion and sediment control measures, and other protective measures in good and effective operating condition by performing routine inspections to determine condition and effectiveness, by restoration of destroyed vegetative cover, and by repair of erosion and sediment control measures and other protective measures. Use the following procedures to maintain the protective measures.

3.3.1 Silt Fence Maintenance

Inspect the silt fences in accordance with paragraph, titled "Inspections," of this section. Any required repairs shall be made promptly. Pay close attention to the repair of damaged silt fence resulting from end runs and undercutting. Should the fabric on a silt fence decompose or become ineffective, and the barrier is still necessary, replace the fabric promptly. Remove sediment deposits when deposits reach one-third of the height of the barrier. Remove a silt fence when it is no longer required. The immediate area occupied by the fence and any sediment deposits shall be shaped to an acceptable grade. The areas disturbed by this shaping shall be seeded in accordance with Section 32 05 33 LANDSCAPE ESTABLISHMENT, except that the coverage requirements in paragraph, titled "Establishment" of this section do not apply.

3.3.2 Straw Bale Maintenance

Inspect straw bale barriers in accordance with paragraph, titled "Inspections". Pay close attention to the repair of damaged bales, end runs and undercutting beneath bales. Accomplish necessary repairs to barriers or replacement of bales in a promptly manner. Remove sediment deposits when deposits reach one-half of the height of the barrier. At the each end of each row turn bales uphill when used to retain sediment. Remove a straw bale barrier when it is no longer required. The immediate area occupied by the bales and any sediment deposits shall be shaped to an acceptable grade. Seed the areas disturbed by this shaping in accordance with Section 32 92 19 SEEDING.

3.3.3 Diversion Dike Maintenance

Inspect diversion dikes in accordance with paragraph, titled "Inspections," of this section. Pay close attention to the repair of damaged diversion dikes and accomplish necessary repairs promptly. When diversion dikes are no longer required, shape to an acceptable grade. Seed the areas disturbed by this shaping in accordance with Section 32 92 19 SEEDING.

3.4 INSPECTIONS

3.4.1 General

Inspect disturbed areas of the construction site, areas that have not been finally stabilized used for storage of materials exposed to precipitation, stabilization practices, structural practices, other controls, and area where vehicles exit the site at least once every seven (7) calendar days and within 24 hours of the end of any storm that produces 0.5 inches or more rainfall at the site. Conduct inspections at least once every month where sites have been finally stabilized.

3.4.2 Inspections Details

Inspect disturbed areas and areas used for material storage that are exposed to precipitation for evidence of, or the potential for, pollutants entering the drainage system. Observe erosion and sediment control measures identified in the Storm Water Pollution Prevention Plan to ensure that they are operating correctly. Inspect discharge locations or points to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Inspect locations where vehicles exit the site for evidence of offsite sediment tracking.

3.4.3 Inspection Reports

For each inspection conducted, prepare a report summarizing the scope of the inspection, name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the Storm Water Pollution Prevention Plan, maintenance performed, and actions taken. Furnish the report to the Contracting Officer within 24 hours of the inspection as a part of the Contractor's daily CQC REPORT. A copy of the inspection report shall be maintained on the job site.

-- End of Section --

SECTION 01 74 19

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT
01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E 1609 (2001) Development and Implementation of a Pollution Prevention Program

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED (2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 GOVERNMENT POLICY

Government policy is to apply sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy: (1) practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction and demolition waste from landfills and incinerators and to facilitate their recycling or reuse. A minimum of 50 percent by weight of total project solid waste shall be diverted from the landfill.

1.3 MANAGEMENT

Develop and implement a waste management program in accordance with **ASTM E 1609** and as specified. Take a pro-active, responsible role in the management of construction and demolition waste and require all subcontractors, vendors, and suppliers to participate in the effort. Construction and demolition waste includes products of demolition or removal, excess or unusable construction materials, packaging materials for construction products, and other materials generated during the construction process but not incorporated into the work. In the management of waste consideration shall be given to the availability of viable markets, the condition of the material, the ability to provide the material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates. The Contractor is responsible for implementation of any special programs involving rebates or similar incentives related to recycling of waste. Revenues or other savings obtained for salvage, or recycling accrue to the Contractor. Appropriately permit firms and facilities used for recycling, reuse, and disposal for the intended use to the extent required by federal, state, and local regulations. Also, provide on-site instruction of appropriate separation, handling, recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Waste Management Plan; G; (LEED)

SD-11 Closeout Submittals

Records; (LEED)

1.5 MEETINGS

Conduct Construction Waste Management meetings. After award of the Contract and prior to commencement of work, schedule and conduct a meeting with the Contracting Officer to discuss the proposed Waste Management Plan and to develop a mutual understanding relative to the details of waste management. The requirements for this meeting may be fulfilled during the coordination and mutual understanding meeting outlined in Section 01 45 00.00 10 QUALITY CONTROL. At a minimum, environmental and waste management goals and issues shall be discussed at the following additional meetings:

- a. Pre-bid meeting.
- b. Preconstruction/Pre-demolition meeting.
- c. Regular site meetings.
- d. Work safety meetings.

1.6 WASTE MANAGEMENT PLAN

A waste management plan shall be submitted within 15 days after notice to proceed and not less than 10 days before the preconstruction/pre-demolition meeting. The plan shall demonstrate how the project waste diversion goal shall be met and shall include the following:

- a. Name of individuals on the Contractor's staff responsible for waste prevention and management.
- b. Actions that will be taken to reduce solid waste generation, including coordination with subcontractors to ensure awareness and participation.
- c. Description of the regular meetings to be held to address waste management.
- d. Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas on site and equipment to be used for processing, sorting, and temporary storage of wastes.
- e. Characterization, including estimated types and quantities, of the

waste to be generated.

f. Name of landfill and/or incinerator to be used and the estimated costs for use, assuming that there would be no salvage or recycling on the project.

g. Identification of local and regional reuse programs, including non-profit organizations such as schools, local housing agencies, and organizations that accept used materials such as materials exchange networks and Habitat for Humanity. Include the name, location, and phone number for each reuse facility to be used, and provide a copy of the permit or license for each facility.

h. List of specific waste materials that will be salvaged for resale, salvaged and reused on the current project, salvaged and stored for reuse on a future project, or recycled. Recycling facilities that will be used shall be identified by name, location, and phone number, including a copy of the permit or license for each facility.

i. Identification of materials that cannot be recycled/reused with an explanation or justification, to be approved by the Contracting Officer.

j. Description of the means by which any waste materials identified in item (h) above will be protected from contamination.

k. Description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site).

l. Anticipated net cost savings determined by subtracting Contractor program management costs and the cost of disposal from the revenue generated by sale of the materials and the incineration and/or landfill cost avoidance.

Revise and resubmit Plan as required by the Contracting Officer. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations or meeting project cumulative waste diversion requirement. Distribute copies of the Waste Management Plan to each subcontractor, the Quality Control Manager, and the Contracting Officer.

1.7 RECORDS

Records shall be maintained to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. Records shall be kept in accordance with the LEED Reference Guide and using the LEED Letter Template. The records shall be made available to the Contracting Officer during construction, and a copy of the records shall be delivered to the Contracting Officer upon completion of the construction and included in the LEED Documentation Notebook.

1.8 COLLECTION

Separate, store, protect, and handle at the site identified recyclable and salvageable waste products in a manner that maximizes recyclability and salvagability of identified materials. Provide the necessary containers, bins and storage areas to facilitate effective waste management and clearly

and appropriately identify them. Provide materials for barriers and enclosures around recyclable material storage areas which are nonhazardous and recyclable or reusable. Locate out of the way of construction traffic. Provide adequate space for pick-up and delivery and convenience to subcontractors. Recycling and waste bin areas are to be kept neat and clean, and recyclable materials shall be handled to prevent contamination of materials from incompatible products and materials. Clean contaminated materials prior to placing in collection containers. Use cleaning materials that are nonhazardous and biodegradable. Handle hazardous waste and hazardous materials in accordance with applicable regulations and coordinate with Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION. Separate materials by one of the following methods:

1.8.1 Source Separated Method.

Waste products and materials that are recyclable shall be separated from trash and sorted as described below into appropriately marked separate containers and then transported to the respective recycling facility for further processing. Deliver materials in accordance with recycling or reuse facility requirements (e.g., free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process). Separate materials into the following category types as appropriate to the project waste and to the available recycling and reuse programs in the project area:

- a. Land clearing debris.
- b. Asphalt.
- c. Concrete and masonry.
- d. Metal (e.g. banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized, stainless steel, aluminum, copper, zinc, lead brass, bronze).
 - (1) Ferrous.
 - (2) Non-ferrous.
- e. Wood (nails and staples allowed).
- f. Debris.
- g. Glass (colored glass allowed).
- h. Paper.
 - (1) Bond.
 - (2) Newsprint.
 - (3) Cardboard and paper packaging materials.
- i. Plastic.
 - (1) Type 1: Polyethylene Terephthalate (PET, PETE).
 - (2) Type 2: High Density Polyethylene (HDPE).

- (3) Type 3: Vinyl (Polyvinyl Chloride or PVC).
- (4) Type 4: Low Density Polyethylene (LDPE).
- (5) Type 5: Polypropylene (PP).
- (6) Type 6: Polystyrene (PS).
- (7) Type 7: Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.

- j. Gypsum.
- k. Non-hazardous paint and paint cans.
- l. Carpet.
- m. Ceiling tiles.
- n. Insulation.
- o. Beverage containers.

1.8.2 Co-Mingled Method.

Waste products and recyclable materials shall be placed into a single container and then transported to a recycling facility where the recyclable materials are sorted and processed.

1.8.3 Other Methods.

Other methods proposed by the Contractor may be used when approved by the Contracting Officer.

1.9 DISPOSAL

Control accumulation of waste materials and trash. Recycle or dispose of collected materials off-site at intervals approved by the Contracting Officer and in compliance with waste management procedures. Except as otherwise specified in other sections of the specifications, disposal shall be in accordance with the following:

1.9.1 Reuse.

First consideration shall be given to salvage for reuse since little or no re-processing is necessary for this method, and less pollution is created when items are reused in their original form. Sale or donation of waste suitable for reuse shall be considered.

1.9.2 Recycle.

Waste materials not suitable for reuse, but having value as being recyclable, shall be made available for recycling. All fluorescent lamps, HID lamps, and mercury-containing thermostats removed from the site shall be recycled. Arrange for timely pickups from the site or deliveries to recycling facilities in order to prevent contamination of recyclable materials.

1.9.3 Compost

Consider composting on site if a reasonable amount of compostable material will be available. Compostable materials include plant material, sawdust, and certain food scraps.

1.9.4 Waste.

Materials with no practical use or economic benefit shall be disposed at a landfill or incinerator.

1.9.5 Return

Set aside and protect misdelivered and substandard products and materials and return to supplier for credit.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used. -- End of Section --

SECTION 01 78 23.00 06

EQUIPMENT OPERATING, MAINTENANCE, AND REPAIR MANUALS
05/97

PART 1 GENERAL

1.1 General Requirements

The Contractor shall provide 6 complete copies of the Equipment Operating, Maintenance, and Repair Manuals. Separate manuals shall be provided for each utility system as defined hereinafter. Operations and Maintenance manuals shall be submitted and approved before field training or 90 days before substantial completion (whichever occurs earlier), and as specified in Section 00 80 00.00 06, paragraph titled "EQUIPMENT DATA". An amount of \$100,000 shall be withheld until submittal and approval of O&M manuals is complete.

1.2 Definitions

1.2.1 Equipment

A single piece of equipment operating alone or in conjunction with other equipment to accomplish a system function.

1.2.2 System

A combination of one or more pieces of equipment which function together to accomplish an intended purpose (i.e. HVAC system is composed of many individual pieces of equipment such as fans, motors, compressors, valves, sensors, relays, etc.)

1.2.3 Hard Cover Binders

The manuals shall be hard cover with posts, or 3-ring binders, so sheets may be substituted easily. The following identification shall be printed on the cover: the words "EQUIPMENT OPERATING, MAINTENANCE, AND REPAIR MANUALS," the project name, building number, and an indication of utility or systems covered, the name of the Contractor, and the Contract number. Manuals shall be approximately 8-1/2 by 11-inches with large sheets folded in and capable of being easily pulled out for reference. All manuals for the project must be similar in appearance, and be of professional quality.

1.2.4 Warning Page

A warning page shall be provided to warn of potential dangers (if they exist, such as high voltage, toxic chemicals, flammable liquids, explosive materials, carcinogens, high pressures, etc.). The warning page shall be placed inside the front cover and in front of the title page. Also, any necessary Material Safety Data Sheets (MDS) shall be included here.

1.2.5 Title Page

The title page shall include the same information shown on the cover and

show the name of the preparing firm and the date of publication.

1.2.6 Table of Contents

Each volume of the set of manuals for this project shall include a table of contents, for the entire set, broken down by volume.

PART 2 PRODUCTS (Not Used.)

PART 3 EXECUTION

3.1 GENERAL

Manuals shall be organized according to the following format, and will include information for each item of equipment (NOTE: This includes any equipment which may have been omitted from the items listed in Paragraph 3.2, System/Equipment Requirements.) A draft outline and table of contents shall be submitted for approval at 50% contract completion.

TABLE OF CONTENTS

PART I. Introduction.

- (a) Equipment Description.
- (b) Functional Description.
- (c) Installation Description.

PART II. Operating Principles.

PART III. Safety.

PART IV. Preventive Maintenance

- (a) Preventive Maintenance Checklist. Lubrication
- (b) Charts and Diagrams.

PART V. Spare Parts Lists

- (a) Troubleshooting Guide
- (b) Adjustments
- (c) Common Repairs and Parts Replacement

PART VI. Illustrations

3.1.1 Part I-Introduction

Part I shall provide an introduction, equipment or system description, functional description and theory of operation, and installation instructions for each piece of equipment. Complete instructions for uncrating, assembly, connection to the power source and pre-operating lubrication shall be included in the installation instructions as applicable. Illustrations, including wiring and cabling diagrams, are required as appropriate in this section. Halftone pictures of the equipment should be included in the introduction and equipment description, as well as system layout drawings with each item of equipment located and marked. Copies of previously submitted shop drawings shall not be used in these manuals.

3.1.2 Part II-Operating Principles

Part II shall provide complete instructions for operating the system, and each piece of equipment. Illustrations, halftone pictures, tables, charts, procedures, and diagrams are required when applicable. This will include step-by-step procedures for start-up and shutdown of both the system and each component piece of equipments, as well as adjustments required to obtain optimum equipment performance, and corrective actions for malfunctions. Performance sheets and graphs showing capacity data, efficiencies, electrical characteristics, pressure drops, and flow rates shall be shown here, also. Marked-up catalogs or catalog pages do not satisfy this requirements. Performance information shall be presented as concisely as possible and contain only data pertaining to equipment actually installed. Actual test data collected for Contractor performance shall be included here.

3.1.3 Part III-Safety

Part III shall contain the general and specific safety requirements peculiar to each item of equipment. Safety information should be repeated as notes cautions, and warnings in other sections where appropriate to operations described.

3.1.4 Part IV-Preventive Maintenance

Part IV shall contain a troubleshooting guide, including detailed instructions for all common adjustments and alignment procedures, including a detailed maintenance schedule. Also, include a diagnostic chart showing symptoms and solutions to problems. Include test hookups to determine the cause, special tools and test equipment, and methods for returning the equipment to operating conditions. Information may be in chart form or in tabular format with appropriate headings. Instructions shall be included for the removal, disassembly, repair, reassembly, and replacement of parts and assemblies where applicable and the task is not obvious.

3.1.5 Part V-Spare Parts List

Part V shall contain a tabulation of description data and parts location illustrations for all mechanical and electrical parts. The heading of the parts list shall clearly identify the supplier, purchase order number, and equipment. The unit price for each part shall be included, also. Parts shall be listed by major assemblies, and the listing shall be arranged in columnar form. Also, names and addresses of the nearest manufacturer's representatives will be included, as well as any special warranty information. A list of spare parts that are recommended to be kept in stock by the Government installation shall be provided.

3.1.6 Part VI-Illustrations

Part VI shall contain assembly drawings for the complete equipment or system and for all major components. Complete wiring diagrams and schematics shall be included. Other illustrations, such as exploded views, block diagrams, and cutaway drawings, are required as appropriate.

3.1.7 Framed Instructions

Framed instructions under glass or in laminated plastic, including wiring

and control diagrams showing the complete layout of the entire system, including equipment, ductwork, piping valves, dampers, and control sequence, shall be posted at a location near the equipment described. Condensed operating instructions explaining preventive maintenance procedures methods of checking the system for normal safe operation, valve schedule and procedures for safely starting and stopping the system shall be prepared in type form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. Proposed diagrams, instructions, and other sheets shall be submitted prior to posting. The framed instructions shall be posted before field training.

3.1.8 Field Training

Contractor shall conduct a training course for the operating staff for each particular system. The training period shall start after the system is functionally completed. The field instructions shall cover all of the items contained in the Equipment Operating, Maintenance and Repair Manuals. The training will include both classroom and "hands-on" training. The Contractor shall submit a lesson plan outlining the information to be discussed during training periods. This lesson plan will be submitted 90 days before contract completion and approved before the field training occurs. Training shall be videotaped and shall be furnished to the Government on DVD media, each system on separate DVD, within ten (10) days following training. Training shall be documented by the Contractor and a list of attendees shall be furnished to the Government.

3.1.9 Videotaping of Training

The Contractor will provide all equipment, materials, and trained personnel to visually and audibly record (videotape) all site operations and maintenance (O&M) training sessions. The video technician/trainer will be employed by a video production company that has been in business for a minimum of 2 years. The Contractor will submit for approval by the Government, the resume of the technician/trainer and the video production company. Videotapes will be produced in the VHS format. Audio will be adjusted, filtered or otherwise controlled to ensure the presenter can be understood at all times. Each system or piece of equipment will be covered in a single tape or set of DVD media, which will be identified with a permanently printed label showing the name of the project, equipment or system, and contract number. This same information will be provided as an introduction on each DVD. When two or more DVD are provided for a single system or piece of equipment, they will be packaged as a set in an appropriate storage case. Provide three copies of each tape(s) for each training session. Training shall be videotaped on DVD media and shall be furnished to the Government within ten (10) days following training

3.2 SYSTEM/EQUIPMENT REQUIREMENTS

3.2.1 Facility Heating System

Information shall be provided on the following equipment: boilers, water treatment, chemical feed pumps and tanks, converters, heat exchangers, pumps, unit heaters, fin-tube radiation, air handling units (both heating only and heating and cooling), and valves (associated with heating systems).

3.2.2 Air-Conditioning Systems

Provide information in chillers, packaged air-conditioning equipment, towers, water treatment, chemical feed pumps and tanks, air-cooled condensers, pumps, compressors, air handling units, and valves (associated with air-conditioning systems).

3.2.3 Temperature Control and HVAC Distribution Systems

Provide all information described for the following equipment: valves, fans, air handling units, pumps, boilers, converters and heat exchangers, chillers, water cooled condensers, cooling towers, and fin-tube radiation, control air compressors, control components (sensors, controllers, adapters and actuators), and flow measuring equipment.

3.2.4 Central Heating Plants

Provide the information described for the following equipment: boilers, converters, heat exchangers, pumps, fans, steam traps, pollution control equipment, chemical feed equipment, control systems, fuel handling equipment, deaerators, tanks (flash, expansion, return waters, etc.), water softeners, and valves.

3.2.5 Heating Distribution Systems

Provide the information described for the following equipment: valves, fans, pumps, converters and heat exchangers, steam traps, tanks (expansion, flash, etc.), and piping systems.

3.2.6 Exterior Electrical Systems

Information shall be provided on the following equipment: power transformers, relays, reclosers, breakers, and capacitor bank controls.

3.2.7 Interior Electrical Systems

Information shall be provided on the following equipment: relays, motor control centers, switchgear, solid state circuit breakers, motor controller, EPS lighting systems, wiring diagrams and troubleshooting flow chart on control systems, and special grounding systems.

3.2.8 Energy Monitoring and Control Systems

The maintenance manual shall include descriptions of maintenance for all equipment, including inspection, periodic preventative maintenance, fault diagnosis, and repair or replacement of defective components.

3.2.9 Domestic Water Systems

The identified information shall be provided on the following equipment: tanks, unit process equipment, pumps, motors, control and monitoring instrumentation, laboratory test equipment, chemical feeders, valves, switching gear, and automatic controls.

3.2.10 Wastewater Treatment Systems

The identified information shall be provided on the following equipment: tanks, unit process equipment, pumps, motors, control and monitoring instrumentations, laboratory test equipment chemical feeders, valves,

scrapers, skimmers, comminutors, blowers, switching gear, and automatic controls.

3.2.11 Fire Protection Systems

Information shall be provided on the following equipment: alarm valves, manual valves, regulators, foam and gas storage tanks, piping materials, sprinkler heads, nozzles, pumps, and pump drivers.

3.2.12 Fire Detection Systems

The maintenance manual shall include description of maintenance for all equipment, including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.

3.2.13 Plumbing Systems

Information shall be provided on the following equipment: water heaters, valves, pressure regulators backflow preventors, piping materials, and plumbing fixtures.

3.2.14 Liquid Fuels Systems

Information shall be provided on the following equipment: tanks, automatic valves manual valves, filter separators, pumps, mechanical loading arms, nozzles, meters, electronic controls, electrical switch gear, and fluidic controls.

3.2.15 Cathodic Protection Systems

Information shall be provided on the following material and equipment: rectifiers, meters, anodes, anode backfill, anode lead wire, insulation material and wire size, automatic controls (if any), rheostats, switches, fuses and circuit breakers, type and size of rectifying elements, type of oil in oil-immersed rectifiers, and rating of shunts.

3.2.16 Generator Installations

Information shall be provided on the following equipment: generator sets, automatic transfer panels, governors, exciters, regulators starting systems, switchgear, and protective devices.

3.2.17 Miscellaneous Systems

Information shall be provided on the following: communication and ADP systems, security and intrusion alarm, elevators, material handling, active solar, photovoltaic, nurse call, paging, intercom, closed circuit TV, irrigation, sound and material delivery systems, kitchen, refrigeration, disposal, icemaking equipment, and other similar type special systems not otherwise specified.

3.2.18 Laboratory, Environmental and Pollution Control Systems

Information shall be provided on the following equipment: wet scrubbers, quench chambers, scrub tanks, liquid oil separators, and fume hoods.

3.3 PRICING OF CONTRACTOR-FURNISHED AND INSTALLED PROPERTY AND GOVERNMENT-FURNISHED CONTRACTOR-INSTALLED PROPERTY

The Contractor shall promptly furnish and shall cause any sub-contractor or supplier to furnish, in like manner, unit prices and descriptive data required by the Government for Property Record purposes of fixtures and equipment furnished and/or installed by the Contractor or sub-contractor, except prices do not need to be provided for Government-Furnished Property. This information shall be listed in the RMS CQC Module furnished by the Government. See example forms at the end of the Special Contractor Requirements.

-- End of Section --

SECTION 02 41 00

DEMOLITION AND DECONSTRUCTION
05/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI Guideline K (2009) Guideline for Containers for Recovered Non-Flammable Fluorocarbon Refrigerants

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.6 (2006) Safety Requirements for Demolition Operations

CARPET AND RUG INSTITUTE (CRI)

CRI 104 (2002) Standard for Installation Specification of Commercial Carpet

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2008; Change 1-2010; Change 3-2010; Errata 1-2010) Safety and Health Requirements Manual

U.S. DEFENSE LOGISTICS AGENCY (DLA)

DLA 4145.25 (June 2000) Storage and Handling of Liquefied and Gaseous Compressed Gases and Their Full and Empty Cylinders

U.S. DEPARTMENT OF DEFENSE (DOD)

DOD 4000.25-1-M (2006) MILSTRIP - Military Standard Requisitioning and Issue Procedures

MIL-STD-129 (2007; Rev P; Change 4 2007) Military Marking for Shipment and Storage

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1 (2007; Rev K) Obstruction Marking and Lighting

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 61 National Emission Standards for Hazardous

Air Pollutants

40 CFR 82

Protection of Stratospheric Ozone

49 CFR 173.301

Shipment of Compressed Gases in Cylinders
and Spherical Pressure Vessels

1.2 PROJECT DESCRIPTION

1.2.1 Demolition/Deconstruction Plan

Prepare a [Demolition Plan](#) and submit proposed salvage, demolition, and removal procedures for approval before work is started. Include in the plan procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, a disconnection schedule of utility services, and airfield lighting, a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Coordinate with Waste Management Plan. Provide procedures for safe conduct of the work in accordance with [EM 385-1-1](#). Plan shall be approved by Contracting Officer prior to work beginning.

1.2.2 General Requirements

Do not begin demolition or deconstruction until authorization is received from the Contracting Officer. Remove rubbish and debris from the project site; do not allow accumulations inside or outside the buildings on airfield pavements. The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Remove rubbish and debris from Government property daily, unless otherwise directed. Store materials that cannot be removed daily in areas specified by the Contracting Officer. In the interest of occupational safety and health, perform the work in accordance with [EM 385-1-1](#), Section 23, Demolition, and other applicable Sections.

1.3 ITEMS TO REMAIN IN PLACE

Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government. Repair or replace damaged items as approved by the Contracting Officer. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract. Do not overload pavements to remain. Provide new supports and reinforcement for existing construction weakened by demolition, deconstruction, or removal work. Repairs, reinforcement, or structural replacement require approval by the Contracting Officer prior to performing such work.

1.3.1 Existing Construction Limits and Protection

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide temporary shoring and bracing for support of building components to prevent settlement or other movement. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove [snow,]dust, dirt, and debris from work areas daily.

1.3.2 Weather Protection

For portions of the building to remain, protect building interior and materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of exposed areas.

1.3.3 Trees

Protect trees within the project site which might be damaged during demolition or deconstruction, and which are indicated to be left in place, by a 6 foot high fence. Erect and secure fence a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Replace any tree designated to remain that is damaged during the work under this contract with like-kind or as approved by the Contracting Officer.

1.3.4 Utility Service

Maintain existing utilities indicated to stay in service and protect against damage during demolition and deconstruction operations. Prior to start of work, utilities serving each area of alteration or removal will be shut off by the Government and disconnected and sealed by the Contractor.

1.3.5 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, must remain standing without additional bracing, shoring, or lateral support until demolished or deconstructed, unless directed otherwise by the Contracting Officer. Ensure that no elements determined to be unstable are left unsupported and place and secure bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract.

1.4 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Existing Conditions; G

SD-07 Certificates

Demolition Plan; G

Notification; G

SD-11 Closeout Submittals

Receipts

1.5 QUALITY ASSURANCE

Submit timely notification of demolition projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61, Subpart M. Notify the State's environmental protection agency or local air pollution control district/agency and the Contracting Officer in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61, Subpart M. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," conform to the safety requirements contained in ASSE/SAFE A10.6. Comply with the Environmental Protection Agency requirements specified. Use of explosives will not be permitted.

1.5.1 Dust and Debris Control

Prevent the spread of dust and debris on airfield pavements and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution. Sweep pavements as often as necessary to control the spread of debris that may result in foreign object damage potential to aircraft.

1.6 PROTECTION

1.6.1 Traffic Control Signs

a. Where aircraft safety is endangered in the area of removal work, use traffic barricades with flashing lights. Anchor barricades in a manner to prevent displacement by wind, jet or prop blast. Notify the Contracting Officer prior to beginning such work.

Provide a minimum of 2 aviation red or high intensity white obstruction lights on temporary structures (including cranes) over 100 feet above ground level. Light construction and installation shall comply with FAA AC 70/7460-1. Lights shall be operational during periods of reduced visibility, darkness, and as directed by the Contracting Officer. Maintain the temporary services during the period of construction and remove only after permanent services have been installed and tested and are in operation.

1.6.2 Protection of Personnel

Before, during and after the demolition work continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the project site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.7 FOREIGN OBJECT DAMAGE (FOD)

Aircraft and aircraft engines are subject to FOD from debris and waste material lying on airfield pavements. Remove all such materials that may appear on operational aircraft pavements due to the Contractor's operations. If necessary, the Contracting Officer may require the Contractor to install a temporary barricade at the Contractor's expense to control the spread of FOD potential debris. The barricade shall include a fence covered with a fabric designed to stop the spread of debris. Anchor the fence and fabric to prevent displacement by winds or jet/prop blasts. Remove barricade when no longer required.

1.8 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Repair or replace items to be relocated which are damaged by the Contractor with new undamaged items as approved by the Contracting Officer.

1.9 EXISTING CONDITIONS

Before beginning any demolition or deconstruction work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing conditions in the presence of the Contracting Officer showing the condition of structures and other facilities adjacent to areas of alteration or removal. Photographs sized 4 inch will be acceptable as a record of existing conditions. Include in the record the elevation of the top of foundation walls, finish floor elevations, possible conflicting electrical conduits, plumbing lines, alarms systems, the location and extent of existing cracks and other damage and description of surface conditions that exist prior to before starting work. It is the Contractor's responsibility to verify and document all required outages which will be required during the course of work, and to note these outages on the record document. Submit survey results.

PART 2 PRODUCTS

2.1 FILL MATERIAL

- a. Comply with excavating, backfilling, and compacting procedures for soils used as backfill material to fill basements, voids, depressions or excavations resulting from demolition or deconstruction of structures.

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

Inspect and evaluate existing structures onsite for reuse. Existing construction scheduled to be removed for reuse shall be disassembled. Dismantled and removed materials are to be separated, set aside, and prepared as specified, and stored or delivered to a collection point for reuse, remanufacture, recycling, or other disposal, as specified. Materials shall be designated for reuse onsite whenever possible.

3.1.1 Structures

- a. Demolish structures in a systematic manner from the top of the structure to the ground. Complete demolition work above each tier or

floor before the supporting members on the lower level are disturbed. Demolish concrete and masonry walls in small sections. Remove structural framing members and lower to ground by means of derricks, platforms hoists, or other suitable methods as approved by the Contracting Officer.

b. Locate demolition and deconstruction equipment throughout the structure and remove materials so as to not impose excessive loads to supporting walls, floors, or framing.

c. Building, or the remaining portions thereof, not exceeding 80 feet in height may be demolished by the mechanical method of demolition.

3.1.2 Utilities and Related Equipment

3.1.2.1 General Requirements

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Contracting Officer. Do not interrupt existing utilities serving facilities occupied and used by the Government except when approved in writing and then only after temporary utility services have been approved and provided. Do not begin demolition or deconstruction work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.

3.1.2.2 Disconnecting Existing Utilities

Remove existing utilities as indicated uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Contracting Officer. When utility lines are encountered but are not indicated on the drawings, notify the Contracting Officer prior to further work in that area. Remove meters and related equipment and deliver to a location in accordance with instructions of the Contracting Officer.

3.1.3 Chain Link Fencing

Remove chain link fencing, gates and other related salvaged items scheduled for removal and transport to designated areas. Remove gates as whole units. Cut chain link fabric to 25 foot lengths and store in rolls off the ground.

3.1.4 Paving and Slabs

Remove sawcut concrete and asphaltic concrete paving and slabs including aggregate base to a depth of 6 inches below new finish grade. Provide neat sawcuts at limits of pavement removal as indicated. Pavement and slabs designated to be recycled and utilized in this project shall be moved, ground and stored as directed by the Contracting Officer. Pavement and slabs not to be used in this project shall be removed from the Installation at Contractor's expense.

3.1.5 Structural Steel

Dismantle structural steel at field connections and in a manner that will prevent bending or damage. Salvage for recycle structural steel, steel joists, girders, angles, plates, columns and shapes. Flame-cutting torches are permitted when other methods of dismantling are not practical. Transport steel joists and girders as whole units and not dismantled.

Transport structural steel shapes to a designated recycling facility, stacked according to size, type of member and length, and stored off the ground, protected from the weather.

3.1.6 Miscellaneous Metal

Salvage shop-fabricated items such as access doors and frames, steel gratings, metal ladders, wire mesh partitions, metal railings, metal windows and similar items as whole units. Salvage light-gage and cold-formed metal framing, such as steel studs, steel trusses, metal gutters, roofing and siding, metal toilet partitions, toilet accessories and similar items. Scrap metal shall become the Contractor's property. Recycle scrap metal as part of demolition and deconstruction operations. Provide separate containers to collect scrap metal and transport to a scrap metal collection or recycling facility, in accordance with the Waste Management Plan.

3.1.7 Carpentry

Salvage for reuse lumber, millwork items, and finished boards, and sort by type and size. Chip or shred and recycle salvaged wood unfit for reuse, except stained, painted, or treated wood. Remove windows, doors, frames, and cabinets, and similar items as whole units, complete with trim and accessories. Do not remove hardware attached to units, except for door closers. Brace the open end of door frames to prevent damage.

3.1.8 Carpet

Remove existing carpet for reclamation in accordance with manufacturer recommendations and as follows. Remove used carpet in large pieces, roll tightly, and pack neatly in a container. Remove adhesive according to recommendations of the Carpet and Rug Institute (CRI). Adhesive removal solvents shall comply with CRI 104. Recycle removed carpet cushion.

3.1.9 Acoustic Ceiling Tile

Remove, neatly stack, and recycle acoustic ceiling tiles. Recycling may be available with manufacturer. Otherwise, priority shall be given to a local recycling organization.

3.1.10 Airfield Lighting

Remove existing airfield lighting as indicated and terminate in a manner satisfactory to the Contracting Officer. Remove edge lights, associated transformers as indicated and deliver to a location on the station in accordance with instructions of the Contracting Officer.

3.1.11 Air Conditioning Equipment

Remove air conditioning, refrigeration, and other equipment containing refrigerants without releasing chlorofluorocarbon refrigerants to the atmosphere in accordance with the Clean Air Act Amendment of 1990. Recover all refrigerants prior to removing air conditioning, refrigeration, and other equipment containing refrigerants and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)." Turn in salvaged Class I ODS refrigerants as specified in paragraph, "Salvaged Materials and Equipment."

3.1.12 Cylinders and Canisters

Remove all fire suppression system cylinders and canisters and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)."

3.1.13 Locksets on Swinging Doors

Remove all locksets from all swinging doors indicated to be removed and disposed of. Deliver the locksets and related items to a designated location for receipt by the Contracting Officer after removal.

3.1.14 Mechanical Equipment and Fixtures

Disconnect mechanical hardware at the nearest connection to existing services to remain, unless otherwise noted. Disconnect mechanical equipment and fixtures at fittings. Remove service valves attached to the unit. Salvage each item of equipment and fixtures as a whole unit; listed, indexed, tagged, and stored. Salvage each unit with its normal operating auxiliary equipment. Transport salvaged equipment and fixtures, including motors and machines, to a designated storage area as directed by the Contracting Officer. Do not remove equipment until approved. Do not offer low-efficiency equipment for reuse; provide to recycling service for disassembly and recycling of parts.

3.1.14.1 Preparation for Storage

Remove water, dirt, dust, and foreign matter from units; tanks, piping and fixtures shall be drained; interiors, if previously used to store flammable, explosive, or other dangerous liquids, shall be steam cleaned. Seal openings with caps, plates, or plugs. Secure motors attached by flexible connections to the unit. Change lubricating systems with the proper oil or grease.

3.1.14.2 Piping

Disconnect piping at unions, flanges and valves, and fittings as required to reduce the pipe into straight lengths for practical storage. Store salvaged piping according to size and type. If the piping that remains can become pressurized due to upstream valve failure, end caps, blind flanges, or other types of plugs or fittings with a pressure gage and bleed valve shall be attached to the open end of the pipe to ensure positive leak control. Carefully dismantle piping that previously contained gas, gasoline, oil, or other dangerous fluids, with precautions taken to prevent injury to persons and property. Store piping outdoors until all fumes and residues are removed. Box prefabricated supports, hangers, plates, valves, and specialty items according to size and type. Wrap sprinkler heads individually in plastic bags before boxing. Classify piping not designated for salvage, or not reusable, as scrap metal.

3.1.14.3 Ducts

Classify removed duct work as scrap metal.

3.1.15 Electrical Equipment and Fixtures

Salvage motors, motor controllers, and operating and control equipment that are attached to the driven equipment. Salvage wiring systems and components. Box loose items and tag for identification. Disconnect

primary, secondary, control, communication, and signal circuits at the point of attachment to their distribution system.

3.1.15.1 Fixtures

Remove and salvage electrical fixtures. Salvage unprotected glassware from the fixture and salvage separately. Salvage incandescent, mercury-vapor, and fluorescent lamps and fluorescent ballasts manufactured prior to 1978, boxed and tagged for identification, and protected from breakage.

3.1.15.2 Electrical Devices

Remove and salvage switches, switchgear, transformers, conductors including wire and nonmetallic sheathed and flexible armored cable, regulators, meters, instruments, plates, circuit breakers, panelboards, outlet boxes, and similar items. Box and tag these items for identification according to type and size.

3.1.15.3 Wiring Ducts or Troughs

Remove and salvage wiring ducts or troughs. Dismantle plug-in ducts and wiring troughs into unit lengths. Remove plug-in or disconnecting devices from the busway and store separately.

3.1.15.4 Conduit and Miscellaneous Items

Salvage conduit except where embedded in concrete or masonry. Consider corroded, bent, or damaged conduit as scrap metal. Sort straight and undamaged lengths of conduit according to size and type. Classify supports, knobs, tubes, cleats, and straps as debris to be removed and disposed.

3.1.16 Elevators and Hoists

Remove elevators, hoists, and similar conveying equipment and salvage as whole units, to the most practical extent. Remove and prepare items for salvage without damage to any of the various parts. Salvage and store rails for structural steel with the equipment as an integral part of the unit.

3.2 CONCURRENT EARTH-MOVING OPERATIONS

Do not begin excavation, filling, and other earth-moving operations that are sequential to demolition or deconstruction work in areas occupied by structures to be demolished or deconstructed until all demolition and deconstruction in the area has been completed and debris removed. Fill holes, open basements and other hazardous openings.

3.3 DISPOSITION OF MATERIAL

3.3.1 Title to Materials

Except for salvaged items specified in related Sections, and for materials or equipment scheduled for salvage, all materials and equipment removed and not reused or salvaged, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition and deconstruction, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition, deconstruction, and removal

procedures, and authorization by the Contracting Officer to begin demolition and deconstruction. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Showing for sale or selling materials and equipment on site is prohibited.

3.3.2 Salvaged Materials and Equipment

Remove materials and equipment that are listed in the Demolition Plan to be removed by the Contractor and that are to remain the property of the Government, and deliver to a storage site , as directed within 10 miles of the work site].

- a. Salvage items and material to the maximum extent possible.
- b. Store all materials salvaged for the Contractor as approved by the Contracting Officer and remove from Government property before completion of the contract. On site sales of salvaged material is prohibited.
- c. Remove salvaged items to remain the property of the Government in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage must be repaired or replaced to match existing items. Properly identify the contents of containers. Deliver the following items reserved as property of the Government to the areas designated: any airfield lighting.
- d. Remove historical items in a manner to prevent damage. Deliver the following historical items to the Government for disposition: Corner stones, contents of corner stones, and document boxes wherever located on the site.

3.3.3 Disposal of Ozone Depleting Substance (ODS)

Class I and Class II ODS are defined in Section, 602(a) and (b), of The Clean Air Act. Prevent discharge of Class I and Class II ODS to the atmosphere. Place recovered ODS in cylinders meeting AHRI Guideline K suitable for the type ODS (filled to no more than 80 percent capacity) and provide appropriate labeling. Recovered ODS shall be removed from Government property and disposed of in accordance with 40 CFR 82. Products, equipment and appliances containing ODS in a sealed, self-contained system (e.g. residential refrigerators and window air conditioners) shall be disposed of in accordance with 40 CFR 82. Submit Receipts or bills of lading, as specified. Submit a shipping receipt or bill of lading for all containers of ozone depleting substance (ODS) shipped to the Defense Depot, Richmond, Virginia.

3.3.3.1 Special Instructions

No more than one type of ODS is permitted in each container. A warning/hazardous label shall be applied to the containers in accordance with Department of Transportation regulations. All cylinders including but not limited to fire extinguishers, spheres, or canisters containing an ODS shall have a tag with the following information:

- a. Activity name and unit identification code
- b. Activity point of contact and phone number

- c. Type of ODS and pounds of ODS contained
- d. Date of shipment
- e. Naval stock number (for information, call (804) 279-4525).

3.3.3.2 Fire Suppression Containers

Deactivate fire suppression system cylinders and canisters with electrical charges or initiators prior to shipment. Also, safety caps must be used to cover exposed actuation mechanisms and discharge ports on these special cylinders.

3.3.4 Transportation Guidance

Ship all ODS containers in accordance with MIL-STD-129, DLA 4145.25 (also referenced one of the following: Army Regulation 700-68, Naval Supply Instruction 4440.128C, Marine Corps Order 10330.2C, and Air Force Regulation 67-12), 49 CFR 173.301, and DOD 4000.25-1-M.

3.3.5 Unsalvageable and Non-Recyclable Material

Dispose of unsalvageable and non-recyclable noncombustible material in the disposal area located on the plans. The fill in the disposal area shall be uniformly graded to drain. Dispose of unsalvageable and non-recyclable combustible material in the sanitary fill area located off the site.

3.4 CLEANUP

Remove debris and rubbish from basement and similar excavations. Remove and transport the debris in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

3.5 DISPOSAL OF REMOVED MATERIALS

3.5.1 Regulation of Removed Materials

Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations with all applicable federal, state and local regulations as contractually specified in the Waste Management Plan.

3.5.2 Burning on Government Property

Burning of materials removed from demolished and deconstructed structures will not be permitted on Government property.

3.5.3 Removal to Spoil Areas on Government Property

Transport noncombustible materials removed from demolition and deconstruction structures to designated spoil areas on Government property.

3.5.4 Removal from Government Property

Transport waste materials removed from demolished and deconstructed structures, except waste soil, from Government property for legal disposal. Dispose of waste soil as directed.

3.6 REUSE OF SALVAGED ITEMS

Recondition salvaged materials and equipment designated for reuse before installation. Replace items damaged during removal and salvage operations or restore them as necessary to usable condition.

-- End of Section --

SECTION 03 30 00.00 10

CAST-IN-PLACE CONCRETE
11/10

PART 1 GENERAL

1.1 UNIT PRICES

1.1.1 Measurement

Measurement of concrete for payment will be made on the basis of the actual volume within the pay lines of the structure as indicated on the contract drawings. Measurement for payment of concrete placed against the sides of any excavation without intervening forms will be made only within the pay lines of the structure as shown on the contract drawings. No deductions will be made for rounded or beveled edges, for space occupied by metal work, for conduits, for voids, or for embedded items which are less than 5 cubic feet in volume or 1 square foot in cross section.

1.1.2 Payment

Unless otherwise specified, payment for concrete will be made at the respective unit prices per cubic yard for the various items of the schedule, measured as specified above, which price includes the cost of all labor, materials, and the use of equipment and tools required to complete the concrete work, except for any reinforcement and embedded parts specified to be paid separately. Unit price payment will not be made for concrete placed in structures for which payment is made as a lump sum.

1.2 LUMP SUM CONTRACT

Under this type of contract, concrete items will be paid for by lump sum and will not be measured. The work covered by these items consists of furnishing all concrete materials, reinforcement, miscellaneous embedded materials, and equipment, and performing all labor for the forming, manufacture, transporting, placing, finishing, curing, and protection of concrete in these structures.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

- | | |
|-----------|--|
| ACI 117 | (2010) Specifications for Tolerances for Concrete Construction and Materials and Commentary |
| ACI 211.1 | (1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete |
| ACI 211.2 | (1998; R 2004) Standard Practice for Selecting Proportions for Structural |

Lightweight Concrete

ACI 214R	(2002; Errata 2010) Evaluation of Strength Test Results of Concrete
ACI 301	(2010) Specifications for Structural Concrete
ACI 305.1	(2006) Specification for Hot Weather Concreting
ACI 318	(2008; Errata 2010; Errata 2010) Building Code Requirements for Structural Concrete and Commentary

ASTM INTERNATIONAL (ASTM)

ASTM C 1017/C 1017M	(2007) Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1059/C 1059M	(1999; R 2008) Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete
ASTM C 1064/C 1064M	(2008) Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C 1077	(2010d) Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 1107/C 1107M	(2008) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 1116/C 1116M	(2010a) Standard Specification for Fiber-Reinforced Concrete
ASTM C 1240	(2010a) Standard Specification for Silica Fume Used in Cementitious Mixtures
ASTM C 1260	(2007) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C 131	(2006) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143/C 143M	(2010) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C 150/C 150M	(2009) Standard Specification for Portland

Cement

ASTM C 1567	(2008) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C 173/C 173M	(2010b) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 192/C 192M	(2007) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 31/C 31M	(2010) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 33/C 33M	(2011) Standard Specification for Concrete Aggregates
ASTM C 330	(2009) Standard Specification for Lightweight Aggregates for Structural Concrete
ASTM C 39/C 39M	(2010) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42/C 42M	(2010a) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 494/C 494M	(2010a) Standard Specification for Chemical Admixtures for Concrete
ASTM C 552	(2007) Standard Specification for Cellular Glass Thermal Insulation
ASTM C 567	(2005a) Determining Density of Structural Lightweight Concrete
ASTM C 578	(2010a) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(2009) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 595/C 595M	(2010) Standard Specification for Blended Hydraulic Cements
ASTM C 618	(2008a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C 685/C 685M	(2010) Concrete Made by Volumetric Batching and Continuous Mixing

ASTM C 881/C 881M	(2010) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 937	(2010) Grout Fluidifier for Preplaced-Aggregate Concrete
ASTM C 94/C 94M	(2010a) Standard Specification for Ready-Mixed Concrete
ASTM C 989	(2010) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C172/C172M	(2010) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C231/C231M	(2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C78/C78M	(2010) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM D 75/D 75M	(2009) Standard Practice for Sampling Aggregates
ASTM E 1155	(1996; R 2008) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers
ASTM E 96/E 96M	(2010) Standard Test Methods for Water Vapor Transmission of Materials
NATIONAL READY MIXED CONCRETE ASSOCIATION (NRMCA)	
NRMCA CPMB 100	(2000; R 2006) Concrete Plant Standards
NRMCA QC 3	(2003) Quality Control Manual: Section 3, Plant Certifications Checklist: Certification of Ready Mixed Concrete Production Facilities
NRMCA TMMB 100	(2001; R 2007) Truck Mixer, Agitator and Front Discharge Concrete Carrier Standards
U.S. ARMY CORPS OF ENGINEERS (USACE)	
COE CRD-C 104	(1980) Method of Calculation of the Fineness Modulus of Aggregate
COE CRD-C 400	(1963) Requirements for Water for Use in Mixing or Curing Concrete
COE CRD-C 521	(1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete

COE CRD-C 94

(1995) Corps of Engineers Specification
for Surface Retarders

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED

(2002; R 2009) Leadership in Energy and
Environmental Design(tm) Green Building
Rating System for New Construction
(LEED-NC)

1.4 SYSTEM DESCRIPTION

Provide concrete composed of [portland cement](#), other cementitious and pozzolanic materials as specified, aggregates, water and admixtures as specified.

1.4.1 Proportioning Studies-Normal Weight Conc

Trial design batches, [mixture proportions](#) studies, and testing requirements for various classes and types of concrete specified are the responsibility of the Contractor. Except as specified for flexural strength concrete, mixture proportions shall be based on compressive strength as determined by test specimens fabricated in accordance with [ASTM C 192/C 192M](#) and tested in accordance with [ASTM C 39/C 39M](#).

- a. Samples of all materials used in mixture proportioning studies shall be representative of those proposed for use in the project and be accompanied by the manufacturer's or producer's test reports indicating compliance with these specifications.
- b. Make trial mixtures having proportions, consistencies, and air content suitable for the work based on methodology described in [ACI 211.1](#), using at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required on the project.
- c. The maximum water-cement ratios required in subparagraph Water-Cement Ratio below will be the equivalent water-cement ratio as determined by conversion from the weight ratio of water to cement plus pozzolan, silica fume, and ground granulated blast furnace slag (GGBF slag) by the weight equivalency method as described in [ACI 211.1](#). In the case where silica fume or GGBF slag is used, the weight of the silica fume and GGBF slag shall be included in the equations in [ACI 211.1](#) for the term P, which is used to denote the weight of pozzolan. If pozzolan is used in the concrete mixture, the minimum pozzolan content shall be 15 percent by weight of the total cementitious material, and the maximum shall be 35 percent.
- d. Design laboratory trial mixtures for maximum permitted slump and air content. Make separate sets of trial mixture studies for each combination of cementitious materials and each combination of admixtures proposed for use. No combination of either shall be used until proven by such studies, except that, if approved in writing and otherwise permitted by these specifications, an accelerator or a retarder may be used without separate trial mixture study. Separate trial mixture studies shall also be made for concrete for any conveying or placing method proposed which requires special properties and for concrete to be placed in unusually difficult placing locations.

- e. Report the temperature of concrete in each trial batch. For each water-cement ratio, at least three test cylinders for each test age shall be made, cured in accordance with [ASTM C 192/C 192M](#) and tested at 7 and 28 days in accordance with [ASTM C 39/C 39M](#). From these test results, plot a curve showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition, a curve shall be plotted showing the relationship between 7 day and 28 day strengths. Design each mixture to promote easy and suitable concrete placement, consolidation and finishing, and to prevent segregation and excessive bleeding.
- f. Submit the results of trial mixture design studies along with a statement giving the maximum nominal coarse aggregate size and the proportions of ingredients that will be used in the manufacture of each strength or class of concrete, at least 14 days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface dry condition. Accompany the statement with test results from an approved independent commercial testing laboratory, showing that mixture design studies have been made with materials proposed for the project and that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the mixture design studies without additional tests to show that the quality of the concrete is satisfactory.

1.4.2 Proportioning Studies-Flexural Strength Conc

Trial design batches, mixture proportioning studies, and testing requirements shall conform to the requirements specified in paragraph Proportioning Studies for Normal Weight Concrete above, except that proportions shall be based on flexural strength as determined by test specimens (beams) fabricated in accordance with [ASTM C 192/C 192M](#) and tested in accordance with [ASTM C 78/C 78M](#). Modify procedures given in [ACI 211.1](#) as necessary to accommodate flexural strength.

1.4.3 Proportioning Studies-Lightweight Aggregate Structural Conc

Trial design batches, mixture proportioning studies, and testing requirements shall conform to the requirements specified in paragraph Proportioning Studies for Normal Weight Concrete above, except as follows. Trial mixtures having proportions, consistencies and air content suitable for the work shall be made based on methodology described in [ACI 211.2](#), using at least three different cement contents. Proportion trial mixes to produce air dry unit weight, concrete strengths, maximum permitted slump, and air content. Test specimens and testing shall be as specified for normal weight concrete except that 28-day compressive strength shall be determined from test cylinders that have been air dried at 50 percent relative humidity for the last 21 days. Determine air dry unit weight in accordance with [ASTM C 567](#), designed to be at least 2.0 pcf less than the maximum specified air dry unit weight. Plot curves using these results showing the relationship between cement factor and strength and air dry unit weight. Normal weight fine aggregate may be substituted for part or all of the lightweight fine aggregate, provided the concrete meets the strength and unit weight. A correlation shall also be developed showing the ratio between air dry unit weight and fresh concrete unit weight for each mix.

1.4.4 Average Compressive Strength

The mixture proportions selected during mixture design studies shall produce a required average compressive strength (f'_{cr}) exceeding the specified compressive strength (f'_c) by the amount indicated below. This required average compressive strength, f'_{cr} , will not be a required acceptance criteria during concrete production. However, whenever the daily average compressive strength at 28 days drops below f'_{cr} during concrete production, or daily average 7-day strength drops below a strength correlated with the 28-day f'_{cr} , adjust the mixture, as approved, to bring the daily average back up to f'_{cr} . During production, the required f'_{cr} shall be adjusted, as appropriate, based on the standard deviation being attained on the job.

1.4.5 Computations from Test Records

Where a concrete production facility has test records, establish a standard deviation in accordance with the applicable provisions of [ACI 214R](#). Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected; shall represent concrete produced to meet a specified strength or strengths (f'_c) within 1,000 psi of that specified for proposed work; and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days. Required average compressive strength f'_{cr} used as the basis for selection of concrete proportions shall be the larger of the equations that follow using the standard deviation as determined above:

$$f'_{cr} = f'_c + 1.34S \text{ where units are in psi}$$

$$f'_{cr} = f'_c + 2.33S - 500 \text{ where units are in psi}$$

Where S = standard deviation

Where a concrete production facility does not have test records meeting the requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation shall be established as the product of the calculated standard deviation and a modification factor from the following table:

NUMBER OF TESTS	MODIFICATION FACTOR FOR STANDARD DEVIATION
15	1.16
20	1.08
25	1.03
30 or more	1.00

1.4.6 Computations without Previous Test Records

When a concrete production facility does not have sufficient field strength test records for calculation of the standard deviation, the required average strength f'_{cr} shall be determined as follows:

- a. If the specified compressive strength f'_c is less than 3,000 psi,

$$f'_{cr} = f'_c + 1000 \text{ psi}$$

- b. If the specified compressive strength f'_c is 3,000 to 5,000 psi,

$$f'_{cr} = f'_c + 1,200 \text{ psi}$$

- c. If the specified compressive strength f'_c is over 5,000 psi,

$$f'_{cr} = f'_c + 1,400 \text{ psi}$$

1.4.7 Average Flexural Strength Required for Mixtures

The mixture proportions selected during mixture design studies for flexural strength mixtures and the mixture used during concrete production shall be designed and adjusted during concrete production as approved, except that the overdesign for average flexural strength shall simply be 15 percent greater than the specified flexural strength at all times.

1.4.8 Mix Design for Bonded Topping for Heavy Duty Floors

The concrete mix design for bonded topping for heavy duty floors shall contain the greatest practical proportion of coarse aggregate within the specified proportion limits. Design the mix to produce concrete having a 28-day strength of at least 5000 psi. Concrete for the topping shall consist of the following proportions, by weight:

- 1.00 part portland cement
- 1.15 to 1.25 parts fine aggregate
- 1.80 to 2.00 parts coarse aggregate

Maximum w/c shall be 0.33. The topping concrete shall not be air-entrained. The concrete shall be mixed so as to produce a mixture of the driest consistency possible to work with a sawing motion of the strike-off and which can be floated and compacted as specified without producing water or excess cement at the surface. In no case shall slump exceed 1 inch as determined by ASTM C 143/C 143M.

1.4.9 Tolerances

Except as otherwise specified herein, tolerances for concrete batching, mixture properties, and construction as well as definition of terms and application practices shall be in accordance with ACI 117. Take level and grade tolerance measurements of slabs as soon as possible after finishing; when forms or shoring are used, the measurements shall be made prior to removal.

1.4.10 Floor Finish

For the purpose of this Section the following terminology correlation between ACI 117 and this Section shall apply:

Floor Profile Quality Classification From ACI 117	This Section
Conventional Bullfloated	Same
Conventional Straightedged	Same

Floor Profile Quality Classification From ACI 117	This Section
Flat	Float Finish or Trowel Finish
Very Flat	Same. Use only with F-system

Levelness tolerance does not apply where design requires floors to be sloped to drains or sloped for other reasons.

1.4.10.1 Floors by the F-Number System

The flatness and levelness of floors shall be carefully controlled and the tolerances shall be measured by the F-Number system of Paragraph 4.8.5 and 4.8.5.1 of **ACI 117**. Furnish an approved floor profilograph or other equipment capable of measuring the floor flatness (FF) number and the floor levelness (FL) number in accordance with **ASTM E 1155**. Perform the tolerance measurements within 72 hours after floor slab construction while being observed by the Contracting Officer. The tolerances of surfaces beyond the limits of **ASTM E 1155** (the areas within 24 inches of embedments and construction joints) will be acceptable to the Contracting Officer. Tolerances of the following areas shall meet the requirements for the listed surfaces as specified in paragraphs 4.8.5 and 4.8.5.1 of **ACI 117**.

Surface	Areas
Bullfloated	[_____]
Straightedged	[_____]
Float Finish	[_____]
Trowel Finish	[_____]
Very Flat	[_____]

1.4.10.2 Floors by the Straightedge System

The flatness of the floors shall be carefully controlled and the tolerances shall be measured by the straightedge system as specified in paragraph 4.5.7 of **ACI 117**, using a 10 foot straightedge, within 72 hours after floor slab installation and before shores and/or forms are removed. The listed tolerances shall be met at any and every location at which the straightedge can be placed.

Bullfloated	[_____]
Straightedged	[_____]
Float Finish	[_____]

Bullfloated	[_____]
Trowel Finish	[_____]

1.4.11 Strength Requirements

Specified compressive strength (f'c) shall be as follows:

COMPRESSIVE STRENGTH	STRUCTURE OR PORTION OF STRUCTURE
5000 psi at 28 days	Aircraft Apron
[4000 psi at 28 days	[_____]
[3000 psi at 28 days	[_____]
[[_____] psi at [_____] days	[_____]

Concrete slabs on-grade shall have a 28-day flexural strength of 650 psi. Concrete made with high-early strength cement shall have a 7-day strength equal to the specified 28-day strength for concrete made with Type I or II portland cement. Compressive strength shall be determined in accordance with ASTM C 39/C 39M. Flexural strength shall be determined in accordance with ASTM C78/C78M.

- a. Evaluation of Concrete Compressive Strength. Fabricate compressive strength specimens (6 by 12 inch cylinders), laboratory cure them in accordance with ASTM C 31/C 31M and test them in accordance with ASTM C 39/C 39M. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength f'c and no individual test result falls below the specified strength f'c by more than 500 psi. A "test" is defined as the average of two companion cylinders, or if only one cylinder is tested, the results of the single cylinder test. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the structure is considered potentially deficient.
- b. Investigation of Low-Strength Compressive Test Results. When any strength test of standard-cured test cylinders falls below the specified strength requirement by more than 500 psi or if tests of field-cured cylinders indicate deficiencies in protection and curing, take steps to assure that the load-carrying capacity of the structure is not jeopardized. When the strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42/C 42M. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores will be determined by the Contracting Officer to least impair the strength of the structure. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength

requirement. Non-destructive tests (tests other than test cylinders or cores) shall not be used as a basis for acceptance or rejection. Perform the coring and repair the holes; cores will be tested by the Government.

- c. Load Tests. If the core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be directed by the Contracting Officer in accordance with the requirements of **ACI 318**. Concrete work evaluated by structural analysis or by results of a load test as being understrength shall be corrected in a manner satisfactory to the Contracting Officer. All investigations, testing, load tests, and correction of deficiencies shall be performed by and at the expense of the Contractor and approved by the Contracting Officer, except that if all concrete is found to be in compliance with the drawings and specifications, the cost of investigations, testing, and load tests will be at the expense of the Government.
- d. Evaluation of Concrete Flexural Strength. Fabricate flexural strength specimens (beams) laboratory cure them in accordance with **ASTM C 31/C 31M** and test them in accordance with **ASTM C78/C78M**. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified flexural strength and no individual test result falls below the specified flexural strength by more than **50 psi**. A "test" is defined as the average of two companion beams. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the slab is considered potentially deficient.

1.4.12 Water-Cement Ratio

Maximum water-cement ratio (w/c) for normal weight concrete shall be as follows:

WATER-CEMENT RATIO, BY WEIGHT	STRUCTURE OR PORTION OF STRUCTURE
[0.40]	[_____]
0.45	Aircraft Apron
[0.50]	[_____]
[0.55]	[_____]
[_____]	[_____]

These w/c's may cause higher strengths than that required above for compressive or flexural strength. The maximum w/c required will be the equivalent w/c as determined by conversion from the weight ratio of water to cement plus pozzolan, silica fume, and ground granulated blast furnace slag (GGBF slag) by the weight equivalency method as described in **ACI 211.1**. In the case where silica fume or GGBF slag is used, the weight of the silica fume and GGBF slag shall be included in the equations of **ACI 211.1** for the term P which is used to denote the weight of pozzolan.

1.4.13 Air Entrainment

Except as otherwise specified for lightweight concrete, all normal weight concrete shall be air entrained to contain between 4 and 7 percent total air, except that when the nominal maximum size coarse aggregate is $3/4$ inch or smaller it shall be between 4.5 and 7.5 percent. Concrete with specified strength over 5000 psi may have 1.0 percent less air than specified above. Specified air content shall be attained at point of placement into the forms. Air content for normal weight concrete shall be determined in accordance with ASTM C231/C231M. Lightweight concrete in the [_____] parts of the structure shall be air-entrained with a total air content of 4.5 to 7.5 percent, except that if the nominal maximum size coarse aggregate is $3/8$ inch or less, the air content shall be 5.5 to 8.5 percent. Air content for lightweight concrete shall be determined in accordance with ASTM C 173/C 173M.

1.4.14 Slump

Slump of the concrete, as delivered to the point of placement into the forms, shall be within the following limits. Slump shall be determined in accordance with ASTM C 143/C 143M.

Structural Element	Slump	
	Minimum	Maximum
Walls, columns and beams	2 in.	4 in.
Foundation walls, substructure walls, footings, slabs	1 in.	3 in.
Any structural concrete approved for placement by pumping:		
At pump	2 in.	6 in.
At discharge of line	1 in.	4 in.

When use of a plasticizing admixture conforming to ASTM C 1017/C 1017M or when a Type F or G high range water reducing admixture conforming to ASTM C 494/C 494M is permitted to increase the slump of concrete, concrete shall have a slump of 2 to 4 inches before the admixture is added and a maximum slump of 8 inches at the point of delivery after the admixture is added.

1.4.15 Concrete Temperature

The temperature of the concrete as delivered shall not exceed 90 degrees F. When the ambient temperature during placing is 40 degrees F or less, or is expected to be at any time within 6 hours after placing, the temperature of the concrete as delivered shall be between 55 and 75 degrees F.

1.4.16 Size of Coarse Aggregate

Use the largest feasible nominal maximum size aggregate (NMSA), specified in PART 2 paragraph AGGREGATES, in each placement. However, nominal maximum size of aggregate shall not exceed any of the following: three-fourths of the minimum cover for reinforcing bars, three-fourths of

the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.

1.4.17 Lightweight Aggregate Structural Concrete

Lightweight aggregate structural concrete shall conform to the requirements specified for normal weight concrete except as specified herein. Specified compressive strength shall be at least 5,000 at 28 days, as determined by test specimens that have been air dried at 50 percent relative humidity for the last 21 days. Air-dry unit weight shall not be over [_____] at equilibrium as determined by [ASTM C 567](#). However, fresh unit weight shall be used for acceptance during concreting, using a correlation factor between the two types of unit weight as determined during mixture design studies. Lightweight aggregate structural concrete floor fill shall have a 28-day compressive strength of at least 2500 psi and an air-dry unit weight not exceeding 115 pcf at equilibrium.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section [01 33 00 SUBMITTAL PROCEDURES](#):

[SD-03 Product Data](#)

[Recycled Content Products](#); ([LEED](#))
[Portland Cement](#); ([LEED](#))
[Ready-Mixed Concrete](#); ([LEED](#))
[Vapor Barrier](#)
[Latex Bonding Agent](#); ([LEED](#))
[Floor Finish](#); ([LEED](#))
[Floor Hardener](#); ([LEED](#))
[Chemical Admixtures](#)
[Epoxy Resin](#); ([LEED](#))

[Low-Emitting Materials](#); ([LEED](#))

Submit manufacturer's product data, indicating VOC content. Manufacturer's catalog data for the following items must include printed instructions for admixtures, bonding agents, epoxy-resin adhesive binders, waterstops, and liquid chemical floor hardeners.

[Local/Regional Materials](#); ([LEED](#))

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.]

[Recycled Content](#); ([LEED](#))

Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

SD-04 Samples

Surface Retarder

SD-05 Design Data

Mixture Proportions; G
Lightweight Aggregate Concrete

SD-06 Test Reports

Testing and Inspection for CQC; G

SD-07 Certificates

Qualifications

1.6 QUALITY ASSURANCE

Submit [qualifications](#) for Contractor Quality Control personnel assigned to concrete construction as American Concrete Institute (ACI) Certified Workmen in one of the following grades or show written evidence of having completed similar qualification programs:

Concrete Field Testing Technician	Grade I
Concrete Laboratory Testing Technician	Grade I or II
Concrete Construction Inspector	Level II
Concrete Transportation Construction Inspector or Reinforced Concrete Special Inspector	Jointly certified by American Concrete Institute (ACI), Building Official and Code Administrators International (BOCA), International Code Council (ICC), and Southern Building Code Congress International (SBCCI)
Foreman or Lead Journeyman of the flatwork finishing crew	Similar qualification for ACI Concrete Flatwork Technician/Finisher or equal, with written documentation

1.6.1 Pre-installation Meeting

A pre-installation meeting with the Contracting Officer will be required at least 10 days prior to start of construction on . The Contractor is responsible for calling the meeting; the Project Superintendent and active installation personnel shall be present.

1.6.2 Special Properties and Products

Concrete may contain admixtures other than air entraining agents, such as water reducers, superplasticizers, or set retarding agents to provide special properties to the concrete, if specified or approved. Any of these

materials to be used on the project shall be used in the mix design studies.

1.6.3 Technical Service for Specialized Concrete

Obtain the services of a factory trained technical representative to oversee proportioning, batching, mixing, placing, consolidating, and finishing of specialized structural concrete. The technical representative shall be on the job full time until the Contracting Officer is satisfied that field controls indicate concrete of specified quality is furnished and that the Contractor's crews are capable of continued satisfactory work. The technical representative shall be available for consultation with, and advice to, Government forces.

1.6.4 Government Assurance Inspection and Testing

Day-to day inspection and testing shall be the responsibility of the Contractor Quality Control (CQC) staff. However, representatives of the Contracting Officer can and will inspect construction as considered appropriate and will monitor operations of the Contractor's CQC staff. Government inspection or testing will not relieve the Contractor of any CQC responsibilities.

1.6.4.1 Materials

The Government will sample and test aggregates, cementitious materials, other materials, and concrete to determine compliance with the specifications as considered appropriate. Provide facilities and labor as may be necessary for procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with [ASTM D 75/D 75M](#). Other materials will be sampled from storage at the jobsite or from other locations as considered appropriate. Samples may be placed in storage for later testing when appropriate.

1.6.4.2 Fresh Concrete

Fresh concrete will be sampled as delivered in accordance with [ASTM C172/C172M](#) and tested in accordance with these specifications, as considered necessary.

1.6.4.3 Hardened Concrete

Tests on hardened concrete will be performed by the Government when such tests are considered necessary.

1.6.4.4 Inspection

Concrete operations may be tested and inspected by the Government as the project progresses. Failure to detect defective work or material will not prevent rejection later when a defect is discovered nor will it obligate the Government for final acceptance.

1.7 DELIVERY, STORAGE, AND HANDLING

Store cement and other cementitious materials in weathertight buildings, bins, or silos which will exclude moisture and contaminants and keep each material completely separated. Aggregate stockpiles shall be arranged and used in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of aggregates. Aggregate shall not be stored directly on ground unless a sacrificial layer

is left undisturbed. Store reinforcing bars and accessories above the ground on platforms, skids or other supports. Other materials shall be stored in such a manner as to avoid contamination and deterioration. Admixtures which have been in storage at the project site for longer than 6 months or which have been subjected to freezing shall not be used unless retested and proven to meet the specified requirements. Materials shall be capable of being accurately identified after bundles or containers are opened.

PART 2 PRODUCTS

In accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS submit documentation indicating: distance between manufacturing facility and the project site, distance of raw material origin from the project site, percentage of post-industrial and post-consumer recycled content per unit of product and relative dollar value of recycled content products to total dollar value of products included in project. Submittals shall be as specified in the subject Section.

2.1 CEMENTITIOUS MATERIALS

Cementitious Materials shall be portland cement, portland-pozzolan cement, portland blast-furnace slag cement, or portland cement in combination with pozzolan or ground granulated blast furnace slag conforming to appropriate specifications listed below. Restrict usage of cementitious materials in concrete that will have surfaces exposed in the completed structure so there is no change in color, source, or type of cementitious material.

2.1.1 Portland Cement

ASTM C 150/C 150M, Type I low alkali with a maximum 15 percent amount of tricalcium aluminate, or Type II low alkali or Type V. White portland cement shall meet the above requirements except that it may be Type I, Type II or Type III low alkali. White Type III shall be used only in specific areas of the structure, when approved in writing.

2.1.2 High-Early-Strength Portland Cement

ASTM C 150/C 150M, Type III with tricalcium aluminate limited to 5 percent, low alkali. Use Type III cement only in isolated instances and only when approved in writing.

2.1.3 Blended Cements

ASTM C 595/C 595M, Type IP IS .

2.1.4 Pozzolan (Fly Ash)

Pozzolan shall conform to ASTM C 618, Class C or F, including low alkali uniformity, requirements in Table 3 of ASTM C 618. If pozzolan is used, it shall never be less than 15 percent nor more than 35 percent by weight of the total cementitious material. Comply with EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS.

2.1.5 Ground Granulated Blast-Furnace (GGBF) Slag

ASTM C 989, Grade 120.

2.1.6 Silica Fume

Silica fume shall conform to [ASTM C 1240](#). Available alkalis shall conform to the optimal limit given in Table 2 of [ASTM C 1240](#). Silica fume may be furnished as a dry, densified material or as a slurry. In accordance with paragraph Technical Service for Specialized Concrete in PART 1, provide at no cost to the Government the services of a manufacturer's technical representative experienced in mixing, proportioning, placement procedures, and curing of concrete containing silica fume.

2.2 AGGREGATES

Fine and coarse aggregates shall "be tested and evaluated for alkali-aggregate reactivity in accordance with [ASTM C 1260](#). The fine and coarse aggregates shall be evaluated separately and in combination, which matches the Contractor's proposed mix design proportioning. All results of the separate and combination testing shall have a measured expansion less than 0.10 (0.08) percent at 16 days after casting. Should the test data indicate an expansion of 0.10 (0.08) percent or greater, the aggregate(s) shall be rejected or additional testing using [ASTM C 1260](#) and [ASTM C 1567](#) shall be performed. The additional testing using [ASTM C 1260](#) and [ASTM C 1567](#) shall be performed using the low alkali portland cement in combination with ground granulated blast furnace (GGBF) slag, or Class F fly ash. GGBF slag shall be used in the range of 40 to 50 percent of the total cementitious material by mass. Class F fly ash shall be used in the range of 25 to 40 percent of the total cementitious material by mass."

2.2.1 Fine Aggregate

Fine aggregate shall conform to the quality and gradation requirements of [ASTM C 33/C 33M](#).

2.2.2 Coarse Aggregate

Coarse aggregate shall conform to [ASTM C 33/C 33M](#), Class 5S, size designation 7.

2.2.3 Lightweight Aggregate

Lightweight fine and coarse aggregate shall conform to the quality and gradation requirements of [ASTM C 330](#), size 7 for coarse aggregate. Prewet and vacuum saturate lightweight aggregate in accordance with the Manufacturer's instructions unless otherwise specified. For pumped concrete, prewet sufficiently to ensure that slump loss through the pump line does not exceed 4 inches.

2.2.4 Materials for Bonded Topping for Heavy Duty Floors

In addition to the requirements specified above, coarse aggregate used for this purpose shall be a well graded, hard, sound diabase, trap rock, emery, granite or other natural or manufactured aggregate having equivalent hardness and wearing qualities and shall have a percentage of loss not to exceed 30 after 500 revolutions when tested in accordance with [ASTM C 131](#). Gradation of the aggregates when tested in accordance with [ASTM C 136](#) shall be as follows:

Coarse Aggregate	
Sieve Size	Cumulative Percent Cumulative Percent
3/4 in.	100
1/2 in.	50-100
3/8 in.	25-50
No. 4	0-15
No. 8	0-8

Fine Aggregate	
Sieve Size	Cumulative Percent
3/8 in.	100
No. 4	95-100
No. 8	65-80
No. 16	45-65
No. 30	25-45
No. 50	5-15
No. 100	0-5

2.3 CHEMICAL ADMIXTURES

Chemical admixtures, when required or permitted, shall conform to the appropriate specification listed. Admixtures shall be furnished in liquid form and of suitable concentration for easy, accurate control of dispensing.

2.3.1 Air-Entraining Admixture

ASTM C260/C260M and shall consistently entrain the air content in the specified ranges under field conditions.

2.3.2 Accelerating Admixture

ASTM C 494/C 494M, Type C or E, except that calcium chloride or admixtures containing calcium chloride shall not be used.

2.3.3 Water-Reducing or Retarding Admixture

ASTM C 494/C 494M, Type A, B, or D, except that the 6-month and 1-year compressive and flexural strength tests are waived.

2.3.4 High-Range Water Reducer

ASTM C 494/C 494M, Type F or G, except that the 6-month and 1-year strength requirements are waived. The admixture shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

2.3.5 Surface Retarder

COE CRD-C 94. Submit sample of surface retarder material with manufacturer's instructions for application in conjunction with air-water cutting.

2.3.6 Expanding Admixture

Aluminum powder type expanding admixture conforming to ASTM C 937.

2.3.7 Other Chemical Admixtures

Chemical admixtures for use in producing flowing concrete shall comply with ASTM C 1017/C 1017M, Type I or II. These admixtures shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

2.4 WATER

Water for mixing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that non-potable water may be used if it meets the requirements of COE CRD-C 400.

2.5 NONSHRINK GROUT

Nonshrink grout shall conform to ASTM C 1107/C 1107M, and shall be a commercial formulation suitable for the proposed application.

2.6 NONSLIP SURFACING MATERIAL

Provide nonslip surfacing material consisting of 55 percent, minimum, aluminum oxide or silicon-dioxide abrasive ceramically bonded together to form a homogeneous material sufficiently porous to provide a good bond with portland cement paste; or factory-graded emery aggregate consisting of not less than 45 percent aluminum oxide and 25 percent ferric oxide. The aggregate shall be well graded from particles retained on the No. 30 sieve to particles passing the No. 8 sieve.

2.7 LATEX BONDING AGENT

Latex agents for bonding fresh to hardened concrete shall conform to ASTM C 1059/C 1059M.

2.8 EPOXY RESIN

Epoxy resins for use in repairs shall conform to ASTM C 881/C 881M, Type V, Grade 2. Class as appropriate to the existing ambient and surface temperatures. Submit manufacturer's product data, indicating VOC content. Manufacturer's catalog data for the items above, including printed instructions.

2.9 EMBEDDED ITEMS

Embedded items shall be of the size and type indicated or as needed for the application. Dovetail slots shall be galvanized steel. Hangers for suspended ceilings shall be as specified in Section 09 51 00 ACOUSTICAL CEILINGS. Inserts for shelf angles and bolt hangers shall be of malleable iron or cast or wrought steel.

2.10 FLOOR HARDENER

Floor hardener shall be a colorless aqueous solution containing zinc silicofluoride, magnesium silicofluoride, or sodium silicofluoride. These silicofluorides can be used individually or in combination. Proprietary hardeners may be used if approved in writing by the Contracting Officer.

2.11 PERIMETER INSULATION

Perimeter insulation shall be polystyrene conforming to ASTM C 578, Type II; polyurethane conforming to ASTM C 591, Type II; or cellular glass conforming to ASTM C 552, Type I or IV. Comply with EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS.

2.12 VAPOR BARRIER

Vapor barrier shall be polyethylene sheeting with a minimum thickness of 6 mils or other equivalent material having a vapor permeance rating not exceeding 0.5 perms as determined in accordance with ASTM E 96/E 96M.

2.13 JOINT MATERIALS

2.13.1 Joint Fillers, Sealers, and Waterstops

Materials for expansion joint fillers and waterstops shall be in accordance with Section 03 15 00.00 10 CONCRETE ACCESSORIES. Materials for and sealing of joints shall conform to the requirements of Section 32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS .

2.13.2 Contraction Joints in Slabs

Materials for contraction joint inserts shall be in accordance with Section 03 15 00.00 10 CONCRETE ACCESSORIES.

PART 3 EXECUTION

3.1 PREPARATION FOR PLACING

Before commencing concrete placement, perform the following: Surfaces to receive concrete shall be clean and free from frost, ice, mud, and water. Forms shall be in place, cleaned, coated, and adequately supported, in accordance with Section 03 11 13.00 10 STRUCTURAL CONCRETE FORMWORK. Reinforcing steel shall be in place, cleaned, tied, and adequately supported, in accordance with Section 03 20 00.00 10 CONCRETE REINFORCEMENT. Transporting and conveying equipment shall be in-place, ready for use, clean, and free of hardened concrete and foreign material. Equipment for consolidating concrete shall be at the placing site and in proper working order. Equipment and material for curing and for protecting concrete from weather or mechanical damage shall be at the placing site, in proper working condition and in sufficient amount for the entire placement. When hot, windy conditions during concreting appear probable, equipment and material shall be at the placing site to provide windbreaks, shading, fogging, or other action to prevent plastic shrinkage cracking or other damaging drying of the concrete.

3.1.1 Foundations

3.1.1.1 Concrete on Earth Foundations

Earth (subgrade, base, or subbase courses) surfaces upon which concrete is to be placed shall be clean, damp, and free from debris, frost, ice, and standing or running water. Prior to placement of concrete, the foundation shall be well drained and shall be satisfactorily graded and uniformly compacted.

3.1.1.2 Preparation of Rock

Rock surfaces upon which concrete is to be placed shall be free from oil, standing or running water, ice, mud, drummy rock, coating, debris, and loose, semidetached or unsound fragments. Joints in rock shall be cleaned to a satisfactory depth, as determined by the Contracting Officer, and to firm rock on the sides. Immediately before the concrete is placed, rock surfaces shall be cleaned thoroughly by the use of air-water jets or sandblasting as specified below for Previously Placed Concrete. Keep rock surfaces continuously moist for at least 24 hours immediately prior to placing concrete thereon. All horizontal and approximately horizontal surfaces shall be covered, immediately before the concrete is placed, with a layer of mortar proportioned similar to that in the concrete mixture. Place concrete before the mortar stiffens.

3.1.1.3 Excavated Surfaces in Lieu of Forms

Concrete for footings and walls may be placed directly against the soil provided the earth or rock has been carefully trimmed, is uniform and stable, and meets the compaction requirements of Section 31 00 00 EARTHWORK. Place the concrete without becoming contaminated by loose material, and outlined within the specified tolerances.

3.1.2 Previously Placed Concrete

Concrete surfaces to which additional concrete is to be bonded shall be prepared for receiving the next horizontal lift by cleaning the construction joint surface with either air-water cutting, sandblasting, high-pressure water jet, or other approved method. Prepare concrete at the side of vertical construction joints as approved by the Contracting Officer. Air-water cutting shall not be used on formed surfaces or surfaces congested with reinforcing steel. Regardless of the method used, the resulting surfaces shall be free from all laitance and inferior concrete so that clean surfaces of well bonded coarse aggregate are exposed and make up at least 10-percent of the surface area, distributed uniformly throughout the surface. The edges of the coarse aggregate shall not be undercut. Keep the surface of horizontal construction joints continuously wet for the first 12 hours during the 24-hour period prior to placing fresh concrete. The surface shall be washed completely clean as the last operation prior to placing the next lift. For heavy duty floors and two-course floors, a thin coat of neat cement grout of about the consistency of thick cream shall be thoroughly scrubbed into the existing surface immediately ahead of the topping placing. The grout shall be a 1:1 mixture of portland cement and sand passing the No. 8 sieve. The topping concrete shall be deposited before the grout coat has had time to stiffen.

3.1.2.1 Air-Water Cutting

Air-water cutting of a fresh concrete surface shall be performed at the

proper time and only on horizontal construction joints. The air pressure used in the jet shall be 100 psi, plus or minus 10 psi, and the water pressure shall be just sufficient to bring the water into effective influence of the air pressure. When approved by the Contracting Officer, a surface retarder complying with the requirements of COE CRD-C 94 may be applied to the surface of the lift in order to prolong the period of time during which air-water cutting is effective. After cutting, the surface shall be washed and rinsed as long as there is any trace of cloudiness of the wash water. Where necessary to remove accumulated laitance, coatings, stains, debris, and other foreign material, high-pressure waterjet or sandblasting shall be used as the last operation before placing the next lift.

3.1.2.2 High-Pressure Water Jet

Use a stream of water under a pressure of not less than 3,000 psi for cutting and cleaning. Its use shall be delayed until the concrete is sufficiently hard so that only the surface skin or mortar is removed and there is no undercutting of coarse-aggregate particles. If the waterjet is incapable of a satisfactory cleaning, the surface shall be cleaned by sandblasting.

3.1.2.3 Wet Sandblasting

Use wet sandblasting after the concrete has reached sufficient strength to prevent undercutting of the coarse aggregate particles. After wet sandblasting, the surface of the concrete shall then be washed thoroughly to remove all loose materials.

3.1.2.4 Waste Disposal

The method used in disposing of waste water employed in cutting, washing, and rinsing of concrete surfaces shall be such that the waste water does not stain, discolor, or affect exposed surfaces of the structures, or damage the environment of the project area. The method of disposal shall be subject to approval.

3.1.2.5 Preparation of Previously Placed Concrete

Concrete surfaces to which other concrete is to be bonded shall be abraded in an approved manner that will expose sound aggregate uniformly without damaging the concrete. Remove laitance and loose particles. Surfaces shall be thoroughly washed and shall be moist but without free water when concrete is placed.

3.1.3 Vapor Barrier

Provide vapor barrier beneath the interior on-grade concrete floor slabs. Use the greatest widths and lengths practicable to eliminate joints wherever possible. Joints shall be lapped a minimum of 12 inches. Torn, punctured, or damaged vapor barrier material shall be removed and new vapor barrier shall be provided prior to placing concrete. For minor repairs, patches may be made using laps of at least 12 inches. Lapped joints shall be sealed and edges patched with pressure-sensitive adhesive or tape not less than 2 inches wide and compatible with the membrane. Place vapor barrier directly on underlying subgrade, base course, or capillary water barrier, unless it consists of crushed material or large granular material which could puncture the vapor barrier. In this case, a thin layer of approximately 1/2 inch of fine graded material should be rolled or

compacted over the fill before installation of the vapor barrier to reduce the possibility of puncture. Control concrete placement so as to prevent damage to the vapor barrier.

3.1.4 Perimeter Insulation

Install perimeter insulation at locations indicated. Adhesive shall be used where insulation is applied to the interior surface of foundation walls and may be used for exterior application.

3.1.5 Embedded Items

Before placement of concrete, determine that all embedded items are firmly and securely fastened in place as indicated on the drawings, or required. Conduit and other embedded items shall be clean and free of oil and other foreign matter such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable materials to prevent the entry of concrete into voids. Welding shall not be performed on embedded metals within 12 inches of the surface of the concrete. Tack welding shall not be performed on or to embedded items.

3.2 CONCRETE PRODUCTION

3.2.1 General Requirements

Concrete shall either be batched and mixed onsite or shall be furnished from a ready-mixed concrete plant. Ready-mixed concrete shall be batched, mixed, and transported in accordance with ASTM C 94/C 94M, except as otherwise specified. Truck mixers, agitators, and nonagitating transporting units shall comply with NRMCA TMMB 100. Ready-mix plant equipment and facilities shall be certified in accordance with NRMCA QC 3. Approved batch tickets shall be furnished for each load of ready-mixed concrete. Site-mixed concrete shall conform to the following subparagraphs.

3.2.2 Truck Mixers

Truck mixers, the mixing of concrete therein, and concrete uniformity shall conform to the requirements of ASTM C 94/C 94M. A truck mixer may be used either for complete mixing (transit-mixed) or to finish the partial mixing done in a stationary mixer (shrink-mixed). Each truck shall be equipped with two counters from which it is possible to determine the number of revolutions at mixing speed and the number of revolutions at agitating speed. Or, if approved in lieu of this, the number of revolutions shall be marked on the batch tickets. Water shall not be added at the placing site unless specifically approved; and in no case shall it exceed the specified w/c. Any such water shall be injected at the base of the mixer, not at the discharge end.

3.3 CONCRETE PRODUCTION, SMALL PROJECTS

Use batch-type equipment for producing concrete. Ready-mixed concrete shall be batched, mixed, and transported in accordance with ASTM C 94/C 94M, except as otherwise specified. Truck mixers, agitators, and nonagitating transporting units shall comply with NRMCA TMMB 100. Ready-mix plant equipment and facilities shall be certified in accordance with NRMCA QC 3. Furnish approved batch tickets for each load of ready-mixed concrete.

Produce site-mixed concrete in accordance with [ACI 301](#), with plant conforming to [NRMCA CPMB 100](#). In lieu of batch-type equipment, concrete may be produced by volumetric batching and continuous mixing, which shall conform to [ASTM C 685/C 685M](#).

3.4 LIGHTWEIGHT AGGREGATE CONCRETE

In addition to the requirements specified for normal weight concrete, conform lightweight aggregate concrete to the following. The batching and mixing cycle shall be based on written recommendations from the aggregate supplier furnished by the Contractor, submitted for approval. Unless otherwise directed, charge the mixer with approximately 2/3 of the total mixing water and all of the aggregate. This shall be mixed for at least 1.5 minutes in a stationary mixer or 15 revolutions at mixing speed in a truck mixer. The remaining ingredients shall then be added and mixing continued as specified for normal weight concrete. Lightweight aggregate concrete shall not be vibrated to the extent that large particles of aggregate float to the surface. During finishing, lightweight aggregate concrete shall not be worked to the extent that mortar is driven down and lightweight coarse aggregate appears at the surface. Lightweight aggregate concrete to be pumped shall have a cement content of at least [564 lb/cu. yd.](#)

3.5 FIBER REINFORCED CONCRETE

Fiber reinforced concrete shall conform to [ASTM C 1116/C 1116M](#) and as follows, using the fibers specified in Section [03 20 00.00 10 CONCRETE REINFORCING](#). Use a minimum of [1.5 pounds of fibers per cubic yard](#) of concrete. Add fibers at the batch plant. Provide the services of a qualified technical representative to instruct the concrete supplier in proper batching and mixing of materials.

3.6 TRANSPORTING CONCRETE TO PROJECT SITE

Transport concrete to the placing site in truck mixers, or by approved pumping equipment. Nonagitating equipment, other than pumps, shall not be used for transporting lightweight aggregate concrete.

3.7 CONVEYING CONCRETE ONSITE

Convey concrete from mixer or transporting unit to forms as rapidly as possible and within the time interval specified by methods which will prevent segregation or loss of ingredients using following equipment. Conveying equipment shall be cleaned before each placement.

3.7.1 Buckets

The interior hopper slope shall be not less than 58 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least 5 times the nominal maximum-size aggregate, and the area of the gate opening shall not be less than [2 square feet](#). The maximum dimension of the gate opening shall not be greater than twice the minimum dimension. The bucket gates shall be essentially grout tight when closed and may be manually, pneumatically, or hydraulically operated except that buckets larger than [2 cubic yards](#) shall not be manually operated. The design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.

3.7.2 Transfer Hoppers

Concrete may be charged into nonagitating hoppers for transfer to other conveying devices. Transfer hoppers shall be capable of receiving concrete directly from delivery vehicles and shall have conical-shaped discharge features. Equip the transfer hopper with a hydraulically operated gate and with a means of external vibration to effect complete discharge. Concrete shall not be held in nonagitating transfer hoppers more than 30 minutes.

3.7.3 Trucks

Truck mixers operating at agitating speed or truck agitators used for transporting plant-mixed concrete shall conform to the requirements of [ASTM C 94/C 94M](#). Use nonagitating equipment only for transporting plant-mixed concrete over a smooth road and when the hauling time is less than 15 minutes. Bodies of nonagitating equipment shall be smooth, watertight, metal containers specifically designed to transport concrete, shaped with rounded corners to minimize segregation, and equipped with gates that will permit positive control of the discharge of the concrete.

3.7.4 Chutes

When concrete can be placed directly from a truck mixer, agitator, or nonagitating equipment, the chutes normally attached to this equipment by the manufacturer may be used. Use a discharge deflector when required by the Contracting Officer. Separate chutes and other similar equipment will not be permitted for conveying concrete.

3.7.5 Belt Conveyors

Design and operate belt conveyors to assure a uniform flow of concrete from mixer to final place of deposit without segregation of ingredients or loss of mortar and provided with positive means, such as discharge baffle or hopper, for preventing segregation of the concrete at the transfer points and the point of placing. Construct belt conveyors such that the idler spacing does not exceed [36 inches](#). The belt speed shall be a minimum of [300 feet](#) per minute and a maximum of [750 feet](#) per minute. If concrete is to be placed through installed horizontal or sloping reinforcing bars, the conveyor shall discharge concrete into a pipe or elephant truck that is long enough to extend through the reinforcing bars.

3.7.6 Concrete Pumps

Concrete may be conveyed by positive displacement pump when approved. The pumping equipment shall be piston or squeeze pressure type; pneumatic placing equipment shall not be used. The pipeline shall be rigid steel pipe or heavy-duty flexible hose. The inside diameter of the pipe shall be at least 3 times the nominal maximum-size coarse aggregate in the concrete mixture to be pumped but not less than [4 inches](#). Aluminum pipe shall not be used.

3.8 PLACING CONCRETE

Discharge mixed concrete within 1.5 hours or before the mixer drum has revolved 300 revolutions, whichever comes first after the introduction of the mixing water to the cement and aggregates. When the concrete temperature exceeds [85 degrees F](#), reduce the time to 45 minutes. Place concrete within 15 minutes after it has been discharged from the transporting unit. Concrete shall be handled from mixer or transporting

unit to forms in a continuous manner until the approved unit of operation is completed. Provide adequate scaffolding, ramps and walkways so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities prevent proper consolidation, finishing and curing. Provide sufficient placing capacity so that concrete can be kept free of cold joints.

3.8.1 Depositing Concrete

Deposit concrete as close as possible to its final position in the forms, and with no vertical drop greater than 5 feet except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so regulated that it will be effectively consolidated in horizontal layers not more than 12 inches thick, except that all slabs shall be placed in a single lift. Concrete to receive other construction shall be screeded to the proper level. Concrete shall be deposited continuously in one layer or in layers so that fresh concrete is deposited on in-place concrete that is still plastic. Fresh concrete shall not be deposited on concrete that has hardened sufficiently to cause formation of seams or planes of weakness within the section. Concrete that has surface dried, partially hardened, or contains foreign material shall not be used. When temporary spreaders are used in the forms, the spreaders shall be removed as their service becomes unnecessary. Concrete shall not be placed in slabs over columns and walls until concrete in columns and walls has been in-place at least two hours or until the concrete begins to lose its plasticity. Place concrete for beams, girders, brackets, column capitals, haunches, and drop panels at the same time as concrete for adjoining slabs.

3.8.2 Consolidation

Immediately after placing, consolidate each layer of concrete by internal vibrators, except for slabs 4 inches thick or less. The vibrators shall at all times be adequate in effectiveness and number to properly consolidate the concrete; keep a spare vibrator at the jobsite during all concrete placing operations. The vibrators shall have a frequency of not less than 10,000 vibrations per minute, an amplitude of at least 0.025 inch, and the head diameter shall be appropriate for the structural member and the concrete mixture being placed. Insert vibrators vertically at uniform spacing over the area of placement. The distance between insertions shall be approximately 1.5 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just-vibrated area by a reasonable amount. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding layer if there is such. Vibrator shall be held stationary until the concrete is consolidated and then vertically withdrawn slowly while operating. Form vibrators shall not be used unless specifically approved and unless forms are constructed to withstand their use. Vibrators shall not be used to move concrete within the forms. Slabs 4 inches and less in thickness shall be consolidated by properly designed vibrating screeds or other approved technique. Excessive vibration of lightweight concrete resulting in segregation or flotation of coarse aggregate shall be prevented. Frequency and amplitude of vibrators shall be determined in accordance with COE CRD-C 521. Grate tampers ("jitterbugs") shall not be used.

3.8.3 Cold Weather Requirements

Use special protection measures, approved by the Contracting Officer, if

freezing temperatures are anticipated before the expiration of the specified curing period. The ambient temperature of the air where concrete is to be placed and the temperature of surfaces to receive concrete shall be not less than 40 degrees F. The temperature of the concrete when placed shall be not less than 50 degrees F nor more than 75 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. Upon written approval, an accelerating admixture conforming to ASTM C 494/C 494M, Type C or E may be used, provided it contains no calcium chloride. Calcium chloride shall not be used.

3.8.4 Hot Weather Requirements

When job-site conditions are present or anticipated that accelerate the rate of moisture loss or rate of cement hydration of freshly mixed concrete, including an ambient temperature of 80 degrees F or higher, and an evaporation rate that exceeds 0.2 lb/ft²/h, concrete work shall conform to all requirements of ACI 305.1.

3.8.5 Prevention of Plastic Shrinkage Cracking

During hot weather with low humidity, and particularly with appreciable wind, as well as interior placements when space heaters produce low humidity, the Contractor shall be alert to the tendency for plastic shrinkage cracks to develop and shall institute measures to prevent this. Take particular care if plastic shrinkage cracking is potentially imminent and especially if it has developed during a previous placement. Conform with the requirement of ACI 305.1. In addition the concrete placement shall be further protected by erecting shades and windbreaks and by applying fog sprays of water, sprinkling, ponding or wet covering. Plastic shrinkage cracks that occur shall be filled by injection of epoxy resin as directed, after the concrete hardens. Plastic shrinkage cracks shall never be troweled over or filled with slurry.

3.8.6 Placing Concrete Underwater

Deposit concrete in water by a tremie or concrete pump. The methods and equipment used shall be subject to approval. Concrete buckets shall not be used for underwater placement of concrete except to deliver concrete to the tremie. The tremie shall be watertight and sufficiently large to permit a free flow of concrete. The concrete shall be deposited so that it enters the mass of the previously placed concrete from within, displacing water with a minimum disturbance to the surface of the concrete. Keep the discharge end of the pump line or tremie shaft continuously submerged in the concrete. The underwater seal at start of placing shall not produce undue turbulence in the water. Keep the tremie shaft full of concrete to a point well above the water surface. Placement shall proceed without interruption until the concrete has been brought to the required height. The tremie shall not be moved horizontally during a placing operation, and a sufficient number of tremies shall be provided so that the maximum horizontal flow of concrete will be limited to 15 feet. Concrete shall not be deposited in running water or in water with a temperature below 35 degrees F.

3.8.7 Placing Concrete in Congested Areas

Use special care to ensure complete filling of the forms, elimination of

all voids, and complete consolidation of the concrete when placing concrete in areas congested with reinforcing bars, embedded items, waterstops and other tight spacing. An appropriate concrete mixture shall be used, and the nominal maximum size of aggregate (NMSA) shall meet the specified criteria when evaluated for the congested area. Vibrators with heads of a size appropriate for the clearances available shall be used, and the consolidation operation shall be closely supervised to ensure complete and thorough consolidation at all points. Where necessary, splices of reinforcing bars shall be alternated to reduce congestion. Where two mats of closely spaced reinforcing are required, the bars in each mat shall be placed in matching alignment to reduce congestion. Reinforcing bars may be temporarily crowded to one side during concrete placement provided they are returned to exact required location before concrete placement and consolidation are completed.

3.8.8 Placing Flowable Concrete

If a plasticizing admixture conforming to [ASTM C 1017/C 1017M](#) is used or if a Type F or G high range water reducing admixture is permitted to increase the slump, the concrete shall meet all requirements of paragraph SYSTEM DESCRIPTION. Use extreme care in conveying and placing the concrete to avoid segregation. No relaxation of requirements to accommodate flowable concrete will be permitted.

3.9 JOINTS

Locate and construct joints as indicated or approved. Joints not indicated on the drawings shall be located and constructed to minimize the impact on the strength of the structure. In general, locate such joints near the middle of the spans of supported slabs, beams, and girders unless a beam intersects a girder at this point, in which case the joint in the girder shall be offset a distance equal to twice the width of the beam. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and at the tops of footings or floor slabs, unless otherwise approved. Joints shall be perpendicular to the main reinforcement. All reinforcement shall be continued across joints; except that reinforcement or other fixed metal items shall not be continuous through expansion joints, or through construction or contraction joints in slabs on grade. Reinforcement shall be [2 inches](#) clear from each joint. Except where otherwise indicated, construction joints between interior slabs on grade and vertical surfaces shall consist of [30 pound](#) asphalt-saturated felt, extending for the full depth of the slab. The perimeters of the slabs shall be free of fins, rough edges, spalling, or other unsightly appearance. Reservoir for sealant for construction and contraction joints in slabs shall be formed to the dimensions shown on the drawings by removing snap-out joint-forming inserts, by sawing sawable inserts, or by sawing to widen the top portion of sawed joints. Joints to be sealed shall be cleaned and sealed as indicated and in accordance with [Section 07 92 00 JOINT SEALANTS](#).

3.9.1 Construction Joints

For concrete other than slabs on grade, locate construction joints so that the unit of operation does not exceed [10 feet](#). Concrete shall be placed continuously so that each unit is monolithic in construction. Fresh concrete shall not be placed against adjacent hardened concrete until it is at least 24 hours old. Locate construction joints as indicated or approved. Where concrete work is interrupted by weather, end of work shift or other similar type of delay, location and type of construction joint

shall be subject to approval of the Contracting Officer. Unless otherwise indicated and except for slabs on grade, extend reinforcing steel through construction joints. Construction joints in slabs on grade shall be keyed or doweled as shown. Concrete columns, walls, or piers shall be in place at least 2 hours, or until the concrete begins to lose its plasticity, before placing concrete for beams, girders, or slabs thereon. In walls having door or window openings, terminate lifts at the top and bottom of the opening. Other lifts shall terminate at such levels as to conform to structural requirements or architectural details. Where horizontal construction joints in walls or columns are required, a strip of 1 inch square-edge lumber, beveled and oiled to facilitate removal, shall be tacked to the inside of the forms at the construction joint. Place concrete to a point 1 inch above the underside of the strip. The strip shall be removed 1 hour after the concrete has been placed, and any irregularities in the joint line shall be leveled off with a wood float, and all laitance shall be removed. Prior to placing additional concrete, horizontal construction joints shall be prepared as specified in paragraph Previously Placed Concrete above.

3.9.2 Contraction Joints in Slabs on Grade

Contraction joints shall be located and detailed as shown on the drawings. Produce contraction joints by forming a weakened plane in the concrete slab using materials and procedures specified in Section 03 15 00.00 10 CONCRETE ACCESSORIES.

3.9.3 Expansion Joints

Installation of expansion joints and sealing of these joints shall conform to the requirements of Section 03 15 00.00 10 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS and Section 07 92 00 JOINT SEALANTS.

3.9.4 Waterstops

Install waterstops in conformance with the locations and details shown on the drawings using materials and procedures specified in Section 03 15 00.00 10 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS.

3.9.5 Dowels and Tie Bars

Install dowels and tie bars at the locations shown on the drawings and to the details shown, using materials and procedures specified in Section 03 20 00.00 10 CONCRETE REINFORCEMENT and herein. Conventional smooth "paving" dowels shall be installed in slabs using approved methods to hold the dowel in place during concreting within a maximum alignment tolerance of 1/8 inch in 12 inches. "Structural" type deformed bar dowels, or tie bars, shall be installed to meet the specified tolerances. Care shall be taken during placing adjacent to and around dowels and tie bars to ensure there is no displacement of the dowel or tie bar and that the concrete completely embeds the dowel or tie bar and is thoroughly consolidated.

3.10 SPECIALTY FLOORS

3.10.1 Heavy Duty Floors

[Areas as indicated on the drawings] [The following areas [____]] shall have heavy duty floors constructed as follows:

3.10.1.1 General

Construct heavy duty floor by placing a heavy duty bonded topping on a base slab which has had a rough slab finish left 2 inches below final grade. Concrete in the base slab shall be thoroughly hardened but not more than 30 hours old. The temperature of the fresh concrete topping shall not vary more than 10 degrees F plus or minus from the temperature of the base slab. The ambient temperature of the space adjacent to the concrete placement and of the base slab shall be between 50 and 90 degrees F.

3.10.1.2 Preparation of Base Slab

Keep the base slab continuously damp until topping is placed. The surface of the base slab shall be thoroughly cleaned with an air-water jet immediately before placing the topping. A thin coat of neat cement grout of about the consistency of thick cream shall be thoroughly scrubbed into the existing surface immediately ahead of the overlay placing. At the time the neat cement grout is placed, the existing concrete surface shall be damp but shall have no free water present. Deposit the overlay concrete before the grout coat has had time to stiffen.

3.10.2 Two-Course Floor Construction

[Areas as indicated on the drawings] [The following areas [____]] shall have floors constructed with two-course construction by placing a bonded topping on the thoroughly hardened concrete base slab which has been left with a rough slab finish 2 inches below final grade as shown on the drawings. Apply topping at an approved time late in the contract period. The floor topping mixture shall have a specified compressive strength of 5000 psi at 28 days, a 2 inch maximum slump, 1/2 inch maximum size coarse aggregate, and shall be proportioned to obtain required finishability. The surface of the base slab shall be thoroughly cleaned by sandblasting or high-pressure waterjet immediately before placing topping. The temperature of the fresh concrete topping shall not vary more than 10 degrees F plus or minus from the temperature of the base slab. The ambient temperature of the space adjacent to the concrete placement and of the base slab shall be between 50 and 90 degrees F. The base slab shall be kept continuously wet for the first 12 hours during the 24 hour period immediately prior to placing the finished floor. After all free water has evaporated or has been removed from the surface, a grout shall be scrubbed in. The grout shall be a 1:1 mixture of portland cement and sand passing the No. 8 sieve mixed to a creamlike consistency. Scrub the grout into the surface just ahead of the concrete topping placing operation. While the grout is still damp, the top course shall be spread and screeded and darbied or bull floated.

3.11 FLOOR HARDENER

[Areas as indicated on the drawings] [The following areas [____]] shall be treated with floor hardener applied after the concrete has been cured and then air dried for [14] [28] days. Apply three coats, each the day after the preceding coat was applied. For the first application, one pound of the silicofluoride shall be dissolved in one gallon of water. For subsequent applications, the solution shall be two pounds of silicofluoride to each gallon of water. Floor should be mopped with clear water shortly after the preceding application has dried to remove encrusted salts. Apply proprietary hardeners in accordance with the manufacturer's instructions. During application, area should be well ventilated. Take precautions when applying silicofluorides due to the toxicity of the salts. Any compound

that contacts glass or aluminum should be immediately removed with clear water.

3.12 EXTERIOR SLAB AND RELATED ITEMS

3.12.1 Pavements

Construct pavements where shown on the drawings. After forms are set and underlying material prepared as specified, place the concrete uniformly throughout the area and thoroughly vibrated. As soon as placed and vibrated, the concrete shall be struck off and screeded to the crown and cross section and to such elevation above grade that when consolidated and finished, the surface of the pavement will be at the required elevation. The entire surface shall be tamped with the strike off, or consolidated with a vibrating screed, and this operation continued until the required compaction and reduction of internal and surface voids are accomplished. Take care to prevent bringing excess paste to the surface. Curing shall be as specified.

3.12.2 Sidewalks

Concrete shall be 4 inches minimum thickness. Provide contraction joints at 5 feet spaces unless otherwise indicated. Contraction joints shall be cut 1 inch deep with a jointing tool after the surface has been finished. Provide transverse expansion joints 1/2 inch thick at changes in direction and where sidewalk abuts curbs, steps, rigid pavement, or other similar structures. A transverse slope of 1/4 inch per foot shall be provided, unless otherwise indicated. Variations in cross section shall be limited to 1/4 inch in 5 feet.

3.12.3 Curbs and Gutters

Concrete shall be formed, placed, and finished by hand using a properly shaped "mule" or constructed using a slipform machine specially designed for this work. Contraction joints shall be cut 3 inches deep with a jointing tool after the surface has been finished. Expansion joints (1/2 inch wide) shall be provided at 100 feet maximum spacing unless otherwise indicated.

3.12.4 Pits and Trenches

Construct pits and trenches as indicated on the drawings. Bottoms and walls shall be placed monolithically or waterstops and keys, shall be provided as approved.

3.13 SETTING BASE PLATES AND BEARING PLATES

After being properly positioned, column base plates, bearing plates for beams and similar structural members, and machinery and equipment base plates shall be set to the proper line and elevation with damp-pack bedding mortar, except where nonshrink grout is indicated. The thickness of the mortar or grout shall be approximately 1/24 the width of the plate, but not less than 3/4 inch. Concrete and metal surfaces in contact with grout shall be clean and free of oil and grease, and concrete surfaces in contact with grout shall be damp and free of laitance when grout is placed. Use nonshrink grout for [_____].

3.13.1 Damp-Pack Bedding Mortar

Damp-pack bedding mortar shall consist of 1 part cement and 2-1/2 parts fine aggregate having water content such that a mass of mortar tightly squeezed in the hand will retain its shape but will crumble when disturbed. The space between the top of the concrete and bottom of the bearing plate or base shall be packed with the bedding mortar by tamping or ramming with a bar or rod until it is completely filled.

3.13.2 Nonshrink Grout

Nonshrink grout shall be a ready-mixed material requiring only the addition of water. Water content shall be the minimum that will provide a flowable mixture and completely fill the space to be grouted without segregation, bleeding, or reduction of strength.

3.13.2.1 Mixing and Placing of Nonshrink Grout

Mixing and placing shall be in conformance with the material manufacturer's instructions and as specified therein. Ingredients shall be thoroughly dry-mixed before adding water. After adding water, mix the batch for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Discard grout not used within 30 minutes after mixing. The space between the top of the concrete or machinery-bearing surface and the plate shall be filled solid with the grout. Forms shall be of wood or other equally suitable material for completely retaining the grout on all sides and on top and shall be removed after the grout has set. The placed grout shall be carefully worked by rodding or other means to eliminate voids; however, overworking and breakdown of the initial set shall be avoided. Grout shall not be retempered or subjected to vibration from any source. Where clearances are unusually small, placement shall be under pressure with a grout pump. Temperature of the grout, and of surfaces receiving the grout, shall be maintained at 65 to 85 degrees F until after setting.

3.13.2.2 Treatment of Exposed Surfaces

For metal-oxidizing nonshrink grout, exposed surfaces shall be cut back 1 inch and immediately covered with a parge coat of mortar consisting of 1 part portland cement and 2-1/2 parts fine aggregate by weight, with sufficient water to make a plastic mixture. The parge coat shall have a smooth finish. For other mortars or grouts, exposed surfaces shall have a smooth-dense finish and be left untreated. Curing shall comply with Section 03 39 00.00 10 CONCRETE CURING.

3.14 TESTING AND INSPECTION FOR CQC

Perform the inspection and tests described below and, based upon the results of these inspections and tests, take the action required. Submit certified copies of laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolan, ground granulated blast furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.

- a. When, in the opinion of the Contracting Officer, the concreting operation is out of control, cease concrete placement and correct the operation.
- b. The laboratory performing the tests shall be onsite and shall conform

with **ASTM C 1077**. Materials may be subjected to check testing by the Government from samples obtained at the manufacturer, at transfer points, or at the project site.

- c. The Government will inspect the laboratory, equipment, and test procedures prior to start of concreting operations and at least once per month thereafter for conformance with **ASTM C 1077**.

3.14.1 Grading and Corrective Action

3.14.1.1 Fine Aggregate

At least once during each shift when the concrete plant is operating, there shall be one sieve analysis and fineness modulus determination in accordance with **ASTM C 136** and **COE CRD-C 104** for the fine aggregate or for each fine aggregate if it is batched in more than one size or classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits. When the amount passing on any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure on any sieve, the fact shall be immediately reported to the Contracting Officer, concreting shall be stopped, and immediate steps taken to correct the grading.

3.14.1.2 Coarse Aggregate

At least once during each shift in which the concrete plant is operating, there shall be a sieve analysis in accordance with **ASTM C 136** for each size of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control. However, the Contractor shall be responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken at the same locations shall show the results of the current test as well as the average results of the five most recent tests including the current test. The Contractor may adopt limits for control coarser than the specification limits for samples taken other than as delivered to the mixer to allow for degradation during handling. When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be immediately resampled and retested. If the second sample fails on any sieve, that fact shall be reported to the Contracting Officer. Where two consecutive averages of 5 tests are outside specification limits, the operation shall be considered out of control and reported to the Contracting Officer. Concreting shall be stopped and immediate steps shall be taken to correct the grading.

3.14.2 Quality of Aggregates

Thirty days prior to the start of concrete placement, perform all tests for aggregate quality required by **ASTM C 33/C 33M**. In addition, after the start of concrete placement, perform tests for aggregate quality at least every three months, and when the source of aggregate or aggregate quality changes. Samples tested after the start of concrete placement shall be taken immediately prior to entering the concrete mixer.

3.14.3 Scales, Batching and Recording

Check the accuracy of the scales by test weights prior to start of concrete operations and at least once every three months. Such tests shall also be

made as directed whenever there are variations in properties of the fresh concrete that could result from batching errors. Once a week the accuracy of each batching and recording device shall be checked during a weighing operation by noting and recording the required weight, recorded weight, and the actual weight batched. At the same time, test and ensure that the devices for dispensing admixtures are operating properly and accurately. When either the weighing accuracy or batching accuracy does not comply with specification requirements, the plant shall not be operated until necessary adjustments or repairs have been made. Discrepancies in recording accuracies shall be corrected immediately.

3.14.4 Batch-Plant Control

Continuously control the measurement of concrete materials, including cementitious materials, each size of aggregate, water, and admixtures. Adjust the aggregate weights and amount of added water as necessary to compensate for free moisture in the aggregates. The amount of air-entraining agent shall be adjusted to control air content within specified limits. Prepare a report indicating type and source of cement used, type and source of pozzolan or slag used, amount and source of admixtures used, aggregate source, the required aggregate and water weights per cubic yard amount of water as free moisture in each size of aggregate, and the batch aggregate and water weights per cubic yard for each class of concrete batched during each day's plant operation.

3.14.5 Concrete Mixture

- a. Air Content Testing. Perform air content tests when test specimens are fabricated. In addition, at least two tests for air content shall be made on randomly selected batches of each separate concrete mixture produced during each 8-hour period of concrete production. Perform additional tests when excessive variation in workability is reported by the placing foreman or Government inspector. Tests shall be made in accordance with [ASTM C231/C231M](#) for normal weight concrete and [ASTM C 173/C 173M](#) for lightweight concrete. Plot test results on control charts which shall at all times be readily available to the Government and submitted weekly. Keep copies of the current control charts in the field by testing crews and results plotted as tests are made. When a single test result reaches either the upper or lower action limit, perform a second test immediately. The results of the two tests shall be averaged and this average used as the air content of the batch to plot on both the air content and the control chart for range, and for determining need for any remedial action. The result of each test, or average as noted in the previous sentence, shall be plotted on a separate control chart for each mixture on which an "average line" is set at the midpoint of the specified air content range from paragraph Air Entrainment in PART 1. Set an upper warning limit and a lower warning limit line 1.0 percentage point above and below the average line, respectively. An upper action limit and a lower action limit line shall be set 1.5 percentage points above and below the average line, respectively. The range between each two consecutive tests shall be plotted on a secondary control chart for range where an upper warning limit is set at 2.0 percentage points and an upper action limit is set at 3.0 percentage points. Samples for air content may be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated air content. If the Contractor's materials or transportation methods cause air content loss between the mixer and the placement, correlation samples shall be taken at the placement site as

required by the Contracting Officer, and the air content at the mixer controlled as directed.

- b. **Air Content Corrective Action.** Whenever points on the control chart for percent air reach either warning limit, an adjustment shall immediately be made in the amount of air-entraining admixture batched. As soon as practical after each adjustment, another test shall be made to verify the result of the adjustment. Whenever a point on the secondary control chart for range reaches the warning limit, the admixture dispenser shall be recalibrated to ensure that it is operating accurately and with good reproducibility. Whenever a point on either control chart reaches an action limit line, the air content shall be considered out of control and the concreting operation shall immediately be halted until the air content is under control. Additional air content tests shall be made when concreting is restarted.
- c. **Slump Testing.** In addition to slump tests which are made when test specimens are fabricated, at least four slump tests shall be made on randomly selected batches in accordance with [ASTM C 143/C 143M](#) for each separate concrete mixture produced during each 8-hour or less period of concrete production each day. Also, additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Plot test results on control charts which shall at all times be readily available to the Government and submitted weekly. Keep copies of the current control charts in the field by testing crews and results plotted as tests are made. When a single slump test reaches or goes beyond either the upper or lower action limit, immediately perform a second test. The results of the two tests shall be averaged and this average used as the slump of the batch to plot on both the control charts for slump and the chart for range, and for determining need for any remedial action. Set limits on separate control charts for slump for each type of mixture. The upper warning limit shall be set at $1/2$ inch below the maximum allowable slump specified in paragraph Slump in PART 1 for each type of concrete and an upper action limit line and lower action limit line shall be set at the maximum and minimum allowable slumps, respectively, as specified in the same paragraph. The range between each consecutive slump test for each type of mixture shall be plotted on a single control chart for range on which an upper action limit is set at 2 inches. Take samples for slump at the mixer. However, the Contractor is responsible for delivering the concrete to the placement site at the stipulated slump. If the Contractor's materials or transportation methods cause slump loss between the mixer and the placement, take correlation samples at the placement site as required by the Contracting Officer, and the slump at the mixer controlled as directed.
- d. **Slump Corrective Action.** Whenever points on the control charts for slump reach the upper warning limit, make an adjustment immediately in the batch weights of water and fine aggregate. The adjustments are to be made so that the total water content does not exceed that amount allowed by the maximum w/c ratio specified, based on aggregates which are in a saturated surface dry condition. When a single slump reaches the upper or lower action limit, no further concrete shall be delivered to the placing site until proper adjustments have been made. Immediately after each adjustment, another test shall be made to verify the correctness of the adjustment. Whenever two consecutive individual slump tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range at or above the upper action limit, halt the concreting operation immediately, and take

appropriate steps to bring the slump under control. Additional slump tests shall be made as directed.

- e. Temperature. Measure the temperature of the concrete when compressive strength specimens are fabricated in accordance with [ASTM C 1064/C 1064M](#). Report the temperature along with the compressive strength data.
- f. Strength Specimens. Perform at least one set of test specimens, for compressive or flexural strength as appropriate, on each different concrete mixture placed during the day for each 500 cubic yards or portion thereof of that concrete mixture placed each day. Perform additional sets of test specimens, as directed by the Contracting Officer, when the mixture proportions are changed or when low strengths have been detected. Develop a truly random (not haphazard) sampling plan for approval by the Contracting Officer prior to the start of construction. The plan shall ensure that sampling is done in a completely random and unbiased manner. A set of test specimens for concrete with a 28-day specified strength in accordance with paragraph Strength Requirements in PART 1 shall consist of four specimens, two to be tested at 7 days and two at 28 days. A set of test specimens for concrete with a 90-day strength in accordance with the same paragraph shall consist of six specimens, two tested at 7 days, two at 28 days, and two at 90 days. Test specimens shall be molded and cured in accordance with [ASTM C 31/C 31M](#) and tested in accordance with [ASTM C 39/C 39M](#) for test cylinders and [ASTM C 78/C 78M](#) for test beams. Results of all strength tests shall be reported immediately to the Contracting Officer. Quality control charts shall be kept for individual strength "tests", ("test" as defined in paragraph Strength Requirements in PART 1) moving average of last 3 "tests" for strength, and moving average for range for the last 3 "tests" for each mixture. The charts shall be similar to those found in [ACI 214R](#).

3.14.6 Inspection Before Placing

Inspect foundations, construction joints, forms, and embedded items in sufficient time prior to each concrete placement in order to certify to the Contracting Officer that they are ready to receive concrete. Report the results of each inspection in writing.

3.14.7 Placing

The placing foreman shall supervise placing operations, shall determine that the correct quality of concrete or grout is placed in each location as specified and as directed by the Contracting Officer, and shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, volume placed, and method of placement. The placing foreman shall not permit batching and placing to begin until it has been verified that an adequate number of vibrators in working order and with competent operators are available. Placing shall not be continued if any pile of concrete is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, immediate steps shall be taken to improve temperature controls.

3.14.8 Vibrators

Determine the frequency and amplitude of each vibrator in accordance with [COE CRD-C 521](#) prior to initial use and at least once a month when concrete is being placed. Perform additional tests as directed when a vibrator does

not appear to be adequately consolidating the concrete. The frequency shall be determined while the vibrator is operating in concrete with the tachometer being held against the upper end of the vibrator head while almost submerged and just before the vibrator is withdrawn from the concrete. Determine the amplitude with the head vibrating in air. Take two measurements, one near the tip and another near the upper end of the vibrator head, and these results averaged. Report the make, model, type, and size of the vibrator and frequency and amplitude results in writing. Any vibrator not meeting the requirements of paragraph Consolidation above, shall be immediately removed from service and repaired or replaced.

3.14.9 Cold-Weather Protection

At least once each shift and once per day on non-work days, an inspection shall be made of all areas subject to cold-weather protection. Any deficiencies shall be noted, corrected, and reported.

3.14.10 Mixer Uniformity

- a. Stationary Mixers. Prior to the start of concrete placing and once every 6 months when concrete is being placed, or once for every 75,000 cubic yards of concrete placed, whichever results in the shortest time interval, uniformity of concrete mixing shall be determined in accordance with ASTM C 94/C 94M.
- b. Truck Mixers. Prior to the start of concrete placing and at least once every 6 months when concrete is being placed, uniformity of concrete mixing shall be determined in accordance with ASTM C 94/C 94M. Select the truck mixers randomly for testing. When satisfactory performance is found in one truck mixer, the performance of mixers of substantially the same design and condition of the blades may be regarded as satisfactory.
- c. Mixer Uniformity Corrective Action. When a mixer fails to meet mixer uniformity requirements, either the mixing time shall be increased, batching sequence changed, batch size reduced, or adjustments shall be made to the mixer until compliance is achieved.

3.14.11 Reports

Report all results of tests or inspections conducted, informally as they are completed and in writing daily. Prepare a weekly report for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all contractor quality control records.

-- End of Section --

SECTION 26 00 00.00 20

BASIC ELECTRICAL MATERIALS AND METHODS

07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 709 (2001; R 2007) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100 (2000; Archived) The Authoritative Dictionary of IEEE Standards Terms

IEEE C2 (2007; TIA 2007-1; TIA 2007-2; TIA 2007-3; TIA 2007-4; TIA 2007-5; Errata 2006-1; Errata 2007-2; Errata 2009-3) National Electrical Safety Code

IEEE C57.12.28 (2005) Standard for Pad-Mounted Equipment - Enclosure Integrity

IEEE C57.12.29 (2005) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to certain sections of [Division 02, EXISTING CONDITIONS] [Division 11, EQUIPMENT,] [Division 13, SPECIAL CONSTRUCTION,] [and] [Division 14, CONVEYING EQUIPMENT] [and] [Divisions 22 and 23, PLUMBING and HEATING VENTILATING AND AIR CONDITIONING]. This section applies to all sections of Division 26 and 33, ELECTRICAL and UTILITIES, of this project specification unless specified otherwise in the individual sections. This section has been incorporated into, and thus, does not apply to, and is not referenced in the following sections.

Section 26 12 19.10 THREE-PHASE PAD MOUNTED TRANSFORMERS
 Section 26 12 19.20 SINGLE-PHASE PAD MOUNTED TRANSFORMERS
 Section 26 11 16 SECONDARY UNIT SUBSTATIONS

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM
Section 26 23 00 SWITCHBOARDS AND SWITCHGEAR
Section 26 51 00 INTERIOR LIGHTING
Section 26 56 00 EXTERIOR LIGHTING
Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM
Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION
Section 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT

1.3 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.
- b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.
- c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 15 kV primary, three phase, four wire, 60 Hz, and 480Y/277 volts secondary, three phase, four wire. Final connections to the power distribution system at the existing substation shall be made by the Government.

1.5 ADDITIONAL SUBMITTALS INFORMATION

Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

1.5.1 Shop Drawings (SD-02)

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.5.2 Product Data (SD-03)

Submittal shall include performance and characteristic curves.

1.6 QUALITY ASSURANCE

1.6.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of

similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.6.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.6.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.8 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

- a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
- b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- c. Safety precautions.
- d. The procedure in the event of equipment failure.
- e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For

operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.9 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.10 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, **0.125 inch** thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be **one by 2.5 inches**. Lettering shall be a minimum of **0.25 inch** high normal block style.

1.11 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, generators, and switchgear having a nominal rating exceeding 600 volts.

- a. When the enclosure integrity of such equipment is specified to be in accordance with **IEEE C57.12.28** or **IEEE C57.12.29**, such as for pad-mounted transformers, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of **7 by 10 inches** with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal **2 inch** high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPS0710D72 or approved equal.
- b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of **14 by 10 inches** with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal **3 inch** high white letters on a red and black field.

1.12 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to **IEEE C2**, **NFPA 70**, and requirements specified herein.

1.13 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation

and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section.

PART 2 PRODUCTS

2.1 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test and the additional requirements specified in the technical sections.

PART 3 EXECUTION

3.1 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in the section specifying the associated electrical equipment.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

-- End of Section --

SECTION 26 05 00.00 40

COMMON WORK RESULTS FOR ELECTRICAL

11/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 709 (2001; R 2007) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100 (2000; Archived) The Authoritative Dictionary of IEEE Standards Terms

IEEE C57.12.28 (2005) Standard for Pad-Mounted Equipment - Enclosure Integrity

IEEE C57.12.29 (2005) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE (2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI Z535.1 (2006) American National Standard for Safety--Color Code

ANSI/NEMA FB 1 (2007; AMD 2010) Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable

ANSI/NEMA OS 1 (2008) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports

NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

NEMA KS 1 (2001; R 2006) Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)

NEMA PB 1 (2006; Errata 2008) Panelboards

NEMA RN 1 (2005) Polyvinyl-Chloride (PVC) Externally

Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

NEMA TC 2 (2003) Standard for Electrical Polyvinyl Chloride (PVC) Conduit

NEMA TC 3 (2004) Standard for Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1 (2005; Reprint Jul 2007) Standard for Flexible Metal Conduit

UL 1242 (2006; Reprint Jul 2007) Standard for Electrical Intermediate Metal Conduit -- Steel

UL 489 (2009) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

UL 506 (2008; Reprint Mar 2010) Specialty Transformers

UL 6 (2007) Electrical Rigid Metal Conduit-Steel

UL 797 (2007) Electrical Metallic Tubing -- Steel

1.2 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.
- b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.
- c. Vertical assembly: A vertical assembly is a pole, tower or other such support, mounting hardware, arms, brackets and the load. Load can be a luminaire, siren, loudspeaker or other device. All components of a vertical assembly will be rated by the manufacturer to withstand 135 mph wind loading.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Material, Equipment, and Fixture Lists for the following:

Conduits, Raceway sand Fittings

Wire and Cable

Splices and Connectors

Switches

Circuit Breakers

Panelboards

Dry-Type Distribution Transformers

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Conduits, Raceway sand Fittings

Wire and Cable

Splices and Connectors

Switches

Circuit Breakers

Panelboards

Dry-Type Distribution Transformers

Spare Parts

Certification

Submittal for vertical assemblies will be reviewed by a licensed Mechanical, Civil or Structural Engineer to determine that the entire assembly will withstand 135 mph wind loading.

SD-06 Test Reports

Continuity Test

Phase-Rotation Tests

Insulation Resistance Test

SD-08 Manufacturer's Instructions

Submit Manufacturer's Instructions.

1.4 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by

NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

1.5 PREVENTION OF CORROSION

Protect metallic materials against corrosion. Provide equipment enclosures with the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and/or abrasive action), and all outdoor installations, refer to Section 09 96 00 HIGH-PERFORMANCE COATINGS. Do not use aluminum when in contact with earth or concrete and, where connected to dissimilar metal, protect by approved fittings and treatment. Ferrous metals such as, but not limited to, anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous spare parts not of corrosion-resistant steel shall be hot-dip galvanized except where other equivalent protective treatment is specifically approved in writing.

1.6 GENERAL REQUIREMENTS

Submit material, equipment, and fixture lists for the following items showing manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site.

Submit manufacturer's instructions including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.

Submit certification required to install equipment components and system packages.

1.7 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

- a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
- b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- c. Safety precautions.
- d. The procedure in the event of equipment failure.
- e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and be secured to prevent easy removal or peeling.

1.8 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.9 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, **0.125 inch** thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be **one by 2.5 inches**. Lettering shall be a minimum of **0.25 inch** high normal block style.

1.10 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, generators, and switchgear having a nominal rating exceeding 600 volts.

- a. When the enclosure integrity of such equipment is specified to be in accordance with **IEEE C57.12.28** or **IEEE C57.12.29**, such as for pad-mounted transformers, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and have nominal dimensions of **7 by 10 inches** with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal **2 inch** high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPS0710D72 or approved equal.
- b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of **14 by 10 inches** with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal **3 inch** high white letters on a red and black field.

PART 2 PRODUCTS

2.1 MATERIALS

Materials and equipment to be provided shall be the standard cataloged products of manufacturers regularly engaged in the manufacture of the products.

2.1.1 Rigid Steel Conduit

Rigid steel conduit shall comply with **UL 6** and be galvanized by the hot-dip process. Rigid steel conduit shall be polyvinylchloride (PVC) coated in

accordance with NEMA RN 1, where underground and in corrosive areas, or must be painted with bitumastic.

Fittings for rigid steel conduit shall be threaded.

Gaskets shall be solid. Conduit fittings with blank covers shall have gaskets, except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

Covers shall have captive screws and be accessible after the work has been completed.

2.1.2 Electrical Metallic Tubing (EMT)

EMT shall be in accordance with UL 797 and be zinc coated steel. Couplings and connectors shall be zinc-coated, raintight, gland compression with insulation throat. Crimp, spring, or setscrew type fittings are not acceptable.

2.1.3 Flexible Metallic Conduit

Flexible metallic conduit shall comply with UL 1 and be galvanized steel.

Fittings for flexible metallic conduit shall be specifically designed for such conduit.

Provide liquidtight flexible metallic conduit with a protective jacket of PVC extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes.

Specifically design fittings for liquidtight flexible metallic conduit for such conduit.

2.1.4 Intermediate Metal Conduit

Intermediate metal conduit shall comply with UL 1242 and be galvanized.

2.1.5 Rigid Nonmetallic Conduit

Rigid nonmetallic conduit shall comply with NEMA TC 2 and NEMA TC 3 with wall thickness not less than Schedule 40.

2.1.6 Wireways and Auxiliary Gutters (NOT USED)

2.1.7 Surface Raceways and Assemblies (NOT USED)

2.1.8 Cable Trays (NOT USED)

2.2 WIRE AND CABLE

Conductors installed in conduit shall be copper 600-volt type XHHW. All conductors AWG No. 8 and larger, shall be stranded. All conductors smaller than AWG No. 8 shall be solid.

Flexible cable shall be Type SO and contain a grounding conductor with green insulation.

Conductors installed in plenums shall be marked plenum rated.

2.3 SPLICES AND CONNECTORS

Make all splices in AWG No. 8 and smaller with approved indentor crimp-type connectors and compression tools.

Make all splices in AWG No. 6 and larger with bolted clamp-type connectors. Joints shall be wrapped with an insulating tape that has an insulation and temperature rating equivalent to that of the conductor.

2.4 SWITCHES

2.4.1 Safety Switches

Safety switches shall comply with NEMA KS 1, and be the heavy-duty type with enclosure, voltage, current rating, number of poles, and fusing as indicated. Switch construction shall be such that, when the switch handle in the "ON" position, the cover or door cannot be opened. Cover release device shall be coinproof and be so constructed that an external tool shall be used to open the cover. Make provisions to lock the handle in the "OFF" position, but the switch shall not be capable of being locked in the "ON" position.

Provide switches of the quick-make, quick-break type. Approve terminal lugs for use with copper conductors.

Safety color coding for identification of safety switches shall conform to ANSI Z535.1.

2.4.2 Toggle Switches (NOT USED)

2.5 RECEPTACLES (NOT USED)

2.6 OUTLETS, OUTLET BOXES, AND PULL BOXES

Outlet boxes for use with conduit systems shall be in accordance with ANSI/NEMA FB 1 and ANSI/NEMA OS 1 and be not less than 1-1/2 inches deep. Furnish all pull and junction boxes with screw-fastened covers.

2.7 PANELBOARDS

Lighting and appliance branch circuit panelboards shall be the circuit-breaker type in accordance with NEMA PB 1. Bolt circuit breakers to the bus. Plug-in circuit breakers are not acceptable. Buses shall be copper of the rating indicated, with main lugs or main circuit breaker as indicated. Provide all panelboards for use on grounded ac systems with a full-capacity isolated neutral bus and a separate grounding bus bonded to the panelboard enclosure. Panelboard enclosures shall be NEMA 250, Type 1, in accordance with NEMA PB 1. Provide enclosure fronts with latchable hinged doors.

2.8 CIRCUIT BREAKERS

Circuit-breaker interrupting rating shall be not less than those indicated and in no event less than 20,000 amperes root-mean-square (rms) symmetrical at 277 volts, respectively. Multipole circuit breakers shall be the common-trip type with a single handle. Molded case circuit breakers shall be bolt-on type conforming to UL 489.

2.9 LAMPS AND LIGHTING FIXTURES

Manufacturers and catalog numbers shown are indicative of the general type desired and are not intended to restrict the selection to fixtures of any particular manufacturer. Fixtures with the same salient features and equivalent light distribution and brightness characteristics, of equal finish and quality, are acceptable. Provide lamps of the proper type and wattage for each fixture.

Ballasts shall be high power factor and be energy efficient. Ballasts shall have a Class P terminal protective device for 277-volt operation as indicated.

Lighting fixtures shall have prewired integral ballasts and cast aluminum housings complete with tempered glass lenses suitable for installation in damp or wet locations. Provide fixtures and lamps.

2.10 DRY-TYPE DISTRIBUTION TRANSFORMERS

General purpose dry-type transformers with windings 600 volts or less shall be two-winding, 60 hertz, self-cooled in accordance with UL 506. Windings shall have a minimum of two 2-1/2-percent taps above and below nominal voltage.

PART 3 EXECUTION

3.1 CONDUITS, RACEWAYS AND FITTINGS

Conduit runs between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting.

Do not install crushed or deformed conduit. Avoid trapped conduit runs where possible. Take care to prevent the lodgment of foreign material in the conduit, boxes, fittings, and equipment during the course of construction. Clear any clogged conduit of obstructions or be replaced.

3.1.1 Rigid Steel Conduit

Make field-made bends and offsets with approved hickey or conduit bending machine. Conduit elbows larger than 2-1/2 inches shall be long radius.

Provide all conduit stubbed-up through concrete floors or slabs for connections to free-standing equipment with the exception of motor-control centers, cubicles, and other such items of equipment, with a flush coupling when the floor slab is of sufficient thickness. Otherwise, provide a floor box set flush with the finished floor or slab. Conduits installed for future use shall be terminated with a coupling and plug set flush with the floor or slab.

3.1.2 Electrical Metallic Tubing (EMT)

EMT shall be grounded in accordance with NFPA 70, using pressure grounding connectors especially designed for EMT.

3.1.3 Flexible Metallic Conduit

Use flexible metallic conduit to connect recessed fixtures from outlet

boxes in ceilings, transformers, and other approved assemblies.

Bonding wires shall be used in flexible conduit as specified in [NFPA 70](#), for all circuits. Flexible conduit shall not be considered a ground conductor.

Electrical connections to vibration-isolated equipment shall be made with flexible metallic conduit.

Liquidtight flexible metallic conduit shall be used in wet and oily locations and to complete the connection to motor-driven equipment.

3.1.4 Intermediate Conduit

Make all field-made bends and offsets with approved hickey or conduit bending machine. Use intermediate metal conduit only for indoor installations.

3.1.5 Rigid Nonmetallic Conduit

Rigid PVC conduit shall be direct buried.

A green insulated copper grounding conductor shall be in conduit with conductors and be solidly connected to ground at each end. Grounding wires shall be sized in accordance with [NFPA 70](#).

3.1.6 Wireway and Auxiliary Gutter (NOT USED)

3.1.7 Surface Raceways and Assemblies (NOT USED)

3.1.8 Cable Trays (NOT USED)

3.2 WIRING

Feeder and branch circuit conductors shall be color coded as follows:

<u>CONDUCTOR</u>	<u>COLOR AC</u>
Phase A	Brown
Phase B	Orange
Phase C	Yellow
Neutral	White
Equipment Grounds	Green

Conductors up to and including [AWG No. 2](#) shall be manufactured with colored insulating materials. Conductors larger than [AWG No. 2](#) shall have ends identified with color plastic tape in outlet, pull, or junction boxes.

Splice in accordance with the [NFPA 70](#). Provide conductor identification within each enclosure where a tap, splice, or termination is made and at the equipment terminal of each conductor. Terminal and conductor identification shall match as indicated.

Where several feeders pass through a common pullbox, the feeders shall be tagged to clearly indicate the electrical characteristics, circuit number,

and panel designation.

3.3 SAFETY SWITCHES

Securely fasten switches to the supporting structure, utilizing a minimum of four 1/4 inch bolts. Do not use sheet metal screws and small machine screws for mounting. Do not mount switches in an inaccessible location. Mounting height shall be 5 feet above finished grade, when possible.

3.4 WIRING DEVICES (NOT USED)

3.5 BOXES AND FITTINGS (NOT USED)

3.6 LAMPS AND LIGHTING FIXTURES

Install new lamps of the proper type and wattage in each fixture. Securely fasten fixtures and supports to structural members and install parallel and perpendicular to major axes of structures.

3.7 PANELBOARDS

Securely mount panelboards so that the top operating handle does not exceed 72-inches above the finished floor or finished grade. Do not mount equipment within 36 inches of the front of the panel. Directory card information shall be complete and legible.

3.8 DRY-TYPE DISTRIBUTION TRANSFORMERS

Connect dry-type transformers with flexible metallic conduit.

[Mount all dry-type transformers on vibration isolators in accordance with Section 23 05 48.00 40 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT.

]3.9 IDENTIFICATION PLATES AND WARNINGS

Furnish and install identification plates for lighting and power panelboards, motor control centers, all line voltage heating and ventilating control panels, fire detector and sprinkler alarms, door bells, pilot lights, disconnect switches, manual starting switches, and magnetic starters. Process control devices and pilot lights shall have identification plates.

Furnish identification plates for all line voltage enclosed circuit breakers, identifying the equipment served, voltage, phase(s) and power source. Circuits 480 volts and above shall have conspicuously located warning signs in accordance with OSHA requirements.

3.10 PAINTING

Exposed conduit, supports, fittings, cabinets, pull boxes, and racks shall be thoroughly cleaned and painted as specified in Section 09 90 00 PAINTS AND COATINGS or Section 09 96 00 HIGH-PERFORMANCE COATINGS.

3.11 FIELD TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

Submit Test Reports in accordance with referenced standards in this section.

After completion of the installation and splicing, and prior to energizing the conductors, perform wire and cable continuity and insulation tests as herein specified before the conductors are energized.

Contractor shall provide all necessary test equipment, labor, and personnel to perform the tests, as herein specified.

Isolate completely all wire and cable from all extraneous electrical connections at cable terminations and joints. Substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panel boards, and other disconnecting devices shall be used to isolate the circuits under test.

Perform [insulation-resistance test](#) on each field-installed conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Take readings after 1 minute and until the reading is constant for 15 seconds. Minimum insulation-resistance values shall not be less than 25 Megohms for 300 volt rated cable and 100 Megohms for 600 volt rated cable. For circuits with conductor sizes 8AWG and smaller insulation resistance testing is not required.

Perform [continuity test](#) to insure correct cable connection (i.e correct phase conductor, grounded conductor, and grounding conductor wiring) end-to-end. Any damages to existing or new electrical equipment resulting from contractor mis-wiring will be repaired and re-verified at contractor's expense. All repairs shall be approved by the CO prior to acceptance of the repair.

Conduct [phase-rotation tests](#) on all three-phase circuits using a phase-rotation indicating instrument. Perform phase rotation of electrical connections to connected equipment clockwise, facing the source.

Final acceptance will depend upon the successful performance of wire and cable under test. Do not energize any conductor until the final test reports are reviewed and approved by the CO.

-- End of Section --

SECTION 26 05 13.00 40

MEDIUM-VOLTAGE CABLES

08/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC C8 (2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV

AEIC CS1 (1990e11) Impregnated-Paper-Insulated, Metallic Sheathed Cable, Solid Type

ASTM INTERNATIONAL (ASTM)

ASTM B 3 (2001; R 2007) Standard Specification for Soft or Annealed Copper Wire

ASTM D 746 (2007) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 383 (2003; R 2008) Standard for Qualifying Class 1E Electric Cables and, Field Splices for Nuclear Power Generating Stations 2004

IEEE 400.2 (2004) Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE (2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA WC 71/ICEA S-96-659 (1999) Standard for Nonshielded Cables Rated 2001-5000 Volts for use in the Distribution of Electric Energy

NEMA WC 2 (1980; Rev 1 1989; R 1998; R 2005) Standard for Steel Armor and Associated Coverings for Impregnated Paper Insulated Cables (ICEA S-67-401 5th Edition)

NEMA WC 27500 (2005) Standard for Aerospace and

Industrial Electrical Cable

NEMA WC 70

(2009) Power Cable Rated 2000 V or Less for the Distribution of Electrical Energy--S95-658

NEMA WC 74/ICEA S-93-639

(2006) 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70

(2011) National Electrical Code

1.2 DEFINITIONS

Medium voltage power cables includes all cables rated above 600 to 35,000 volts.

1.3 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Provide [Certificates](#) for the following showing that the cable manufacturer has made factory-conducted tests on each shipping length of cable. Provide certified copies of test data that shows conformance with the referenced standards and is approved prior to delivery of cable.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that reviews the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

[SD-03 Product Data](#)

Provide equipment and performance data and manufacturer's catalog data for the following items:

[Multiple-Conductor Shielded Cables](#)

[Multiple-Conductor Nonshielded Cables](#)

[Single-Conductor Shielded Cables](#)

[Single-Conductor Nonshielded Cables](#)

[Portable Cables](#)

[Nonmetallic Jacket](#)

[SD-06 Test Reports](#)

Provide test reports for the following in accordance with the paragraph entitled, "Field Testing," of this section.

Dielectric Absorption Tests

High-Voltage Tests

Radiographic Tests

SD-07 Certificates

Provide listing of products installed showing qualifications of Cable Splicers to the Contracting Officer prior to specified work.

Provide **Certificates** for the following:

Lead Sheath

Flammability

Minimum Bending Radius

High-Voltage Tests

Dielectric Absorption Tests

Cable Splicers

SD-08 Manufacturer's Instructions

Provide manufacturer's instructions showing the recommended sequence and method of installation for the following:

Medium-Voltage Power Cables

High-Voltage Power Cables

Pothead Terminations

1.5 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with **RCBEA GUIDE** to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section **01 86 26.07 40** RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

1.6 QUALIFICATIONS

Cable splicers performing splicing are required to have 5 years experience in cable splicing and terminations. Once a termination or splice has been started by a worker, the same person completes that particular splice. Start and complete each termination and splice in one continuous work period.

1.7 CABLE VOLTAGE RATINGS

Provide [Medium-voltage power cables](#) including multiple- and single-conductor cables rated as follows, phase-to-phase, for grounded and ungrounded neutral systems:

Use cables rated 15,000 volts, ungrounded neutral, on 12,470-volt, three-phase, 60-hertz distribution systems.

1.8 SHIPMENT

Ship cables on reels such that the cable is protected from mechanical injury. Hermetically seal and securely attach each end of each length of cable to the reel.

Make minimum reel drum diameter 14 times the overall diameter of the cable. Provide a pulling eye that is installed by the manufacturer for each length of cable supplied for installation in ducts, manholes, and utility tunnels.

PART 2 PRODUCTS

2.1 CONDUCTORS

Provide conductors that are solid copper conforming to [ASTM B 3](#).

2.2 CABLE IDENTIFICATION

Provide cables that have a tape placed immediately under the lead sheath or outer jacket showing the name of the manufacturer, the year in which the cable was manufactured, and a unique number for identification purposes. Closely group information on the tape at [1-foot](#) intervals to permit complete identification.

2.3 FLAMMABILITY

Test cables not to be enclosed in metallic conduit for flammability in accordance with [IEEE 383](#), 70,000 Btu per hour per hour vertical tray flame test.

2.4 MULTIPLE-CONDUCTOR SHIELDED CABLES

2.4.1 Varnished Cambric and Lead

Provide multiple-conductor, varnished-cambric-insulated, lead-covered, shielded cable that conforms to [NEMA WC 27500](#).

Provide cables that have a nonmetallic jacket over the [lead sheath](#) in accordance with paragraph entitled, "Nonmetallic Jacket," of this section.

2.4.2 Varnished Cambric with Interlocked Armor

Provide multiple-conductor, varnished-cambric-insulated, interlocked-armor-covered, shielded cable that conforms to [NEMA WC 27500](#).

Apply close-fitting, interlocked-armor tape of aluminum over the jacket in accordance with [NEMA WC 2](#).

2.4.3 Synthetic Rubber with Interlocked Armor

Provide multiple-conductor, synthetic-rubber-insulated, interlocked-armor-covered, shielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659 and NEMA WC 74/ICEA S-93-639.

Apply close-fitting, interlocked-armor tape of aluminum over the jacket in accordance with NEMA WC 2.

2.4.4 Butyl Rubber with Neoprene Jacket

Apply multiple-conductor, butyl-rubber-insulated, neoprene-jacketed, shielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659 and NEMA WC 74/ICEA S-93-639.

2.4.5 Cross-Linked Polyethylene with PVC Jacket

Provide multiple-conductor, cross-linked polyethylene-insulated, polyvinylchloride-jacketed, shielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8. Provide taped shielding that consists of 5-mil thick copper shielding lap applied over 12-mil thick semiconducting tape. Wrap both helically with 10-percent overlap, providing 100-percent coverage.

Shield cross-linked polyethylene (XLP) single- and multiple-conductor cables for grounded and ungrounded neutral voltage ratings of 2,000 volts or more.

2.4.6 Ethylene Propylene Rubber (EPR) with Jacketed Interlocked Armor

Provide multiple-conductor ethylene propylene rubber insulated interlocked armor covered shielded cables that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8.

Shield ethylene propylene (EP) or ethylene propylene rubber (EPR), single- and multiple-conductor cables for grounded or ungrounded neutral voltage ratings of more that 8,000 volts.

2.5 MULTIPLE-CONDUCTOR, NONSHIELDED CABLES

2.5.1 Synthetic Rubber with Neoprene Jacket

Provide multiple-conductor, synthetic-rubber-insulated, neoprene-jacketed, nonshielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659 and NEMA WC 74/ICEA S-93-639.

2.5.2 Butyl Rubber with Neoprene Jacket

Provide multiple-conductor, synthetic-rubber-insulated, neoprene-jacketed, nonshielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659 and NEMA WC 74/ICEA S-93-639.

2.5.3 Cross-Linked Polyethylene with PVC Jacket

Provide multiple-conductor, polyethylene-insulated, polyvinylchloride-jacketed, nonshielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8.

2.5.4 Ethylene-Propylene with PVC Jacket

Provide multiple-conductor, ethylene-propylene-insulated, polyvinylchloride-jacketed, nonshielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8.

2.6 SINGLE-CONDUCTOR SHIELDED CABLES

2.6.1 Butyl Rubber with Neoprene Jacket

Provide single-conductor, butyl-rubber-insulated, neoprene-jacketed, shielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659 and NEMA WC 74/ICEA S-93-639.

2.6.2 Cross-Linked Polyethylene with PVC Jacket

Provide single-conductor, polyethylene-insulated, polyvinylchloride-jacketed, shielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8.

2.6.3 Cross-Linked Polyethylene with Interlocked Armor

Provide single-conductor, polyethylene-insulated, polyvinylchloride-jacketed, shielded cable with interlocked armor that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8.

Apply a close-fitting, interlocked-armor tape of aluminum over the jacket in accordance with NEMA WC 2.

2.6.4 Ethylene-Propylene-Rubber-Insulated with PVC Jacket

Provide single-conductor 15 KV cable assemblies that consist of: Class B stranded copper conductors, an extruded semiconducting shield over the conductors, 220 mils of ethylene propylene rubber insulation, an extruded or other approved semiconducting shield, a 5 mil minimum copper tape shield wrapped helically with a minimum 12.5 percent overlap and a PVC jacket.

Provide single-conductor, ethylene-propylene-insulated, polyvinylchloride-jacketed, shielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8.

2.7 SINGLE-CONDUCTOR NONSHIELDED CABLES

2.7.1 Butyl Rubber with Neoprene Jacket

Provide single-conductor, butyl-rubber-insulated, neoprene-jacketed, nonshielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659 and NEMA WC 74/ICEA S-93-639.

2.7.2 Cross-Linked Polyethylene

Provide single-conductor, cross-linked polyethylene-insulated, nonshielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8.

2.7.3 Ethylene-Propylene-Rubber-Insulated with PVC Jacket

Provide single-conductor, ethylene-propylene-rubber-insulated,

polyvinylchloride-jacketed, nonshielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8.

2.8 PORTABLE CABLES

Provide type SHD multiple-conductor, butyl-rubber-insulated, neoprene-jacketed, shielded portable cable conforming to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659 and NEMA WC 74/ICEA S-93-639.

2.9 NONMETALLIC JACKET

2.9.1 Interlock Armored Cable

Provide nonmetallic, corrosion-resistant jacket over interlock-armored cable that is polyvinylchloride conforming to NEMA WC 27500.

2.9.2 Lead-Sheathed Cable

Provide nonmetallic, corrosion-resistant jacket over lead-sheathed cable that is polyvinylchloride at least 0.11 inch thick, conforming to NEMA WC 2. Provide cover that fits tightly to the lead sheath and is coated with a slipper compound.

2.9.3 Terminations

Provide potheads with grounding terminals and cast-aluminum bells that is rated as follows:

Indoor - 15 kilovolts (kV) rating, to withstand 45 kV ac for 10 seconds, minimum

Outdoor - 25 kV rating, to withstand 60 kV ac for 10 seconds, minimum

2.10 CABLE SUPPORTS AND FITTINGS

Provide cable supports, related fittings, and accessories for use in corrosive underground locations, such as manholes and utility tunnels, with a factory applied coating of polyvinylchloride of at least 20 mils thick. Provide polyvinylchloride (PVC) coated items that have a uniform thickness and be free of blisters, breaks, and holidays. Provide PVC compound that conforms to ASTM D 746.

Provide cable racks, cable tray supports and related fittings that are UL listed heavy-duty nonmetallic polycarbonate.

PART 3 EXECUTION

3.1 INSTALLATION

Install medium-voltage cables in accordance with NFPA 70.

Install cable in underground duct banks; in conduit above and below grade; inside buildings; by open wire method; on insulator hooks; on racks; in wall and ceiling mounted cable trays in utility tunnels and manholes; and by direct burial.

Secure cables with heavy duty cable ties in existing or new trays mounted horizontally, where cable rests on tray bottom. Install cable ties at minimum of 10 foot intervals.

Secure cables with non-metallic cable clamps, straps, hangers, or other approved supporting devices to tunnel walls, ceilings, and in new or existing cable trays mounted vertically, where tray bottom is in a vertical plane.

When field cuts or other damage occurs to the PVC coating, apply a liquid PVC patch to maintain the integrity of the coating. After the installation is complete, perform an inspection to ensure the absence of voids, pinholes, or cuts.

Ensure that all cable tray is properly secured and supported prior to installing new armored cable. Add new permanent and/or temporary tray support devices as required to preclude cable tray failure during cable pulling or after cable is installed.

Cable or conductors of a primary distribution system will be rejected when installed openly in cable trays or openly racked along interior walls; in the same raceway or conduit with ac/dc control circuits or ac power circuits operating at less than 600 volts; or in a manner allowing cable to support its own weight.

3.1.1 Moisture-Testing Before Pulling

Moisture-test cable that has paper insulation before pulling it into underground ducts. Ensure that radii of bends, potheads, fittings, cable risers, and other conditions are suitable for the cable and conform with the recommendations of the cable manufacturer.

3.1.2 Protection During Splicing Operations

Provide blower to force fresh air into manholes or confined areas where free movement or circulation of air is obstructed. Make waterproof protective coverings available on the work site to provide protection against moisture while a splice is being made. Use pumps to keep manholes dry during splicing operations. Never make a splice or termination with the interior of a cable exposed to moisture. Moisture-test conductor insulation paper before the splice is made. Use a manhole ring at least 6 -inches above ground around the manhole entrance to keep surface water from entering the manhole. Plug unused ducts and stop water seepage through ducts in use before the splice is started.

3.1.3 Duct Cleaning (NOT USED)

3.1.4 Pulling Cables in Ducts, Manholes and Utility Tunnels

Pull medium-voltage cables into ducts and utility tunnels with equipment designed for this purpose, including power-driven winch, cable-feeding flexible tube guide, cable grips, and lubricants. Employ a sufficient number of trained personnel and equipment to ensure the careful and proper installation of the cable.

Set up cable reel at the side of the manhole or tunnel hatch opening and above the duct or hatch level, allowing the cable to enter through the opening without reverse bending. Install flexible tube guide through the opening in a manner that prevents the cable from rubbing on the edges of any structural member.

Allow for a pulling force for a cable grip on lead-sheathed cable that does

not exceed 1,500 pounds per square inch of sheath cross-sectional area. Use a dynamometer in the pulling line to ensure that the pulling force is not exceeded. Allow for a pulling force for a nonmetallic-sheathed cable that does not exceed the smaller of 1,000 pounds or a value computed from the following equation:

$$TM = 0.008 \times N \times CM$$

Where: TM = maximum allowable pulling tension in pounds

N = number of conductors in the cable

CM = cross-sectional area of each conductor in circular mils

Unreel cable from the top of the reel. Carefully control payout. Make cable to be pulled be attached through a swivel to the main pulling wire by means of a pulling eye.

Use woven-wire cable grips to grip the cable end when pulling small cables and short straight lengths of heavier cables.

Attach pulling eyes to the cable conductors to prevent damage to the cable structure.

Use pulling eyes and cable grips together for nonmetallic sheathed cables to prevent damage to the cable structure.

Provide a minimum bending radius in accordance with the following:

<u>CABLE TYPE</u>	<u>MINIMUM BENDING RADIUS MULTI- PLIER TIMES CABLE DIAMETER</u>
RUBBER- AND PLASTIC-IN-SULATED CABLE WITH OR WITHOUT INTERLOCKED ARMOR	
[Nonshielded cables	8]
[Shielded cables with shielding tape	12]
[Shielded cables with shielding wire	8]
PAPER-INSULATED AND LEAD-COVERED CABLES, SHIELDED OR NONSHIELDED	
[Cables without armor	10]
[Cables with wire armor	12]
VARNISHED-CAMBRIC-IN-SULATED CABLES WITH OR WITHOUT LEAD SHEATH, SHIELDED OR NONSHIELDED	
[Cables without armor	8]
[Cables with wire armor	12]

<u>CABLE TYPE</u>	<u>MINIMUM BENDING RADIUS MULTI- PLIER TIMES CABLE DIAMETER</u>
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Liberally coat cables with a suitable cable-pulling lubricant as it enters the tube guide or duct. Use grease and oil lubricants only on lead-sheathed cables. Cover nonmetallic sheathed cables with wire-pulling compounds when required which have no deleterious effects on the cable. Provide rollers, sheaves, or tube guides around which the cable is pulled that conform to the minimum bending radius of the cable.

Pull cables into ducts at a speed not to exceed 50 feet per minute and not in excess of maximum permissible pulling tension specified by the cable manufacturer. Cable pulling using a vehicle is not permitted. Stop pulling operations immediately with any indication of binding or obstruction and do not resume until such difficulty is corrected. Provide sufficient slack for free movement of cable due to expansion or contraction.

Make cable splices made up in manholes or utility tunnels that are firmly supported on cable racks as indicated. Do not pull cable splices in ducts. Overlap cable ends at the ends of a section to provide sufficient undamaged cable for splicing. Make cables to be spliced in manholes or utility tunnels overlap the centerline of the proposed joint by not less than 2 feet.

Provide cables cut in the field that have the cut ends immediately sealed to prevent entrance of moisture. Seal nonleaded cables with rubber tape wrapped down to 3 inches from the cable end. Cover-wrap rubber tape with polyvinylchloride tape. Seal lead-covered cables with wiping metal making a firm bond with the end of the sheath or with a disk of lead fitted over the end and wiped to the sheath.

3.1.5 Splices and Terminations

Make splices in manholes or tunnels except where cable terminations are specifically indicated. Expedite splicing and terminating of cables to minimize exposure and cable deterioration.

Terminate cables in potheads. Dry terminations with medium voltage pennants, preformed, and hand wrapped stress cones are allowed for terminating cables. Provide potheads with adequate means for making external connections to the cable conductors of single- or multiple-conductor cables as required; protecting the cable insulation against moisture, oil, or other contaminant; physically protecting and supporting cables, and maintaining the insulation level of the cable.

Field-fabricate Pothead terminations from termination kits supplied by and in accordance with the pothead manufacturer's recommendations for the type, size, and electrical characteristics of the cable.

Installation includes built-up or prefabricated heat or cold shrink stress-relief cones at the terminals of all shielded cables and at the terminals of single-conductor lead-covered cables rated 15 kV and above, ungrounded.

Field fabricate cable splices from splicing kits supplied by and in accordance with the cable manufacturer's recommendations for the type, size, and electrical characteristics of the cable specified. Locate cable splices in manholes midway between cable racks on walls of manholes and

supported with cable arms at approximately the same elevation as the enclosing duct.

Cable splices in the tunnel which are not installed in cable trays, install on cable racks or by other approved methods which minimize physical stress on the splice connections. Support splices at approximately the same elevation as the installed cable except where space limitations or existing cable length limitations make this method impractical or impossible.

Support all universal demountable splices in such manner so as to minimize physical stress on the splice connections. Support each cable end termination using a pair of saddle type supports under the cable end termination and/or cable with a minimum 12 inches and a maximum 30 inches separation between the supports. Secure cable end termination and cable to the supports in such a manner as to prevent movement of termination or cable at the support. Install saddle type supports on galvanized steel framing channel anchored to the wall or securely fastened to the cable tray or installed by other approved methods.

3.1.6 Multiple-Conductor Potheads

Provide multiple-conductor potheads that are hermetically sealed capnut type and that are suitable for the type, size, and electrical characteristics of the cable. Provide potheads that consist of bells or bodies with bell caps, bushing, cable connectors, lugs, and entrance fittings.

Provide pothead bells or bodies that are cast aluminum with mounting brackets as required, pipe plugs for fillings and vent holes, machine-flanged surfaces for bell caps, and cable entrance fittings. Provide pothead bell caps for cables up to 250 kc mils that are cast aluminum; and for cables of larger size and higher current ratings that are cast aluminum. Provide bell caps that have matching machined flanged surfaces for sealing with gasket and cap-screw connections.

Provide bushings that are glazed wet-process electrical porcelain insulators, factory assembled and hermetically sealed to bell cap.

Provide cable connectors that are high-conductivity copper accurately machined and threaded for internal and external electrical connections. Provide cross-sectional and contact areas that are adequate to carry the full-load current rating of the conductors. Provide solder type cable connectors with gasket seal between the connector and bushing.

Provide cable-entrance fittings that are cast-bronze wiping-sleeve type for lead-covered cable, and cast-aluminum positive-sealed stuffing boxes for nonlead-covered cables. Provide cast iron conduit couplings and armor base fittings.

Three-conductor potheads with a neutral stud and lug are allowed in lieu of four-conductor potheads in four-wire grounded neutral systems.

Provide completely filled potheads, leaving no gaps or voids, with an insulating compound suitable for the type of cable, insulation, voltage rating, and ambient operating temperatures in accordance with the pothead manufacturer's recommendations. Ground pothead parts that do not carry current.

3.1.7 Single-Conductor Potheads

Provide single-conductor potheads that are the hermetically sealed capnut type and that are suitable for the type, size, and electrical characteristics of the cable specified. Provide potheads that consist of cast bodies, bushings, cable connectors, lugs, and entrance fittings.

Provide pothead bodies that are metal castings with mounting brackets, when required, pipe plugs for filling and vent holes, and machined flanged surface for cable-entrance fitting. Provide bodies that are cast iron for cables up to 250 kc mils, and cast aluminum for cable of larger size and higher current ratings.

Provide bushings that are glazed wet-process electrical porcelain insulators, factory assembled and hermetically sealed to the pothead body.

Provide cable connectors that are high-conductivity copper accurately machined and threaded for internal and external electrical connections. Provide adequate cross-sectional and contact areas to carry the full-load current rating of the conductors. Provide solder type cable connectors with gasket seal between the connector and bushing.

Completely fill potheads, leaving no gaps or voids, with an insulating compound suitable for the type of cable, insulation, voltage rating, and ambient operating temperatures in accordance with the pothead manufacturer's recommendations. Ground pothead parts that do not carry current.

3.2 FIELD TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

Subject each to dielectric-absorption tests and high-voltage tests after the installation of high-voltage power cables has been completed, including splices, joints, and terminations, and before the cable is energized.

Provide test equipment, labor, and technical personnel as necessary to perform the electrical acceptance tests.

Make arrangements to have tests witnessed and approved by the Contracting Officer.

Completely isolate each power-cable installation from extraneous electrical connections at cable terminations and joints. Observe safety precautions.

First give each power cable a full dielectric-absorption test with 5000-volt insulation-resistance test set. Apply test for a long enough time to fully charge the cable. Record readings every 15 seconds during the first 3 minutes of test and at 1 minute intervals thereafter. Continue test until three equal readings, 1 minute apart, are obtained. Minimum reading is 200 megohms at an ambient temperature of 68 degrees F. Correct readings taken at other than 68 degrees F ambient temperatures.

Upon successful completion of the dielectric absorption tests, subject the cable to a direct-current high-potential test for 5 minutes with test voltages applied in accordance with AEIC CS1 and IEEE 400.2 for paper-impregnated, lead-covered cable; AEIC C8 and IEEE 400.2 for cross-linked, polyethylene-insulated cable; and AEIC C8 and IEEE 400.2 for

ethylene propylene rubber-insulated cable.

Record leakage current readings every 30 seconds during the first 2 minutes and every minute thereafter for the remainder of the test. When the leakage current continues to increase after the first minute, immediately terminate the test and take steps to find and correct the fault. When a second test becomes necessary, repeat this test procedure.

Upon satisfactory completion of the high-potential test, give the cable a second dielectric-absorption test as before.

Provide results of the second dielectric-absorption test that agree with the first test and that indicate no evidence of permanent injury to the cable caused by the high-potential test.

Record test data and include identification of cable and location, megohm readings versus time, leakage current readings versus time, and cable temperature versus time.

Final acceptance depends upon the satisfactory performance of the cable under test. Do not energize cable until recorded test data has been approved by the Contracting Officer. Provide final test reports to the Contracting Officer. Provide reports with a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Report - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

Perform [Radiographic tests](#) on all potheads at the discretion of the Contracting Officer to determine if voids exist in the pothead. Rework unacceptable terminations at no additional expense to the Government.

-- End of Section --

SECTION 26 05 19.00 10

INSULATED WIRE AND CABLE

11/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC C8 (2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV

AEIC CS8 (2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 383 (2003; R 2008) Standard for Qualifying Class 1E Electric Cables and, Field Splices for Nuclear Power Generating Stations 2004

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WC 70 (2009) Power Cable Rated 2000 V or Less for the Distribution of Electrical Energy--S95-658

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data**Installation Instructions**

Cable manufacturing data.

SD-06 Test Reports**Tests, Inspections, and Verifications**

6 certified copies of test reports.

1.3 DELIVERY, STORAGE, AND HANDLING

Furnish cables on reels or coils. Each cable and the outside of each reel

or coil, shall be plainly marked or tagged to indicate the cable length, voltage rating, conductor size, and manufacturer's lot number and reel number. Each coil or reel of cable shall contain only one continuous cable without splices. Cables for exclusively dc applications, as specified in paragraph HIGH VOLTAGE TEST SOURCE, shall be identified as such. Shielded cables rated 2,001 volts and above shall be reeled and marked in accordance with Section I of [AEIC C8](#) or [AEIC CS8](#), as applicable. Reels shall remain the property of the Government.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Wire Table

Furnish wire and cable in accordance with the requirements of the wire table below, conforming to the detailed requirements specified herein.

2.1.2 Rated Circuit Voltages

All wire and cable shall have minimum rated circuit voltages in accordance with [NEMA WC 70](#).

2.1.3 Conductors

2.1.3.1 Material for Conductors

Conductors shall conform to all the applicable requirements of [NEMA WC 70](#), as applicable, and shall be annealed copper. Copper conductors may be bare, or tin- or lead-alloy-coated, if required by the type of insulation used.

2.1.3.2 Size

Minimum wire size shall be No. 12 AWG for power and lighting circuits; No. 10 AWG for current transformer secondary circuits; No. 14 AWG for potential transformer, relaying, and control circuits; No. 16 AWG for annunciator circuits; and No. 19 AWG for alarm circuits. Minimum wire sizes for rated circuit voltages of 2,001 volts and above shall not be less than those listed for the applicable voltage in [NEMA WC 70](#), as applicable.

2.1.3.3 Stranding

Conductor stranding classes cited herein shall be as defined in [NEMA WC 70](#), as applicable. Lighting conductors No. 10 AWG and smaller shall be solid or have Class B stranding. Any conductors used between stationary and moving devices, such as hinged doors or panels, shall have Class H or K stranding. All other conductors shall have Class B or C stranding, except that conductors shown on the drawings, or in the schedule, as No. 12 AWG may be 19 strands of No. 25 AWG, and conductors shown as No. 10 AWG may be 19 strands of No. 22 AWG.

2.1.3.4 Conductor Shielding

Use conductor shielding conforming to [NEMA WC 70](#), as applicable, on power cables having a rated circuit voltage above 2,000 volts. In addition, conductor shielding for shielded cables shall also comply with Section C of [AEIC C8](#) or [AEIC CS8](#). Strict precautions shall be taken after application of the conductor shielding to prevent the inclusion of voids or

contamination between the conductor shielding and the subsequently applied insulation.

2.1.3.5 Separator Tape

Where conductor shielding, strand filling, or other special conductor treatment is not required, a separator tape between conductor and insulation is permitted.

2.1.4 Insulation

2.1.4.1 Insulation Material

Provide insulation which is a cross-linked thermosetting polyethylene (XLPE) type, meeting the requirements of NEMA WC 70, as applicable, or an ethylene-propylene rubber (EPR) type meeting the requirements of NEMA WC 70. For shielded cables of rated circuit voltages above 2,000 volts, the following provisions shall also apply:

- a. XLPE, if used, shall be tree-retardant.
- b. Insulation shall be chemically bonded to conductor shielding.
- c. The insulation material and its manufacturing, handling, extrusion and vulcanizing processes, shall all be subject to strict procedures to prevent the inclusion of voids, contamination, or other irregularities on or in the insulation. Insulation material shall be inspected for voids and contaminants. Inspection methods, and maximum allowable void and contaminant content shall be in accordance with Section B of AEIC C8 or AEIC CS8, as applicable.
- d. Cables with repaired insulation defects discovered during factory testing, or with splices or insulation joints, are not acceptable.

2.1.4.2 Insulation Thickness

The insulation thickness for each conductor shall be based on its rated circuit voltage.

- a. Power Cables/Single-Conductor Control Cables, 2,000 Volts and Below - The insulation thickness for single-conductor cables rated 2,000 volts and below shall be as required by NEMA WC 70, as applicable. Some thicknesses of NEMA WC 70 will be permitted only for single-conductor cross-linked thermosetting polyethylene insulated cables without a jacket. NEMA WC 70 ethylene-propylene rubber-insulated conductors shall have a jacket.
- b. Power Cables, Rated 2,001 Volts and Above - Thickness of insulation for power cables rated 2,001 volts and above shall be in accordance with the following:
 - (1) Non-shielded cables, 2,001 to 5,000 volts, shall comply with NEMA WC 70, as applicable.
 - (2) Shielded cables rated 2,001 volts and above shall comply with Column B of Table B1, of AEIC C8 or AEIC CS8, as applicable.
- c. Multiple-Conductor Control Cables - The insulation thickness of multiple-conductor cables used for control and related purposes shall

be as required by NEMA WC 70, as applicable.

2.1.4.3 Insulation Shielding

Unless otherwise specified, provide insulation shielding for conductors having rated circuit voltages of 2,001 volts and above. The voltage limits above which insulation shielding is required, and the material requirements, are given in NEMA WC 70, as applicable. The material, if thermosetting, shall meet the wafer boil test requirements as described in Section D of AEIC C8 or AEIC CS8, as applicable. The method of shielding shall be in accordance with the current practice of the industry; however, the application process shall include strict precautions to prevent voids or contamination between the insulation and the nonmetallic component. Voids, protrusions, and indentations of the shield shall not exceed the maximum allowances specified in Section C of AEIC C8 or AEIC CS8, as applicable. The cable shall be capable of operating without damage or excessive temperature when the shield is grounded at both ends of each conductor. All components of the shielding system shall remain tightly applied to the components they enclose after handling and installation in accordance with the manufacturer's recommendations. Shielding systems which require heat to remove will not be permitted unless specifically approved.

2.1.5 Jackets

All cables shall have jackets meeting the requirements of NEMA WC 70, as applicable, and as specified herein. Individual conductors of multiple-conductor cables shall be required to have jackets only if they are necessary for the conductor to meet other specifications herein. Jackets of single-conductor cables and of individual conductors of multiple-conductor cables, except for shielded cables, shall be in direct contact and adhere or be vulcanized to the conductor insulation. Multiple-conductor cables and shielded single-conductor cables shall be provided with a common overall jacket, which shall be tightly and concentrically formed around the core. Repaired jacket defects found and corrected during manufacturing are permitted if the cable, including jacket, afterward fully meets these specifications and the requirements of the applicable standards.

2.1.5.1 Jacket Material

The jacket shall be one of the materials listed below. Variations from the materials required below will be permitted only if approved for each specific use, upon submittal of sufficient data to prove that they exceed all specified requirements for the particular application.

a. General Use

- (1) Heavy-duty black neoprene (NEMA WC 70).
- (2) Heavy-duty chlorosulfonated polyethylene (NEMA WC 70).
- (3) Heavy-duty cross-linked (thermoset) chlorinated polyethylene (NEMA WC 70).

b. Accessible Use Only, 2,000 Volts or Less - Cables installed where they are entirely accessible, such as cable trays and raceways with removable covers, or where they pass through less than 10 feet of exposed conduit only, shall have jackets of one of the materials

specified in above paragraph GENERAL USE, or the jackets may be of one of the following:

- (1) General-purpose neoprene (NEMA WC 70).
- (2) Black polyethylene (NEMA WC 70).
- (3) Thermoplastic chlorinated polyethylene (NEMA WC 70).

2.1.5.2 Jacket Thickness

The minimum thickness of the jackets at any point shall be not less than 80 percent of the respective nominal thicknesses specified below.

a. Multiple-Conductor Cables - Thickness of the jackets of the individual conductors of multiple-conductor cables shall be as required by NEMA WC 70, and shall be in addition to the conductor insulation thickness required by Column B of Table 3-1 of the applicable NEMA publication for the insulation used. Thickness of the outer jackets or sheaths of the assembled multiple-conductor cables shall be as required by NEMA WC 70.

b. Single-Conductor Cables - Single-conductor cables, if nonshielded, shall have a jacket thickness as specified in NEMA WC 70. If shielded, the jacket thickness shall be in accordance with the requirements of NEMA WC 70.

2.1.6 Metal-Clad Cable

2.1.6.1 General

The metallic covering shall be interlocked steel tape, conforming to the applicable requirements of NEMA WC 70. If the covering is of ferrous metal, it shall be galvanized. Copper grounding conductor(s) conforming to NEMA WC 70 shall be furnished for each multiple-conductor metal-clad cable. Assembly and cabling shall be as specified in paragraph CABLING. The metallic covering shall be applied over an inner jacket or filler tape. The cable shall be assembled so that the metallic covering will be tightly bound over a firm core.

2.1.6.2 Jackets

Metal-clad cables may have a jacket under the armor, and shall have a jacket over the armor. Jackets shall comply with the requirements of NEMA WC 70. The outer jacket for the metal-clad cable may be of polyvinyl chloride only if specifically approved.

2.2 CABLE IDENTIFICATION

2.2.1 Color-Coding

Insulation of individual conductors of multiple-conductor cables shall be color-coded in accordance with NEMA WC 70, except that colored braids will not be permitted. Only one color-code method shall be used for each cable construction type. Control cable color-coding shall be in accordance with NEMA WC 70. Power cable color-coding shall be black for Phase A, red for Phase B, blue for Phase C, white for grounded neutral, and green for an insulated grounding conductor, if included.

2.2.2 Shielded Cables Rated 2,001 Volts and Above

Marking shall be in accordance with Section H of [AEIC C8](#) or [AEIC CS8](#), as applicable.

2.2.3 Cabling

Individual conductors of multiple-conductor cables shall be assembled with flame-and moisture-resistant fillers, binders, and a lay conforming to [NEMA WC 70](#), except that flat twin cables will not be permitted. Fillers shall be used in the interstices of multiple-conductor round cables with a common covering where necessary to give the completed cable a substantially circular cross section. Fillers shall be non-hygroscopic material, compatible with the cable insulation, jacket, and other components of the cable. The rubber-filled or other approved type of binding tape shall consist of a material that is compatible with the other components of the cable and shall be lapped at least 10 percent of its width.

2.2.4 Dimensional Tolerance

The outside diameters of single-conductor cables and of multiple-conductor cables shall not vary more than 5 percent and 10 percent, respectively, from the manufacturer's published catalog data.

PART 3 EXECUTION

3.1 [INSTALLATION INSTRUCTIONS](#)

The following information shall be provided by the cable manufacturer for each size, conductor quantity, and type of cable furnished:

- a. Minimum bending radius, in inches - For multiple-conductor cables, this information shall be provided for both the individual conductors and the multiple-conductor cable.
- b. Pulling tension and sidewall pressure limits, in [pounds](#).
- c. Instructions for stripping semiconducting insulation shields, if furnished, with minimum effort without damaging the insulation.
- d. Upon request, compatibility of cable materials and construction with specific materials and hardware manufactured by others shall be stated. Also, if requested, recommendations shall be provided for various cable operations, including installing, splicing, terminating, etc.

3.2 [TESTS, INSPECTIONS, AND VERIFICATIONS](#)

3.2.1 Cable Data

Manufacture of the wire and cable shall not be started until all materials to be used in the fabrication of the finished wire or cable have been approved by the Contracting Officer. Cable data shall be submitted for approval including dimensioned sketches showing cable construction, and sufficient additional data to show that these specifications will be satisfied.

3.2.2 Inspection and Tests

Inspection and tests of wire and cable furnished under these specifications shall be made by and at the plant of the manufacturer, and shall be witnessed by the Contracting Officer or his authorized representative, unless waived in writing. The Government may perform further tests before or after installation. Testing in general shall comply with NEMA WC 70. Specific tests required for particular materials, components, and completed cables shall be as specified in the sections of the above standards applicable to those materials, components, and cable types. Tests shall also be performed in accordance with the additional requirements specified below.

3.2.2.1 High-Voltage Test Source

Where the applicable standards allow a choice, high-voltage tests for cables to be used exclusively on dc circuits shall be made with dc test voltages. Cables to be used exclusively on ac circuits shall be tested with ac test voltages. If both ac and dc will be present, on either the same or separate conductors of the cable, ac test voltages shall be used.

3.2.2.2 Shielded Cables Rated 2,001 Volts or Greater

The following tests shall be performed in addition to those specified above. Section or paragraph references are to AEIC C8 or AEIC CS8 as applicable, unless otherwise stated.

a. High potential test voltages shall be as required by Table B1 of AEIC C8 or AEIC CS8 as applicable, rather than by NEMA WC 70.

b. If high potential testing is done with an ac test voltage as specified in paragraph HIGH-VOLTAGE TEST SOURCE, an additional test shall be made using a dc test voltage rated at 75 percent of the specified full dc test voltage, for 5 consecutive minutes.

c. Production sampling tests shall be performed in accordance with Section D. Sampling frequency and failure contingencies shall be in accordance with paragraph G.3. Unless otherwise approved, samples shall not be taken from the middle of extruder runs of insulation or shielding made only for one continuous shipping length of cable, if such sampling will result in the need to repair the sampled area.

d. Partial discharge tests shall be performed in accordance with Section E, paragraph E.2, and Section F.

3.2.2.3 Flame Tests

All multiple-conductor and single-conductor cable assemblies shall pass IEEE 383 flame tests, paragraph 2.5, using the ribbon gas burner. Single-conductor cables and individual conductors of multiple-conductor cables shall pass the flame test of NEMA WC 70. If such tests, however, have previously been made on identical cables, these tests need not be repeated. Instead, certified reports of the original qualifying tests shall be submitted. In this case the reports furnished under paragraph REPORTS, shall verify that all of each cable's materials, construction, and dimensions are the same as those in the qualifying tests.

3.2.2.4 Independent Tests

The Government may at any time make visual inspections, continuity or resistance checks, insulation resistance readings, power factor tests, or dc high-potential tests at field test values. A cable's failure to pass these tests and inspections, or failure to produce readings consistent with acceptable values for the application, will be grounds for rejection of the cable.

3.2.2.5 Reports

Furnish results of tests made. No wire or cable shall be shipped until authorized. Lot number and reel or coil number of wire and cable tested shall be indicated on the test reports.

SECTION 26 09 23.00 40

LIGHTING CONTROL DEVICES

08/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IESNA LM-48 (2001) Guide for Testing the Calibration of Locking-Type Photoelectric Control Devices Used in Outdoor Applications

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE (2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1 (2000; R 2005; R 2008) Standard for Industrial Control and Systems: General Requirements

NEMA ICS 2 (2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V

NEMA ICS 6 (1993; R 2006) Enclosures

UNDERWRITERS LABORATORIES (UL)

UL 773 (1995; Reprint Mar 2002) Standard for Plug-In, Locking Type Photocontrols for Use with Area Lighting

UL 773A (2006; Reprint Jun 2010) Standard for Nonindustrial Photoelectric Switches for Lighting Control

UL 98 (2004; Reprint Apr 2006) Enclosed and Dead-Front Switches

1.2 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Submit [Installation Drawings](#) for control devices in accordance with the manufacturer's recommended instructions for installation.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Submit manufacturer's catalog data for [Photoconductive Control Devices](#).

Submit [Installation Drawings](#) for [Light-Sensitive Control Devices](#) in accordance with paragraph entitled, "General Requirements," of this section.

[Dimming ballast controls; G](#)

[Light Level Sensor; G](#)

[Dimmer Switch; G](#)

[Lighting Contactor; G](#)

[Time Switch; G](#)

[Photocell Switch; G](#)

[Occupancy Sensors; G](#)

[Motion Sensors](#)

SD-06 Test Reports

Submit test reports for [System Operation Tests](#) in the presence of the Contracting Officer.

SD-08 Manufacturer's Instructions

Submit operational instructions for [Light-Sensitive Control Devices](#) consisting of the manufacturer's recommended procedures for operation.

SD-10 Operation and Maintenance Data

[Lighting Control System, Data Package 5; G](#)

1.4 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with [RCBEA GUIDE](#) to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

PART 2 PRODUCTS

2.1 PHOTOCONDUCTIVE CONTROL DEVICES

Provide photoconductive control devices in accordance with UL 773. Control lighting luminaires in banks by a single photo-control element mounted within each bank. Provide physically and electrically interchangeable light sensitive control devices with three-pole, 3-wire locking plug and receptacle connections to the line, load, and neutral conductors of the lighting circuit.

Provide photoconductive control devices for natural daylight and darkness control of incandescent, fluorescent, and outdoor lighting luminaires including a photoconductive cell, thermal actuator, and snap-action switch in a weatherproof housing. Provide a control device which is, when attached to its mounting, weatherproof and constructed to exclude beating rain, snow, dust, and insects and capable of withstanding 96 percent relative humidity at 122 degrees F for 48 hours under operating conditions.

Submit operation and maintenance data, Lighting Control System, Data Package 5, in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein, showing all light fixtures, control modules, control zones, occupancy sensors, motion sensors, light level sensors, power packs, dimming ballasts, schematic diagrams and all interconnecting control wire, conduit, and associated hardware.

2.1.1 Photoconductive Limit Settings

Provide device which turns on within the limits of plus 100 to minus 50 percent of its setting, over a range of input voltage from 105 to 130 volts at rated frequency and ambient temperature, and at rated voltage and frequency over a range of temperature from minus 85 to 122 degrees F, with relative humidities up to 96-percent throughout the temperature range.

Adjust the device to operate within the limits of 0.8 to 1.2 foot-candles, but also capable of calibration of the turn-on light level over a minimum range from 0.5 to 3.0 foot-candles, and adaptable for calibration up to 10 foot-candles. Ratio of turn-off light level to turn-on light level is not to exceed 5.

2.1.2 Device Rating and Accuracy

Rate the devices at 120 or 277 volts, 60 hertz, with rated ambient temperature of 25 plus or minus 41 degrees F

Maintain instrument accuracy by proper calibration in accordance with IESNA LM-48.

2.2 TIME CONTROL SWITCHES

Install switches with not less than four 1/4 inch bolts. The use of sheet metal screws is not allowed.

2.3 MANUAL AND SAFETY SWITCHES

Provide Astronomic dial type arranged to turn "ON" at sunset, and turn

"OFF" at a pre-determined time between 2030 hours and 0230 hours or sunrise, automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Provide a switch rated 120 volts, having battery backed electronic clock to maintain accurate time for a minimum of 7 hours following a power failure, with a time switch with a manual on-off bypass switch. Provide surface mounted housing for the time switch, type NEMA 1 (indoor) enclosure.

Provide switch mechanism consisting of a heavy-duty general-purpose precision snap-acting switch single-pole, single-throw, suitable for operation on a 277 volt, 60 Hz, single-phase system. Provide with a selector switch having a minimum of three positions: ON, OFF, and AUTOMATIC. Use the automatic position when photoelectric or timer control is desired. Interface the selector switch with the lighting system magnetic contactor to control system activity.

Provide switches conforming to UL 98. Provide switch construction of the quick-make, quick-break type, such that a screwdriver is required to open the switch door when the switch is on, with blades visible when the door is open. Coordinate terminal lugs with the wire size.

2.4 LIGHTING CONTACTOR

Provide NEMA ICS 2, mechanically held contactor, rated 600 volts, 30 amperes, and 1 poles, with coils rated 120 volts. Provide in NEMA 1 enclosure conforming to NEMA ICS 6. Provide contactor with silver alloy double-break contacts and coil clearing contacts for mechanically held contactor requiring no arcing contacts. Provide contactor with hand-off-automatic selector switch.

2.5 TIME SWITCH

Provide astronomic dial type or electronic type, arranged to turn "ON" at sunset and turn "OFF" at predetermined time between 8:30 p.m. and 2:30 a.m. or sunrise, automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Provide switch rated 120 volts, having automatically wound spring mechanism or capacitor, to maintain accurate time for a minimum of 7 hours following power failure. Provide time switch with a manual on-off bypass switch. Surface mount the housing for the time switch, NEMA 1 enclosure conforming to NEMA ICS 6.

2.6 PHOTOCCELL SWITCH

Provide photocell switch conforming to UL 773 or UL 773A, hermetically sealed cadmium-sulfide or silicon diode type cell rated 120 volts ac, 60 Hz with single-throw contacts designed to fail to the ON position. Provide switch which turns on at or below 3 footcandles and off at 4 to 10 footcandles. Provide time delay to prevent accidental switching from transient light sources. Provide switch:

- a. In a cast weatherproof aluminum housing with adjustable window slide, rated 1800 VA, minimum.

2.7 EQUIPMENT IDENTIFICATION

2.7.1 Manufacturer's Nameplate

Provide each item of equipment with a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in an

inconspicuous place; the nameplate of the distributing agent is not acceptable.

2.7.2 Labels

Provide labeled control devices, clearly marked for operation of specific lighting functions according to type. Note the following devices characteristics in the format "Use Only [_____]":

Make markings related to control device type clear and locate to be readily visible to service personnel, but unseen from normal viewing angles when devices are in place.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Photoconductive Control Devices

Install photoconductive control devices in accordance with the manufacturer's installation instructions.

3.1.2 Time Control Switches

Install switches with not less than four 1/4 inch bolts. The use of sheet metal screws is not allowed.

3.1.3 Manual and Safety Switches

Coordinate terminal lugs with the wire size. Securely fasten switches to the supporting structure or wall using not less than four 1/4 inch bolts. The use of sheet metal screws is not allowed.

3.1.4 Magnetic Contactors

Provide magnetic contactors mechanically held, electrically operated, conforming to NEMA ICS 1 and NEMA ICS 2, suitable for 277 volts, single phase, 60 Hz, with coil voltage of 120 volts. Provide with maximum continuous ampere rating and number of poles as indicated on drawings. Provide enclosures for contactors mounted indoors conforming to NEMA ICS 6, Type 1. Provide each contactor with a spare, normally open auxiliary contact.

Coordinate terminal lugs with the wire size. Securely fasten switches to the supporting structure or wall using not less than four 1/4 inch bolts. The use of sheet metal screws is not allowed.

3.2 FIELD TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

Demonstrate that photoconductive control devices operate satisfactorily in the presence of the Contracting Officer.

Perform [System Operation Tests](#) in accordance with referenced standards in this section.

-- End of Section --

SECTION 26 35 43

400-HERTZ (HZ) SOLID STATE FREQUENCY CONVERTER

05/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- IEEE 1159 (2009) Recommended Practice on Monitoring Electric Power Quality
- IEEE 519 (1992; R 1993; Errata 2004) Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
- IEEE C2 (2007; Errata 06-1; TIA 07-1; TIA 07-2; TIA 07-3; Errata 07-2; TIA 08-4; TIA 08-5; TIA 08-6; TIA 08-7; TIA 08-8; TIA 08-9; TIA 08-10; TIA 08-11; TIA 09-12; TIA 09-13; TIA 09-14; Errata 09-3; TIA 09-15; TIA 09-16; TIA 10-17) National Electrical Safety Code
- IEEE C62.41.1 (2002; R 2008) Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
- IEEE C62.41.2 (2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
- NEMA ST 20 (1992; R 1997) Standard for Dry-Type Transformers for General Applications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 70 (2011; TIA 11-1; Errata 2011) National Electrical Code

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

- SAE AS5756/6 (2004) Cable, 3-Phase Power, Electric Portable, Multiconductor, 90 Degree C, 600V, Ozone Resistant, Split Phase

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-PRF-24021	(1998; Rev K) Electric Power Monitors, External Aircraft
MIL-STD-461	(2007; Rev F) Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-STD-704	(2004; Rev F; Notice 1 2008) Aircraft Electric Power Characteristics

UNDERWRITERS LABORATORIES (UL)

UL 1012	(2010) Power Units Other than Class 2
UL 1449	(2006; Reprint Feb 2011) Surge Protective Devices
UL 489	(2009) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 506	(2008; Reprint Mar 2010) Specialty Transformers

1.2 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS, applies to this section with addition and modifications specified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Frequency converter drawings; G

SD-03 Product Data

Frequency converter; G

Aircraft power cable assembly; G

Remote Monitoring and Control Panel; G

SD-06 Test Reports

Work Plan; G

Routine Factory Test Plan; G

Special Factory Test Plan; G

Performance Test Plan; G

Test Schedule; G

Routine Factory Tests; G

Special Factory Tests; G

SD-07 Certificates

Qualifications of manufacturer; ; G

UL Listing; ; G

SD-09 Manufacturer's Field Reports

Initial Inspection and Tests; G

Performance Tests; G

Training Syllabus; G

SD-10 Operation and Maintenance Data

Frequency converter, Data Package 5; G

Preliminary Operation and Maintenance Manuals, Data Package 5; G

Remote Monitoring and Control Panel, Data Package 5; G

1.4 QUALITY ASSURANCE

1.4.1 Frequency Converter Drawings

Furnish scaled drawings of enclosure outline including front, top, side views, and overall dimensions. Provide external power and control wiring and cable connections. Provide single line, schematic, and wiring diagrams. Drawings shall include details of input and output circuit breakers, contactors, rectifiers, surge protectors, and control devices. Drawings shall include conduit entry and exit locations. If parallel operation is included, provide an interconnection diagram.

1.4.2 Qualifications of Manufacturer

Submit a certification that the manufacturer has a minimum of five (5) years' experience in the design, manufacturing, and testing of 400 Hz solid state frequency converters at the same or equivalent kVA and voltage ratings for direct connection to aircraft electrical loads. When specifications require multiple converters operating in parallel, the manufacturer shall provide specific experience with equal or greater kVA rated converters.

The certification shall state that the manufacturer is experienced in manufacturing and testing solid state converters of an equivalent or greater kVA rating. Experience in manufacturing motor generator sets does not qualify as equivalent. Experience in manufacturing portable engine-driven 400-hertz power units does not qualify as equivalent. The manufacturer shall be experienced in producing units for installation in permanent buildings in environmentally closed spaces or in weatherproof

enclosures as applicable. The manufacturer shall also document that converters are designed for connection to non-linear loads typically encountered in the aircraft and shipbuilding industries. The manufacturer shall furnish documented experience with converters in various environmental conditions including exterior flight line, hangar, and environmentally enclosed spaces within buildings.

1.4.3 Work Plan

Submit a written schedule of dates of routine and special factory tests, installation, field tests, and operator training for the converter system. Furnish a list of instrumentation equipment for factory and field test reports.

1.4.4 Routine Factory Test Plan

Submit 7 copies of test plans and procedures at least 21 calendar days prior to the tests being conducted. Provide detailed description of test procedures, including test equipment and setups, to be used to ensure the converter meets the performance specification and explain the test methods to be used. As a minimum, the test procedures shall include the tests required under the paragraph entitled "Routine Factory Tests."

1.4.5 Special Factory Test Plan

Submit 7 copies of test plans and procedures with the Routine Factory Test Plan. Provide detailed description of test procedures, including test equipment and setups, used to ensure the converter meets the performance specification and explain the test methods used. As a minimum, the test procedures shall include the tests required under the paragraph entitled "Special Factory Tests."

1.4.6 Performance Test Plan

Submit 7 copies of test plans and procedures at least 15 calendar days prior to the start of field tests. Provide detailed description and dates and times scheduled for performance of tests, and detailed description of test procedures, including test equipment (list make and model and provide functional description of the test instruments and accessories) and setups of the tests to be conducted to ensure the converter meets the performance specification. Explain the test methods to be used. As a minimum, the test procedures shall include the tests required under the paragraph entitled "Field Quality Control." Test reports shall include power quality measurement data collected in accordance with [IEEE 1159](#).

1.4.7 UL Listing

Submit with the initial submittal to verify qualification of manufacturer. Frequency converter shall be identified with a UL or nationally recognized testing laboratory (NRTL) label prior to shipping.

1.4.7.1 Currently Listed Products

Submit UL or NRTL certification or UL file number for the actual frequency converter to be shipped.

1.4.7.2 Proposed Listed Products

Submit UL or NRTL certification or UL file number for same or similar

rating or product size range of like design unit.

1.4.8 Routine Factory Tests Report

Submit within 45 calendar days after completion of tests. Receive approval of test prior to shipping unit. Certify tests were conducted on each converter in accordance with the requirements set forth in paragraph entitled "Routine Factory Tests" and certify converter satisfactorily operated within specified limits. Report shall include copies of the test procedures, test data, and results.

1.4.9 Special Factory Tests Report

Certify tests were conducted on a converter of the same design, construction and kVA and voltage rating to be provided and in accordance with the requirements set forth in paragraph entitled "Special Factory Test" and certify converter operated without malfunctioning within specified limits. Report shall include copies of the test procedures, test data, and results.

1.4.10 Performance Tests Report

Submit report of test results as specified by paragraph entitled "Field Quality Control" within 15 calendar days after completion of tests. Certify tests were conducted on each converter in accordance with the paragraph entitled "Field Quality Control" and certify converter satisfactorily operated within specified limits. Report shall include copies of the test procedures, test data, and results.

1.5 MAINTENANCE

1.5.1 Operation and Maintenance Manuals

Submit frequency converter operation and maintenance manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.5.1.1 Additions to Operation and Maintenance Manuals

In addition to requirements of Data Package 5, include the following on the actual frequency converter provided:

- a. A "one-line diagram" from service entrance to 400 Hz utilization panel or point.
- b. A weatherproof, tear-resistant plastic data sheet with operating instructions for each unit including startup, shutdown, and paralleling procedures.
- c. Routine and field acceptance test reports.
- d. UL or NRTL certification or UL file number.

1.5.1.2 Preliminary Operation and Maintenance Manuals

Prior to scheduling Field Performance Tests, 2 copies of a Preliminary Operation and Maintenance Manual must be submitted to and approved by the Contracting Officer.

1.5.1.3 Extra Material

Furnish recommended manufacturer's spare parts list and schedule of prices for each type of converter and other equipment specified in this section. This list shall include the following:

- a. Power semi-conductors
- b. Power filter capacitors
- c. Plug-in logic cards
- d. Output switching modules
- e. Fuses
- f. Indicator lamp/LED
- g. Ventilation system filters

PART 2 PRODUCTS

2.1 FREQUENCY CONVERTER

Provide frequency converter consisting of modular construction solid-state components for 60 to 400 Hz conversion, input/output devices, and ancillary control devices. Frequency converter shall be a standard product of the manufacturer and shall be the manufacturer's latest design that complies with the specification requirements. The 400 Hz frequency converters provided under this contract shall be products of the same manufacturer. The unit shall have a calculated MTBF exceeding 24,000 hours as calculated when the converter is provided with yearly servicing and maintenance. The converter shall be UL or third party listed to comply with [UL 1012](#). Circuit breakers operating at 400 Hz shall be designed and UL tested for 60 Hz operation and derated for 400 Hz operation. The converter shall use a minimum 12 pulse or active input rectification circuit. Provide startup and shutdown instructions posted on the front of the unit using engraved plastic plate. Provide a plastic encapsulated schematic diagram attached to the inside of the unit in clear view of maintenance personnel.

2.1.1 Electrical Characteristics

2.1.1.1 Input Voltage

480Y/277 or 208Y/120 V, three phase, four wire, grounded, 60 Hz. Converter shall provide rated output voltage when input voltage is varied plus or minus 10 percent. Input neutral currents shall not exceed 21 percent of any individual phase current at no load and at full load.

2.1.1.2 Input Power Factor

Between 0.8 lagging and unity, under all conditions of steady state line and load variations specified herein.

2.1.1.3 Surge Protection

The converter shall be capable of sustaining an input surge described in and tested in accordance with [UL 1449](#), and [IEEE C62.41.1](#) and [IEEE C62.41.2](#), Location Category C, and continue to operate with no alarms within the

specified tolerance.

2.1.1.4 Inrush Current

The inrush current shall not exceed 100 percent of the rated full load input current. Inrush current limitation is based on a frequency converter that does not require a transformer at the input to the unit. Should the contractor choose to provide a frequency converter with a transformer at the input to the unit, the contractor shall be responsible for increasing the size of the upstream feeder breaker(s) and increasing the size of conductors and raceways in accordance with NFPA 70.

2.1.1.5 Input Current Distortion

Input current THD shall not exceed 5-percent of the fundamental with nominal input voltage at full load. Individual harmonic content shall not exceed 3-percent of the fundamental.

2.1.1.6 Output Voltage

200Y/115 V, three phase, 400 Hz, grounded system. Adjustable to plus or minus 10 percent of the rated voltage. The limits overvoltage and undervoltage shall be as defined in MIL-STD-704. The phase rotation of the output voltage shall be clockwise sequence of AB-BC-CA. Converters shall be designed for compatibility with ship and aircraft power monitors complying with MIL-PRF-24021.

2.1.1.7 Power Output

kVA rating as required at 0.8 power factor lagging.

2.1.1.8 Load Range

Operate into a linear load with a power factor between 0.5 lagging and 0.8 leading and into a non-linear load with not less than 15 percent current THD, composed of not less than 6 percent of the 3rd harmonic and not less than 7 percent of the 5th harmonic.

2.1.1.9 Efficiency

The units shall have a minimum efficiency of 87 at 50 percent load and 91 at 100 percent load. For a frequency converter that requires a transformer at the input to the unit, reduce the specified efficiencies by 2 percent.

2.1.1.10 No Load Input Losses

The frequency converter shall have no-load input losses no greater than 7 per above 30 kVA and 9 percent below 30 kVA of the output kW rating. For a frequency converter that requires a transformer at the input to the unit, increase the specified no load input losses by 2 percent.

2.1.1.11 Overload/Overcurrent

Satisfactory overload/overcurrent operating time is based on no more than one overload in any 4 consecutive hours of operation:

<u>Percent of Full Load</u>	<u>Satisfactory Operating Time</u>
110 percent	60 minutes

<u>Percent of Full Load</u>	<u>Satisfactory Operating Time</u>
125 percent	5 minutes
150 percent	2 minutes
200 percent	20 seconds
300 percent	6 seconds

After minimum operating time is achieved, unit shall interrupt output power. Unit shall be capable of sustaining the overload/overcurrent without damage until the protective device interrupts the overload/overcurrent.

2.1.1.12 Short Circuit

When a bolted line-to-ground fault, a bolted line-to-line fault, or a bolted three phase fault is applied to the unit, unit shall be capable of sustaining the short circuit current without damage until the protective device interrupts the fault.

2.1.1.13 Output Voltage THD

a. Balanced load:

- (1) Output voltage THD: Not to exceed 3 percent line-to-line and line-to-neutral for linear loads as specified in the paragraph entitled "Load Range".
- (2) Output voltage THD: Not to exceed 5 percent line-to-line and line-to-neutral for non-linear loads as specified in the paragraph entitled "Load Range".
- (3) Maximum single harmonic distortion: Not to exceed 2 percent of the fundamental at the nominal voltage for linear loads as specified in the paragraph entitled "Load Range".
- (4) Maximum single harmonic distortion: Not to exceed 3 percent of the fundamental at the nominal voltage for non-linear loads as specified in the paragraph entitled "Load Range".

b. Unbalanced load: Output voltage THD not to exceed 4 percent, line-to-neutral with 15 percent unbalanced linear load.

2.1.1.14 Output Voltage Amplitude Modulation

Output voltage amplitude modulation shall not exceed 1/2 percent of nominal voltage at no load to full load.

2.1.1.15 Frequency Stability

Provide a high frequency crystal clock to control output frequency of the 400 Hz converter within plus or minus 0.5 percent for all operating conditions, including maximum and minimum specified input voltages, ambient temperature and relative humidity. The frequency regulation shall operate independent of supply frequency and load changes.

2.1.1.16 Phase Angle Regulation

Displacement angle between adjacent voltage phases shall be 120 degrees plus or minus 2 degrees with balanced load and plus or minus 4 degrees with

three phase 15 percent unbalanced load. A 15 percent unbalanced load is defined as:

- a. Phase A at full rated single phase load.
- b. Phase B at 85 percent of Phase A.
- c. Phase C at 85 percent of Phase A.

2.1.1.17 Transient Output Voltage Recovery

In accordance with MIL-STD-704.

2.1.2 Environmental Rating

The converter shall operate satisfactorily from no load to rated full load under the following conditions:

- a. Ambient temperatures ranging from 0 degrees C to 55 degrees C.
- b. Relative humidity from 0 to 95 percent noncondensing.
- c. Ambient pressures from sea level to 3,000 feet.

2.1.3 Monitoring and Control Panel

Provide converter with a control panel that is equipped with the following controls, indicators, instrumentation, data logging, diagnostics, and alarm functions.

2.1.3.1 Controls

- a. Start/stop pushbutton.
- b. Lamp/light emitting diode (LED) test - A push-to-test button or switch to test indicator lamps/LEDs.
- c. Alarm silence - A switch that shall disable the audible alarm.
- d. Alarm reset - A pushbutton to silence audible alarms.
- e. Emergency power off - A separate pushbutton for emergency power off.
- f. Circuit breaker.
- g. Output contactor ON/OFF
- h. Output voltage adjust.

2.1.3.2 Indicators

- a. Input power available - Lamp/LED to indicate that the supply voltage is available.
- b. Output power On/Off - Lamp/LED to indicate that the converter output voltage is available.
- c. System alarm - Lamp/LED to indicate that a fault has been detected. This indicator shall be latched in the "ON" position whenever an alarm

condition described in paragraph entitled, "Alarm Annunciator," is detected and shall remain "ON" until the alarm reset pushbutton is pressed.

- d. Indicating lamp/LED to indicate that the alarm silence switch is in the disable position.
- e. Audible alarm.
- f. Output contactor "ON".
- g. Aircraft interlock bypass - Lamp/LED to indicate that the Aircraft Interlock has been bypassed.

2.1.3.3 Instrumentation

- a. Elapsed time meters (in hours).
- b. Output voltmeter selector switch having three phase to neutral positions for monitoring wye voltage outputs in accordance with MIL-STD-704 and one "OFF" position.
- c. Output ammeter selector switch having three phase positions and one "OFF" position.
- d. Output frequency meter, 395 to 405 HZ scale, having a 400 HZ center with an ON-OFF switch.

2.1.3.4 Alarm Annunciator

The unit shall be capable of detecting the following abnormal conditions, sounding an audible alarm and illuminating individual indicator lamp/LEDs that are clearly identified:

- a. Input overvoltage.
- b. Input undervoltage.
- c. Output undervoltage.
- d. Output overvoltage.
- e. Output overload.
- f. System alarm.
- g. Control logic failure.
- h. Overtemperature.
- i. Logic power supply failure.

2.1.4 Input/Output Devices

Provide fully-rated, three-pole, UL approved devices for control of 60 Hz input and 400 Hz output from the converter. Devices and cables operating at 400 Hz shall be derated in accordance with IEEE 519.

2.1.4.1 Circuit Breaker

Conform to requirements of UL 489. Units operating at 400 Hz shall be derated for 400 Hz operation.

2.1.4.2 Input Circuit Breaker

Provide converter with a UL listed input circuit breaker as an integral part of the converter. Breaker shall be operable from the front of the converter. Breaker shall have a short-circuit current rating of 22k amperes symmetrical minimum.

2.1.4.3 Output Contactor

Provide converter output with an automatic magnetically-held contactor with interlock circuit. Output contactor shall be of sufficient capacity to handle rated load, overload, and available short circuit current. Contactor shall open when any circuit identified in the paragraph entitled "Protective Control" causes the system to shut down. Output contactor shall be electrically interlocked with ON/OFF circuitry so that when the frequency converter is shut down, the contactor shall open immediately and remain open.

2.1.4.4 Output Circuit Breaker

Provide converter output with a non-automatic manual circuit breaker with appropriate frame size and a shunt trip coil derated for 400 Hz operation. Circuit breaker shall be tripped by the unit's OFF circuit and when any circuit identified in the paragraph entitled "Protective Control" causes the system to shut down. Output breaker shall be operable from the front of the unit.

2.1.4.5 Aircraft Interlock Circuit

Interlock circuit shall determine the presence or absence of the 28 VDC feedback signal from the aircraft. Interlock circuit shall not allow the output disconnect to close if the 28 VDC signal is not present. If the output disconnect is closed when the 28 VDC is lost, the disconnect shall open within 2 seconds. Converter shall contain terminal block points for the connection of two 12 AWG wire from the aircraft cable assembly for the interlock circuit. Interlock circuit shall not draw more than 20 milliamperes from the aircraft's 28 VDC circuit. For testing purposes, provide a switch inside the converter with two positions:

- a. Normal - For aircraft loads.
- b. Bypass - For testing with dummy load or no load, or for use with aircraft with no 28 VDC.

2.1.5 Protective Controls

Provide circuitry for the following protective controls.

- a. Input undervoltage.
- b. Input overvoltage.
- c. Loss of phase.

- d. Loss of input power.
- e. Door interlock - When any access door is opened, the interlock circuitry shall open the 60 Hz input device and 400 Hz output device and not allow the input or output device to close. For maintenance purposes, provide a bypass switch to defeat the interlock circuitry.
- f. Output overvoltage - Protect by tripping output devices for instantaneous overvoltage of 30 percent or more and for 10 to 30 percent overvoltage lasting more than 0.25 second.
- g. Output undervoltage - Protect by preventing the closing of the output disconnect until the output voltage is 95 percent of the rated output. If, after closing, the voltage decreases to below 90 percent for longer than 5 seconds, provide relaying to trip output devices utilizing a field-adjustable time-delayed circuit with a range of 4 to 10 seconds.
- h. Output frequency - Protect by tripping output devices for frequency change in excess of plus or minus 5 percent of the rated output frequency (400 HZ).
- i. Output overload.
- j. Converter overtemperature protection.

2.1.6 Electromagnetic Interference Limits

Comply with MIL-STD-461 for Class C2 equipment.

2.1.7 Automatic Line Drop Compensation

Provide automatic line drop compensation - 0 to 7 percent adjustable internally.

2.1.8 Built-In Test Equipment

Frequency converter shall include built-in test equipment which monitors both primary circuits and protection circuits of the unit. Provide visual indication to assist diagnosis of unit failures to a modular level. Provide visual indication of converter status using cabinet mounted light emitting diodes.

2.1.9 Magnetic Devices

Provide Class 180 power magnetic transformer and inductors in accordance with NEMA ST 20 and UL 506. The limits of Class 180 shall not be exceeded at the maximum specified ambient temperature and at 100 percent load.

2.1.10 Acoustical Noise

Maximum continuous acoustical noise level shall be 72 dBa (A weighted scale).

2.1.11 Assembly Construction

Provide enclosures suitable for outdoor environments in accordance with NEMA 250, Type 4X. Arrange to provide required cooling air, entry and exit provisions for equipment within enclosures. Construct unit(s) so that components, with the exception of control and monitoring components, are

totally enclosed within the enclosure. Electronic circuits including power circuits shall be modular construction readily accessible for maintenance, repair and module replacement from the exterior of the enclosure. For units installed outdoors or in corrosive environments, electronic circuits shall be enclosed in a sealed electronics compartment that is not provided with direct cooling ventilation or forced air cooling. Provide permanent identification tags for wiring. Uniquely identify each wire. Use the same identification system in the wiring diagrams in the Operation and Maintenance Manual. Provide each enclosure with a finish coat over a substrate which has been provided with a rust inhibiting treatment. Provide two finish coats for outdoor enclosures. Color shall be the manufacturer's standard color.

2.1.12 Nameplates

As specified in Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS.

2.2 AIRCRAFT POWER CABLE ASSEMBLY

For 400 Hz wiring at 200Y/115 volts, provide 7-conductor type cable configured as 6 phase conductors (2xA, 2xB, 2xC) tightly wound around the center located neutral, twisted and jacketed in accordance with SAE AS5756/6. Provide control cabling included within the jacket for interlock circuit and automatic line drop compensation. Terminate control wiring on accessible terminal blocks in unit. Provide cable assembly with integrally molded 400 Hertz male connector aircraft plug in accordance with MS 25486-17. Cable/connector assembly shall be suitable for severe duty. Contact terminations shall be crimped.

2.3 SOURCE QUALITY CONTROL

2.3.1 Converter Test Schedule

The Government reserves the right to witness tests. Provide frequency converter test schedule for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

Test Instrument Calibration.

- a. The manufacturer shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.
- b. The accuracy shall be directly traceable to the National Institute of Standards and Technology.
- c. Instrument calibration frequency schedule shall not exceed 12 months for both test floor instruments and leased specialty equipment.
- d. Dated calibration labels shall be visible on all test equipment.
- e. Calibrating standard shall be of higher accuracy than that of the instrument tested.
- f. Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the

manufacturer on a routine basis, in lieu of third party calibration, include the following:

- (1) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.
- (2) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.3.2 Routine Factory Tests

Routine tests shall be performed by the manufacturer on each of the actual frequency converter(s) prepared for this project to ensure that the design performance is maintained in production. As an exception, automatic line drop compensation shall be tested on only one unit on multiple unit orders.

Submit test reports, by serial number and receive approval before delivery of equipment to the project site.

For tests which require full load, use 1.0 power factor unless otherwise noted. All measurements shall be true RMS measurements. Measurements shall be obtained in accordance with [IEEE 1159](#). Tests shall include the following:

- a. Input current and power factor: Operate converter at low, nominal and high input voltage at full load. Measure and record input voltage, input power factor and input current in each phase and neutral if the neutral conductor is connected to the converter input.
- b. Output voltage, output voltage THD, output current, output power factor, and voltage regulation: Operate converter at nominal input voltage for:
 - (1) 50 percent of rated capacity with 0.8 lagging power factor linear load.
 - (2) 100 percent of rated capacity with 0.5 lagging power factor, 0.8 lagging power factor, 1.0 power factor, and 0.8 leading power factor linear loads.
 - (3) 50 percent of rated capacity with the non-linear load as specified in the paragraph entitled "Load Range".
 - (4) 100 percent of rated capacity at low and high input voltage.
 - (5) 100 percent of rated capacity with the non-linear load as specified in the paragraph entitled "Load Range".

Operate for not less than 10 minutes at each test condition in (1), (2), (3) and (4) above and not less than 30 minutes at test condition in (5) above. Monitor and record output voltage, output voltage THD, output current, output current waveform, output power factor and frequency at the beginning and end of each test condition. Monitor and record output voltage single harmonic distortion for each test condition in (2) and (5) above at the beginning and end of each test condition. Verify output remains within specified regulation limits.

- c. Efficiency: Operate at nominal input voltage at half load and full load at 1.0 power factor. Measure and record input voltage, input

current, input power factor, output voltage, output current, and output power factor. Calculate the unit efficiency.

- d. No load losses: Operate at no load and nominal input voltage. Measure and record input voltage, input current, input power, input power factor, and output voltage.
- e. Burn-in Test: Before delivery, burn-in all units under full load conditions for at least 24 hours by cycling units 6 hours "ON" under full load conditions and 3 hours "OFF" at no load conditions for at least 4 complete "ON" cycles. Burn-in test shall be performed with the converter enclosure doors closed and all ventilation in the final operating condition.
- f. Include harmonic frequency spectrum analysis depicting Harmonic Order and Harmonic Magnitude at the unit's input and output terminals during full load THD test in test reports.
- g. Automatic line drop compensation: Operate converter at nominal voltage at:
 - (1) No-load.
 - (2) 50 percent of rated capacity with a 0.8 lagging power factor linear load.
 - (3) 50 percent of rated capacity with the specified non-linear load.
 - (4) 100 percent of rated capacity with a 0.8 lagging power factor linear load.
 - (5) 100 percent of rated capacity with the specified non-linear load.

Loads shall be connected to the converter with the specified aircraft power cable assembly. No adjustments to the frequency converter shall be allowed between load tests. Monitor and record output voltage at the load end of the cable. Verify specified performance of the line drop compensation.

2.3.3 [Special Factory Tests](#) (Design Tests)

Submit special factory test (design test) reports (complete with test data, explanations, formulas, and results), in the same submittal package as the catalog data and drawings for each of the specified frequency converter(s). Tests shall be certified and signed by a registered professional engineer. Tests shall be on file based on a production model of converters of the same design, construction and kVA rating provided.

As an option, the manufacturer shall test one unit at the same time scheduled for routine tests, of each rating and size converter to assure compliance with the specification. For all tests which require full load, use 1.0 power factor unless otherwise noted. The tests shall include the following:

- a. Surge protection: Apply input surges in accordance with IEEE C62.41.1 and C62.41.2, Location Category C and monitor output. Conduct a minimum of three consecutive successful tests on each unit listed. Confirm there is no interruption to 400 Hz output power and voltage stays within specified regulation tolerances. Surge protection tests

shall be applicable on all frequency converter units utilizing same surge protection device by manufacturer and part number regardless of frequency converter kVA size.

- b. Inrush current: After applying power to the converter, conduct a minimum of three inrush current tests at full load. Provide copies of waveform and THD analysis in test report.
- c. Input current distortion: Operate at nominal input voltage at full load. Measure and record the input current THD for the current in each phase.
- d. Overload/overcurrent: Operate at nominal input voltage with loads listed below:

Percent of Full Load	Minimum Operating Time
110 percent	60 min
125 percent	10 min
150 percent	2 min
200 percent	20 sec
300 percent	6 sec

Monitor output to confirm there is no 400 Hz power interruption. After minimum operating time is achieved, unit shall interrupt output power.

- e. Short-circuit: Apply a bolted line-to-ground, bolted line-to-line, and bolted three phase fault directly to the output terminals of the unit. Conduct a minimum of three consecutive successful tests on each unit. Provide unit capable of carrying the fault current until the integral system protective devices interrupts the fault with no damage to the unit. Provide waveforms of short circuit current during short circuit tests.
- f. Output voltage THD: Operate at nominal input voltage at full load with balanced and 15 percent unbalanced load. A 15 percent unbalanced load is defined as follows:
 - (1) Phase A at full rated single phase load.
 - (2) Phase B at 85 percent of Phase A
 - (3) Phase C at 85 percent of Phase A

Measure and record the output voltage THD for the line-to-neutral voltage of each phase.

- g. Phase angle regulation: Operate at full load with balanced and 15 percent unbalanced loads. Measure and record displacement angle between adjacent output voltage phases. A 15 percent unbalanced load is defined as follows:
 - (1) Phase A at full rated single phase load.
 - (2) Phase B at 85 percent of Phase A.
 - (3) Phase C at 85 percent of Phase A.

- h. Transient recovery: Operate at the following load steps: 0 to 100 percent, 0 to 50 percent, 100 to 0 percent and 50 to 0 percent. Measure and record recovery time and output voltage deviation limits. Provide recordings or display of output voltage during transient recovery test.
- j. Electromagnetic interference (EMI) test: EMI test shall meet the requirements of MIL-STD-461, Part 9, for Class C2 equipment. Certified test results on units of the same design shall be acceptable.

PART 3 EXECUTION

3.1 INSTALLATION

Install products to operate at 400 Hz in the same manner as specified in other sections of this specification for products operating at 60 Hz, unless indicated or specified otherwise. Conform to the requirements of NFPA 70 and IEEE C2 and to manufacturer's instructions and recommendations.

3.1.1 Equipment

3.1.1.1 Floor Mounted

Provide proper floor mounting channels and install in accordance with the manufacturer's drawings and instructions and as indicated. Align, level, and bolt or weld units to channels to allow easy withdrawal or insertion of removable components and to permit proper operation and maintenance of equipment.

3.1.2 Grounding

In accordance with NFPA 70 and as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.1.3 Wiring and Conduit

3.1.3.1 Building Wiring

Provide Type XHHW or THHN with stranded copper conductors wiring for 400 Hz circuits. Provide wiring for 400 Hz circuits in non-magnetic conduit, aluminum or PVC. Provide wiring and conduit for 60 Hz circuits as specified in Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM.

3.1.3.2 Conduit

Use aluminum conduit for exposed feeders. Do not install aluminum conduit underground or encased in concrete. Use aluminum fittings and boxes with aluminum conduit. For underground or concrete encasement use PVC.

3.1.4 Manufacturer's Representative

The manufacturer's representative shall place the system in operation and make necessary adjustments to ensure optimum operation of the equipment. The manufacturer's representative shall have at least 2 years of practical experience in the installation and testing of 400 Hz solid state frequency converters.

3.2 FIELD QUALITY CONTROL

3.2.1 Instruments

Provide test instruments capable of measuring and recording or displaying test data at a higher resolution and greater accuracy than specified for the converter's performance. The test instruments used in the field tests shall have current valid calibration stickers issued by an approved calibration laboratory. Verify calibration and adjustments of converter instruments provided prior to field tests. Instruments shall be calibrated for 400 Hz operation when measuring 400 Hz signals.

3.2.2 Performance of Acceptance Checks and Tests

Perform field tests and conduct inspections. Provide labor, equipment tests instruments, and incidentals required for the tests including load banks, except the Government will furnish electricity. For all electrical load tests, use 1.0 power factor.

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests.

3.2.3 Initial Inspection and Tests

- a. Compare equipment nameplate information with specifications and approved shop drawings.
- b. Inspect physical and mechanical condition.
- c. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.
- d. Perform specific inspections and mechanical tests as recommended by manufacturer.
- e. Verify correct equipment grounding.
- f. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

3.2.4 Performance Tests

Conduct converter performance tests under the supervision of the manufacturer's representative. Successfully complete the preliminary operation, control and protective devices check prior to performing load and transient tests. If the converter fails to operate within the specified limits during any of the performance tests the Contractor shall discontinue the test and shall make necessary repairs to correct the failure and restart testing of the converter.

3.2.4.1 Preliminary Operation

Inspect the converter and make adjustments necessary to assure proper operation in accordance with the manufacturer's instructions. Operate frequency converter at 0, 25, 50, 75, and 100 percent of rated full load. Measure and record the output voltage, current, frequency, and THD at each load. Calculate output voltage regulation. Verify converter is operating

within specified limits at each load level.

3.2.4.2 Control and Protective Device Checks

Operate each control, switch, input/output device that is capable of being operated manually a minimum of three times, demonstrating satisfactory operation each time. Perform operation test on each protective device to ensure that devices function properly. After each operation measure and record the converter output frequency, voltage and current. Verify converter is operating within specified limits.

3.2.4.3 Load Test

Operate each unit continuously a minimum of 2 hours at 100 percent rated load. Measure and record the converter output frequency, voltage and current. Verify converter is operating within specified limits. Load test shall be performed with the converter doors closed and the load connected to the converter with specified aircraft cable assembly.

3.2.4.4 Transient Tests

Transient recovery: Operate at the following load steps: 0 to 100 percent, 0 to 50 percent, 100 to 0 percent, and 50 to 0 percent. Provide recordings or displays of voltage and frequency during each transient test, and indicate on the recordings and displays the time intervals and acceptable limits for voltage and frequency. Repeat each transient test three times, record the results of each test. Verify converter is operating within specified limits.

3.2.4.5 Harmonic Distortion Tests

Perform output voltage harmonic distortion tests at the output of the converter terminals at 0 percent load and 100 percent load at unity power factor. The Contractor shall provide test equipment and instrumentation required for the tests. Tests shall be conducted with a distortion analyzer with test leads within 3 feet of the frequency converter's output terminals. Test data shall include total harmonic distortion amplitudes of all individual harmonics presented in a spectrum analysis format up to the 37th order.

3.2.4.6 Automatic Line Drop Compensation

Conduct automatic line drop compensation tests on each converter with the load connected to the converter with the specified aircraft power cable assembly. Operate each converter at no load, 50 percent and 100 percent of the rated capacity. No adjustments to the frequency converter shall be allowed between load tests. Monitor and record output voltage at the load end of the cable. Verify specified performance of the line drop compensation.

3.2.5 Grounding System

Inspect ground system for compliance with contract plans and specifications.

3.2.6 Follow-up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception

to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.

3.3 DEMONSTRATION

3.3.1 Instructing Government Personnel

Provide field training to Government personnel on the operation and maintenance of the converter provided. Provide field training 2 weeks prior to the scheduled date for field acceptance tests. As a minimum the training shall include 2 hours of instruction on the theory of operation and 4 hours on the repair and maintenance of the converters. The instructor shall be approved by the manufacturer of the unit provided. Submit [training syllabus](#) including each topic of training and a brief outline of each topic to the Contracting Officer at least 4 weeks prior to training for approval. Training shall be approved by the Contracting Officer at least 2 weeks in advance. The Government may record, video and audio, the training sessions and use these recordings to train personnel on the operation and maintenance of the converter system. Provide two copies of video or audio tapes, if used in the training sessions, to the Contracting Officer.

-- End of Section --

SECTION 26 56 00

EXTERIOR LIGHTING

07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)

ATIS ANSI O5.1 (2008) Wood Poles -- Specifications & Dimensions

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO LTS-5 (2009; Errata 2009; Amendment 2010)
Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C1 (2003) All Timber Products - Preservative Treatment by Pressure Processes

AWPA C4 (2003) Poles - Preservative Treatment by Pressure Processes

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M (2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 153/A 153M (2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM B 108/B 108M (2008) Standard Specification for Aluminum-Alloy Permanent Mold Castings

ASTM C 1089 (2006) Standard Specification for Spun Cast Prestressed Concrete Poles

ASTM E 2129 (2005) Standard Practice for Data Collection for Sustainability Assessment of Building Products

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IESNA HB-9 (2000; Errata 2004; Errata 2005; Errata 2006) IES Lighting Handbook

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- IEEE 100 (2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
- IEEE C2 (2007; TIA 2007-1; TIA 2007-2; TIA 2007-3; TIA 2007-4; TIA 2007-5; Errata 2006-1; Errata 2007-2; Errata 2009-3) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- ANSI ANSLG C78.42 (2009) For Electric Lamps: High-Pressure Sodium Lamps
- ANSI C136.13 (2004; R 2009) American National Standard for Roadway Lighting Equipment, Metal Brackets for Wood Poles
- ANSI C136.21 (2004; R 2009) American National Standard for Roadway and Area Lighting Equipment - Vertical Tenons Used with Post-Top-Mounted Luminaires
- ANSI C136.3 (2005; R 2009) American National Standard for Roadway and Area Lighting Equipment Luminaire Attachments
- ANSI C78.1381 (1998) American National Standard for Electric Lamps - 250-Watt, 70 Watt, M85 Metal-Halide Lamps
- ANSI C82.4 (2002) American National Standard for Ballasts for High-Intensity-Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type)
- ANSI/ANSLG C78.43 (2007) American National Standard for Electric Lamps - Single-Ended Metal-Halide Lamps
- NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
- NEMA C136.20 (2008) American National Standard for Roadway and Area Lighting Equipment - Fiber Reinforced Composite (FRC) Lighting Poles
- NEMA ICS 2 (2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V
- NEMA ICS 6 (1993; R 2006) Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 70 (2011) National Electrical Code

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS Bull 345-67 (1998) REA Specification for Filled Telephone Cables, PE-39

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star (1992; R 2006) Energy Star Energy Efficiency Labeling System

UNDERWRITERS LABORATORIES (UL)

UL 1029 (1994; Reprint Jun 2010) High-Intensity-Discharge Lamp Ballasts

UL 1598 (2008; Reprint Jan 2010) Luminaires

UL 773 (1995; Reprint Mar 2002) Standard for Plug-In, Locking Type Photocontrols for Use with Area Lighting

UL 773A (2006; Reprint Jun 2010) Standard for Nonindustrial Photoelectric Switches for Lighting Control

1.2 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.
- b. Average life is the time after which 50 percent will have failed and 50 percent will have survived under normal conditions.
- c. Groundline section is that portion between one foot above and 2 feet below the groundline.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Luminaire drawings; G,

Poles; G,

SD-03 Product Data

Local/Regional Materials

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material

origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Environmental Data

Energy Efficiency

Luminaires; G,

Lamps; G,

Ballasts; G,

Lighting contactor; G,

Time switch; G,

Photocell switch; G,

Concrete poles; G,

Aluminum poles; G,

Steel poles; G,

Fiberglass poles; G,

Brackets

Auxiliary instant-on quartz system; G,

SD-04 Samples

Luminaires; G, [_____]

Submit one sample of each luminaire type[, complete with lamp and ballast]. [Submit one sample for each item other than luminaires.] Sample will be returned to the Contractor for installation in the project work.

SD-05 Design Data

Design Data for luminaires; G,

SD-06 Test Reports

Pressure treated wood pole quality

[Tests for fiberglass poles; G, [_____]]

Operating test

Submit operating test results as stated in paragraph entitled "Field Quality Control."

SD-08 Manufacturer's Instructions

Concrete poles

Submit instructions prior to installation.

Fiberglass poles

Submit instructions prior to installation.

SD-10 Operation and Maintenance Data

Operational Service

Submit documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

1.4 QUALITY ASSURANCE

1.4.1 Drawing Requirements

1.4.1.1 Luminaire Drawings

Include dimensions, effective projected area (EPA), accessories, and installation and construction details. Photometric data, including zonal lumen data, average and minimum ratio, aiming diagram, and computerized candlepower distribution data shall accompany shop drawings.

1.4.1.2 Poles

Include dimensions, wind load determined in accordance with [AASHTO LTS-5](#), pole deflection, pole class, and other applicable information.

1.4.2 Design Data for Luminaires

- a. Distribution data according to IESNA classification type as defined in [IESNA HB-9](#).
- b. Computerized horizontal illumination levels in [footcandles](#) at ground level, taken every 10 feet. Include average maintained [footcandle](#) level and maximum and minimum ratio.

1.4.3 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of [NFPA 70](#) unless more stringent requirements are specified or indicated.

1.4.4 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory

commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.4.4.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.4.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Concrete Poles

Do not store poles on ground. Support poles so they are at least **one foot** above ground level and growing vegetation.

1.5.2 Aluminum Poles

Do not store poles on ground. Support poles so they are at least **one foot** above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

1.6 SUSTAINABLE DESIGN REQUIREMENTS

1.6.1 **Local/Regional Materials**

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a **500 mile** radius from the project site, if available from a minimum of three sources.

1.6.2 **Environmental Data**

[Submit Table 1 of **ASTM E 2129** for the following products: [____].]

1.6.3 **Energy Efficiency**

Comply with National Energy Policy Act and **Energy Star** requirements for lighting products. Submit documentation for **Energy Star** qualifications for equipment provided under this section. Submit data indicating lumens per watt efficiency and color rendition index of light source.

1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.8 POWER SOURCE

Power for parking lot lighting shall be obtained from the Hangar that the parking lot is to serve.

1.9 OPERATIONAL SERVICE

Coordinate with manufacturer for maintenance agreement. Collect information from the manufacturer about maintenance agreement options, and submit to Contracting Officer. Services shall reclaim materials for recycling and/or reuse. Services shall not landfill or burn reclaimed materials. Indicate procedures for compliance with regulations governing disposal of mercury. When such a service is not available, local recyclers shall be sought after to reclaim the materials.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION, Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND, and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.2 LUMINAIRES

UL 1598. Provide luminaires as indicated. Provide luminaires complete with lamps of number, type, and wattage indicated. Details, shapes, and dimensions are indicative of the general type desired, but are not intended to restrict selection to luminaires of a particular manufacturer. Luminaires of similar designs, light distribution and brightness characteristics, and of equal finish and quality will be acceptable as approved.

2.2.1 Lamps

2.2.1.1 High-Pressure Sodium (HPS) Lamps

ANSI ANSLG C78.42. Wattage as indicated. HPS lamps shall have average rated life of 16,000 hours (minimum) for 35 watt lamps and 24,000 hours (minimum) for all higher wattage lamps. 150 watt lamps, if required, shall be 55 volt lamps. Lamps shall have Luminaire Efficiency Ratings (LER) as follows:

a. Upward efficiency of 0%

1. 150-399 watts: minimum 58 LER for closed fixture; minimum 68 for open fixture
2. 400-999 watts: minimum 63 LER for closed fixture; minimum 84 for open fixture

b. Upward efficiency of 1%-10%

1. 150-399 watts: minimum 64 LER for closed fixture; minimum 63 for open fixture
2. 400-999 watts: minimum 82 LER for closed fixture; minimum 89 for

open fixture

3. 1000+ watts: minimum 109 LER for open fixture

c. Upward efficiency of 11% to 20%

1. 150-399 watts: minimum 78 LER for open fixture

2. 400-999 watts: minimum 94 for open fixture

d. Upward efficiency greater than 20%

1. 150-399 watts: minimum 75 LER for closed fixture; minimum 77 for open fixture

2.2.1.2 Metal-Halide Lamps

Provide luminaires with tempered glass lens.

a. Double-ended, 70 watt, conforming to ANSI C78.1381

b. Single-ended, wattage as indicated, conforming to ANSI/ANSI C78.43

Lamps shall have Luminaire Efficiency Ratings (LER) as follows:

a. Upward efficiency of 0%

1. 150-399 watts: minimum 41 LER for closed fixture

2. 400-999 watts: minimum 53 LER for closed fixture; minimum 59 for open fixture

3. 1000+ watts: minimum 77 LER for closed fixture

b. Upward efficiency of 1%-10%

1. 150-399 watts: minimum 56 LER for closed fixture

2. 400-999 watts: minimum 62 LER for closed fixture; minimum 64 for open fixture

3. 1000+ watts: minimum 88 LER for open fixture

c. Upward efficiency greater than 20%

1. 150-399 watts: minimum 62 LER for closed fixture; minimum 77 for open fixture

2. 400-999 watts: minimum 65 LER for closed fixture

2.2.1.3 LED Lamps

2.2.2 Ballasts for High-Intensity-Discharge (HID) Luminaires

UL 1029 and ANSI C82.4, and shall be constant wattage autotransformer (CWA) or regulator, high power-factor type (minimum 90%). Provide single-lamp ballasts which shall have a minimum starting temperature of minus 30

degrees C. Ballasts shall be:

- a. Designed to operate on voltage system to which they are connected.
- b. Constructed so that open circuit operation will not reduce the average life.

HID ballasts shall have a solid-state igniter/starter with an average life in the pulsing mode of 10,000 hours at the intended ambient temperature. Igniter case temperature shall not exceed 90 degrees C.

2.3 LIGHTING CONTACTOR

NEMA ICS 2, mechanically held contactor. Contacts shall be rated 600 volts, 30 amperes, and 1 poles. Coils shall be rated 120 volts. Provide in NEMA 1 enclosure conforming to NEMA ICS 6. Contactor shall have silver alloy double-break contacts and coil clearing contacts for mechanically held contactor and shall require no arcing contacts. Provide contactor with hand-off-automatic selector switch.

2.4 TIME SWITCH

Astronomic dial type or electronic type, arranged to turn "ON" at sunset, and turn "OFF" at predetermined time between 8:30 p.m. and 2:30 a.m. or sunrise, automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Provide switch rated 120 volts, having automatically wound spring mechanism or capacitor, to maintain accurate time for a minimum of 7 hours following power failure. Provide time switch with a manual on-off bypass switch. Housing for the time switch shall be surface mounted, NEMA 1 enclosure conforming to NEMA ICS 6.

2.5 PHOTOCCELL SWITCH

UL 773 or UL 773A, hermetically sealed cadmium-sulfide or silicon diode type cell rated 120 volts ac, 60 Hz with single-throw contacts designed to fail to the ON position. Switch shall turn on at or below 3 footcandles and off at 4 to 10 footcandles. A time delay shall prevent accidental switching from transient light sources. Provide switch:

- a. In a cast weatherproof aluminum housing with adjustable window slide, rated 1800 VA, minimum.

2.6 POLES

Provide poles designed for wind loading of 100 miles per hour determined in accordance with AASHTO LTS-5 while supporting luminaires and all other appurtenances indicated. The effective projected areas of luminaires and appurtenances used in calculations shall be specific for the actual products provided on each pole. Poles shall be anchor-base type designed for use with underground supply conductors. Poles shall have oval-shaped handhole having a minimum clear opening of 2.5 by 5 inches. Handhole cover shall be secured by stainless steel captive screws. Metal poles shall have an internal grounding connection accessible from the handhole near the bottom of each pole. Scratched, stained, chipped, or dented poles shall not be installed.

2.6.1 Concrete Poles

Provide concrete poles conforming to ASTM C 1089. Cross-sectional shape

shall be round.

2.6.1.1 Steel Reinforcing

Prestressed concrete pole shafts shall be reinforced with steel prestressing members. Design shall provide internal longitudinal loading by either pretensioning or post tensioning of longitudinal reinforcing members.

2.6.1.2 Tensioned Reinforcing

Primary reinforcement steel used for a prestressed concrete pole shaft shall be tensioned between 60 to 70 percent of its ultimate strength. The amount of reinforcement shall be such that when reinforcement is tensioned to 70 percent of its ultimate strength, the total resultant tensile force does not exceed the minimum section compressive strength of the concrete.

2.6.1.3 Coating and Sleeves for Reinforcing Members

Where minimum internal coverage cannot be maintained next to required core openings, such as handhole and wiring inlet, reinforcing shall be protected with a vaporproof noncorrosive sleeve over the length without the 1/2 inch concrete coverage. Each steel reinforcing member which is to be post-tensioned shall have a nonmigrating slipper coating applied prior to the addition of concrete to ensure uniformity of stress throughout the length of such member.

2.6.1.4 Strength Requirement

As an exception to the requirements of [ASTM C 1089](#), poles shall be naturally cured to achieve a 28-day compressive strength of [7000 psi](#). Poles shall not be subjected to severe temperature changes during the curing period.

2.6.1.5 Shaft Preparation

Completed prestressed concrete pole shaft shall have a hard, smooth, nonporous surface that is resistant to soil acids, road salts, and attacks of water and frost, and shall be clean, smooth, and free of surface voids and internal honeycombing. Poles shall not be installed for at least 15 days after manufacture.

2.6.2 Aluminum Poles

Provide aluminum poles manufactured of corrosion resistant aluminum alloys conforming to [AASHTO LTS-5](#) for Alloy 6063-T6 or Alloy 6005-T5 for wrought alloys and Alloy 356-T4 (3,5) for cast alloys. Poles shall be seamless extruded or spun seamless type with minimum [0.188 inch](#) wall thickness. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire. Tops of shafts shall be fitted with a round or tapered cover. Base shall be anchor bolt mounted, made of cast 356-T6 aluminum alloy in accordance with [ASTM B 108/B 108M](#) and shall be machined to receive the lower end of shaft. Joint between shaft and base shall be welded. Base cover shall be cast 356-T6 aluminum alloy in accordance with [ASTM B 108/B 108M](#). Hardware, except anchor bolts, shall be either 2024-T4 anodized aluminum alloy or stainless steel. Aluminum poles and brackets for lighting shall have a dark anodic bronze finish to match fixtures and shall not be painted. Manufacturer's standard provision shall be made for protecting the finish during shipment and installation. Minimum protection

shall consist of spirally wrapping each pole shaft with protective paper secured with tape, and shipping small parts in boxes.

2.6.3 Steel Poles

AASHTO LTS-5. Provide steel poles having minimum 11-gage steel with minimum yield/strength of **48,000 psi** and hot-dipped galvanized in accordance with **ASTM A 123/A 123M** factory finish. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire. Pole shall be anchor bolt mounted type. Poles shall have tapered tubular members, either round in cross section or polygonal. Pole shafts shall be one piece. Poles shall be welded construction with no bolts, rivets, or other means of fastening except as specifically approved. Pole markings shall be approximately **3 to 4 feet** above grade and shall include manufacturer, year of manufacture, top and bottom diameters, and length. Base covers for steel poles shall be structural quality hot-rolled carbon steel plate having a minimum yield of **36,000 psi**.

2.6.4 Wood Poles

ATIS ANSI O5.1 and **RUS Bull 345-67** of [Southern Yellow Pine][Douglas Fir][_____]. Poles shall be gained, bored, and roofed before treatment. Poles shall be treated full length with chromated copper arsenate (CCA) or ammoniacal copper arsenate (ACA) according to **AWPA C1** and **AWPA C4** as referenced in **RUS Bull 345-67**. Poles shall be branded by manufacturer with manufacturer's mark and date of treatment, height and class of pole, wood species, preservation code, and retention. Place the brand so that the bottom of the brand or disc is **10 feet** from the pole butt for poles up to **50 feet** long[and **14 feet** from the butt for poles over **50 feet** long].

2.6.5 Fiberglass Poles

NEMA C136.20. Designed specifically for supporting luminaires and having factory-formed cable entrance and handhole. Resin color shall be dark bronze, and pigment shall provide uniform coloration throughout entire wall thickness. Finish surface shall be pigmented polyurethane having a minimum dry film thickness of **1.5 mils**. Polyurethane may be omitted if the surface layer of the pole is inherently ultraviolet inhibited. Minimum fiberglass content shall be 65 percent with resin and pigment comprising the other 35 percent material content.

2.7 BRACKETS AND SUPPORTS

ANSI C136.3, **ANSI C136.13**, and **ANSI C136.21**, as applicable. Pole brackets shall be not less than **1 1/4 inch** galvanized steel pipe secured to pole. Slip-fitter or pipe-threaded brackets may be used, but brackets shall be coordinated to luminaires provided, and brackets for use with one type of luminaire shall be identical. Brackets for pole-mounted street lights shall correctly position luminaire no lower than mounting height indicated. Mount brackets not less than **24 feet** above street. Special mountings or brackets shall be as indicated and shall be of metal which will not promote galvanic reaction with luminaire head.

2.8 POLE FOUNDATIONS

Anchor bolts shall be steel rod having a minimum yield strength of **50,000 psi**; the top **12 inches** of the rod shall be galvanized in accordance with **ASTM A 153/A 153M**. Concrete shall be as specified in Section **03 30 00.00 10** CAST-IN-PLACE CONCRETE.

2.9 EQUIPMENT IDENTIFICATION

2.9.1 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.9.2 Labels

Provide labeled luminaires in accordance with [UL 1598](#) requirements. Luminaires shall be clearly marked for operation of specific lamps and ballasts according to proper lamp type. The following lamp characteristics shall be noted in the format "Use Only _____":

- a. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
- b. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
- c. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.
- d. ANSI ballast type (M98, M57, etc.) for HID luminaires.
- e. Correlated color temperature (CCT) and color rendering index (CRI) for all luminaires.

Markings related to lamp type shall be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place. Ballasts shall have clear markings indicating multi-level outputs and indicate proper terminals for the various outputs.

2.10 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of [NEMA 250](#) corrosion-resistance test.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to [IEEE C2](#), [NFPA 70](#), and to the requirements specified herein.

[3.1.1 Concrete Poles

Install according to pole manufacturer's instructions.

]3.1.2 Fiberglass Poles

Install according to pole manufacturer's instructions.

]3.1.3 Aluminum Poles

Provide pole foundations with galvanized steel anchor bolts, threaded at the top end and bent 90 degrees at the bottom end. Provide ornamental covers to match pole and galvanized nuts and washers for anchor bolts. Concrete for anchor bases, polyvinyl chloride (PVC) conduit ells, and ground rods shall be as specified in Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath and the end of conduit ell. Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location.

3.1.4 Pole Setting

Poles in straight runs shall be in a straight line. Dig holes large enough to permit the proper use of tampers to the full depth of the hole. Place backfill in the hole in 6 inch maximum layers and thoroughly tamp. Place surplus earth around the pole in a conical shape and pack tightly to drain water away.

3.1.5 Photocell Switch Aiming

Aim switch according to manufacturer's recommendations.

3.1.6 GROUNDING

Ground noncurrent-carrying parts of equipment including metal poles, luminaires, mounting arms, brackets, and metallic enclosures as specified in Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.1.7 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.2 FIELD QUALITY CONTROL

Upon completion of installation, verify that equipment is properly installed, connected, and adjusted. Conduct an [operating test](#) to show that the equipment operates in accordance with the requirements of this section.

-- End of Section --

SECTION 26 56 20.00 10

AIRFIELD AND HELIPORT LIGHTING AND VISUAL NAVIGATION AIDS

10/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 780/A 780M	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM B 117	(2009) Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM D 1248	(2005) Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
ASTM D 1654	(2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 709	(2001; R 2007) Laminated Thermosetting Materials

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/CC_host/pages/public/custom
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INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 48	(2009) Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV
IEEE C2	(2007; TIA 2007-1; TIA 2007-2; TIA 2007-3; TIA 2007-4; TIA 2007-5; Errata 2006-1; Errata 2007-2; Errata 2009-3) National

Electrical Safety Code

IEEE C57.12.50 (1981; R 1998) Ventilated Dry-Type Distribution Transformers, 1 to 500 kVA, Single-Phase, and 15 to 500 kVA, Three-Phase, with High-Volt 601 to 34,500 Volts

IEEE C62.11 (2005; Amd 1 2008) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)

IEEE C62.41.1 (2002; R 2008) Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits

IEEE C62.41.2 (2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C119.1 (2006) Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts

NEMA LA 1 (2009) Standard for Surge Arresters

NEMA RN 1 (2005) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

NEMA TC 2 (2003) Standard for Electrical Polyvinyl Chloride (PVC) Conduit

NEMA TC 3 (2004) Standard for Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing

NEMA TC 6 & 8 (2003) Standard for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011) National Electrical Code

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 20 (2002; E 2004) Zinc-Rich Primers (Type I, Inorganic, and Type II, Organic)

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS Bull 345-67 (1998) REA Specification for Filled Telephone Cables, PE-39

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA 6850.19	(1978) Frangible Coupling
FAA AC 150/5345-10	(2005; Rev F) Specification for Constant Current Regulators Regulator Monitors
FAA AC 150/5345-26	(2008; Rev D) FAA Specification for L-823 Plug and Receptacle, Cable Connectors
FAA AC 150/5345-42	(2006; Rev F) Specification for Airport Light Bases, Transformer Housings, Junction Boxes and Accessories
FAA AC 150/5345-45	(2007; Rev C) Low-Impact Resistant (LIR) Structures
FAA AC 150/5345-46	(2009; Rev D) Specification for Runway and Taxiway Light Fixtures
FAA AC 150/5345-47	(2005; Rev B) Specification for Series to Series Isolation Transformers for Airport Lighting Systems
FAA AC 150/5345-7	(2001; Rev E) Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
FAA AC 150/5370-10	(2009; Rev E) Standards for Specifying Construction of Airports
FAA E-2519	(1972; Rev A) Types I and II
FAA E-2702	(2007; Rev A) Low Impact Resistant (LIR) Structures

UNDERWRITERS LABORATORIES (UL)

UL 1	(2005; Reprint Jul 2007) Standard for Flexible Metal Conduit
UL 1242	(2006; Reprint Jul 2007) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 360	(2009; Reprint Jun 2009) Liquid-Tight Flexible Steel Conduit
UL 44	(2010) Thermoset-Insulated Wires and Cables
UL 486A-486B	(2003; Reprint Feb 2010) Wire Connectors
UL 510	(2005; Reprint Apr 2008) Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 514A	(2004; Reprint Apr 2010) Metallic Outlet Boxes

UL 6	(2007) Electrical Rigid Metal Conduit-Steel
UL 797	(2007) Electrical Metallic Tubing -- Steel
UL 854	(2004; Reprint Oct 2007) Standard for Service-Entrance Cables
UL Electrical Constructn	(2009) Electrical Construction Equipment Directory

1.2 SYSTEM DESCRIPTION

- a. Provide airfield and heliport lighting and visual navigation aids consisting of runway lights taxiway lights, apron lights and the lighting power supply and control.
- b. Luminaires fabricated from ferrous metals, unless hot-dip galvanized or of porcelain enamel finish, shall be factory finished with a weather-resistant finish in accordance with paragraphs FACTORY COATING and FINISHING, except exposure shall be 200 hours. Finish color shall be the manufacturer's standard, unless otherwise indicated.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Lighting and Visual Navigation Aids

Composite drawings showing coordination of work of one trade with that of other trades and with the structural and architectural elements of the work. Drawings shall be in sufficient detail to show overall dimensions of related items, clearances, and relative locations of work in allotted spaces. Drawings shall indicate where conflicts or clearance problems exist between the various trades.

As-Built Drawings

Drawings, as specified.

SD-03 Product Data

Materials and Equipment

1) A complete itemized listing of equipment and materials proposed for incorporation into the work. Each itemization shall include an item number, the quantity of items proposed, and the name of the manufacturer.

2) Data composed of catalog cuts, brochures, circulars, specifications and product data, and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents shall be included.

Protection Plan

Protection plan as specified.

Training

Requirements of training shall be provided 4 weeks before training is scheduled to begin.

Special Tools

List of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor.

List of Parts

A list of parts and components for the system by manufacturer's name, part number, nomenclature, and stock level required for maintenance and repair necessary to ensure continued operation with minimal delays.

Maintenance and Repair

Instructions necessary to check out, troubleshoot, repair, and replace components of the systems, as specified.

Posted Instructions; G

Proposed diagrams, instructions, and other sheets shall be submitted prior to posting.

SD-06 Test Reports

Field Quality Control

Performance test reports, upon completion and testing of the installed system, in booklet form showing all field tests performed to adjust each component and all field tests performed to provide compliance with the specified performance criteria. Each test shall indicate the final position of controls.

Visual Inspection

Inspection reports prepared and provided as each stage of installation is completed. These reports shall identify the activity by contract number, location, quantity of material placed, and compliance with requirements.

SD-07 Certificates

Qualifications

Certified documentation of qualifications, as specified.

Materials and Equipment

When equipment or materials are specified to conform to the standards or publications and requirements of AASHTO, ANSI, ASTM,

AEIC, FM, IEEE, IES, NEMA, NFPA, or UL, or to an FAA, FS, or MS, proof that the items furnished under this section conform to the specified requirements shall be included. The label or listing in **UL Electrical Constructn** or in **FM APP GUIDE** or the manufacturer's certification or published catalog specification data statement that the items comply with applicable specifications, standards, or publications and with the manufacturer's standards will be acceptable evidence of such compliance. Certificates shall be prepared by the manufacturer when the manufacturer's published data or drawings do not indicate conformance with other requirements of these specifications.

SD-10 Operation and Maintenance Data

Operation and Maintenance Procedures

Six copies of operation and six copies of maintenance manuals for the equipment furnished. One complete set shall be furnished prior to performance testing and the remainder shall be furnished upon acceptance. Operating manuals shall detail the step-by-step procedures required for system startup, operation, and shutdown. Operating manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features. Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include conduit and equipment layout and simplified wiring and control diagrams of the system as installed.

1.4 QUALITY ASSURANCE

1.4.1 Code Compliance

The installation shall comply with the requirements and recommendations of **NFPA 70** and **IEEE C2** and local codes where required.

1.4.2 Qualifications

a. Submit certification containing the names and the qualifications of persons recommended to perform the splicing and termination of medium-voltage cables approved for installation under this contract. The certification shall indicate that any person recommended to perform actual splicing and termination has been adequately trained in the proper techniques and has had at least 3 recent years of experience in splicing and terminating the same or similar types of cables approved for installation. Any person recommended by the Contractor may be required to perform a dummy or practice splice and termination, in the presence of the Contracting Officer, before being approved as a qualified installer of medium-voltage cables. If that additional requirement is imposed, provide short sections of the approved types of cables with the approved type of splice and termination kits, and detailed manufacturer's instruction for the proper splicing and termination of the approved cable types. The certification shall be prepared in conformance with paragraph CERTIFICATES OF COMPLIANCE in the SPECIAL CONTRACT REQUIREMENTS, and shall be accompanied by satisfactory proof of the training and experience of persons recommended by the Contractor as cable installers.

b. The SF sub 6 gas pressurized cable and conduit system installer

must be trained and certified in installation of this type of system and must be approved by the manufacturer of the system.

c. Submit **six** copies of qualified procedures and lists of names and identification symbols of qualified welders and welding operators prior to welding operations.

1.4.3 Protection Plan

Submit detailed procedures to prevent damage to existing facilities or infrastructures. If damage does occur, the procedures shall address repair and replacement of damaged property at the Contractor's expense.

1.4.4 Prevention of Corrosion

1.4.4.1 Metallic Materials

Protect metallic materials against corrosion as specified. Aluminum shall not be used in contact with earth or concrete. Where aluminum conductors are connected to dissimilar metal, use fittings conforming to **UL 486A-486B**.

1.4.4.2 Ferrous Metal Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with **ASTM A 123/A 123M** and **ASTM A 153/A 153M**.

1.4.5 As-Built Drawings

Submit as-built drawings that provide current factual information including deviations from, and amendments to the drawings and changes in the work, concealed and visible, as instructed. The as-built drawings shall show installations with respect to fixed installations not associated with the systems specified herein. Cable and wire shall be accurately identified as to direct-burial or in conduit and shall locate the connection and routing to and away from bases, housings, and boxes.

1.5 PROJECT/SITE CONDITIONS

Items furnished under this section shall be specifically suitable for the following unusual service conditions:

1.5.1 Altitude

Any equipment shall be suitable for operation up to an altitude of **10,000 ft**.

1.5.2 Other

Material or equipment to be installed underground or in light bases, shall be suitable for submerged operation.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Provide materials and equipment which are the standard product of a manufacturer regularly engaged in the manufacture of the product and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be

identical including equipment, assemblies, parts, and components.

2.2 NAMEPLATES

Each major component of equipment shall have as a minimum the manufacturer's name, address, and catalog or style number on a nameplate securely attached to the item of equipment. Laminated plastic nameplates shall be provided for equipment, controls, and devices to identify function, and where applicable, position. Nameplates shall be 1/8 inch thick laminated cellulose paper base phenolic resin plastic conforming to ASTM D 709 sheet type, grade ES-3, white with black center core. Surface shall be a matte finish with square corners. Lettering shall be engraved into the black core. Size of nameplates shall be 1 by 2-1/2 inches minimum with minimum 1/4 inch high normal block lettering. Nameplates provided as indicated. Nameplates shall be fastened to the device with a minimum of two sheet metal screws or two rivets.

2.3 ADDITIONAL REQUIREMENTS

Equipment and materials shall be new unless indicated or specified otherwise. Materials and equipment shall be labeled when approved by Underwriters Laboratories (UL) or Factory Mutual (FM) System. Askarel and insulating liquids containing polychlorinated biphenyls (PCB's) will not be allowed in any equipment. Equipment installed below grade in vaults, manholes, and handholes shall be the submersible type.

2.3.1 Electrical Tape

Electrical tape shall be UL 510 plastic insulating tape.

2.3.2 Conduit, Conduit Fittings, and Boxes

2.3.2.1 Rigid Steel or Intermediate Metal Conduit (IMC) and Fittings

The metal conduit and fittings shall be UL 6 and UL 1242, respectively, coated with a polyvinylchloride (PVC) sheath bonded to the galvanized exterior surface, nominal 40 mils thick, conforming to NEMA RN 1.

2.3.2.2 Flexible Metal Conduit

Flexible metal conduit shall be UL 1, zinc-coated steel. UL 360 liquid-tight flexible metal conduit shall be used in wet locations.

2.3.2.3 Outlet Boxes for Use with Steel Conduit, Rigid or Flexible

These outlet boxes shall be UL 514A, cast metal with gasket closures.

2.3.2.4 Plastic Duct for Concrete Encased Burial

These ducts shall be PVC conforming to NEMA TC 6 & 8, Type EB.

2.3.2.5 Plastic Conduit for Direct Burial

This plastic conduit shall be PVC conforming to NEMA TC 2 (conduit) and NEMA TC 3 (fittings) Type EPC-40 PVC.

2.3.2.6 Frangible Couplings and Adapters

These frangible couplings shall be in accordance with FAA 6850.19 and

FAA E-2519. Provide upper section of frangible coupling with one of the following:

- a. Unthreaded for slip-fitter connections.
- b. 2-13/32 inch 16N-1A modified thread for nut and compression ring to secure 2 inch EMT.
- c. 2 inch 11-1/2-N.P.T. (tapered) with 7/32 inch nominal wall thickness to accept rigid conduit coupling.
- d. Frangible Couplings for specialized applications as approved.
- e. Electrical Metallic Tubing UL 797, where indicated for use with frangible couplings and adapters.

2.3.2.7 Low-Impact-Resistant Towers

Fiberglass reinforced low-impact resistant (LIR) towers shall conform to FAA AC 150/5345-45. Anchor bolts, lowering devices and fixture mounting accessories shall be provided as required by tower manufacturer.

2.3.2.8 Semi-Frangible Supports

Lights supported more than 40 feet above the ground shall have a two-element structure, the lower element being a rigid structure and the upper element being a 20 foot LIR structure in accordance with FAA E-2702.

2.3.3 Wire and Cable

Conductors shall be copper except as otherwise indicated.

2.3.3.1 Conductor Sizes

Conductor size shall conform to American Wire Gage (AWG). Conductor sizes larger than No. 8 AWG shall be stranded. No. 8 AWG and smaller may be solid or stranded unless otherwise indicated.

2.3.3.2 Low Voltage Wire and Cable

UL 854, Type USE, 600 volts shall be used for underground low voltage power cables.

2.3.3.3 Power Cables for Airfield and Heliports

Power cables shall be rated 5 kV, 133 percent insulation level, with shield and jacket conforming to AC 150/5345-7 for crosslinked polyethylene insulated cables.

2.3.3.4 Wire and Cable for Airfield and Heliports

- a. Airfield and heliport lighting cable shall be FAA AC 150/5345-7, Type L-824 for crosslinked polyethylene Type C 5000-volt cable. Series airfield and heliport lighting cable shall be unshielded.
- b. Cable for pavement slot installation shall be UL 44 Type XHHW, except as indicated otherwise.
- c. Counterpoise Wire. No. 4 AWG bare stranded copper, annealed or

soft drawn.

d. Control Cable. Multiconductor type for 120 volt AC control, rated 600 volts, No. 12 AWG, and conforming to the following unless indicated otherwise. Conductors shall be color coded. The cable shall have an overall jacket of cross linked polyethylene insulation rated for direct burial.

e. Fused Cable Connectors. Connector shall consist of a line-side receptacle and a load-side plug, each in a molded rubber form and including crimp-on fittings for the cable ends to accommodate a 250-volt cartridge-type fuse with fuse rating as indicated. Connectors in kit form shall be properly sized for the specific cable diameter involved. Completed connection shall be watertight.

f. Cable for sequence flashing trigger circuits shall be RUS Bull 345-67.

2.3.3.5 Cable Tags

Install cable tags for each cable or wire at duct entrances entering or leaving manholes, handholes, and at each terminal within the lighting vault. Cable tags shall be stainless steel, bronze, lead strap, or copper strip, approximately 1/16 inch thick or hard plastic 1/8 inch thick suitable for immersion in salt water and impervious to petroleum products and shall be of sufficient length for imprinting the legend on one line using raised letters. Cable tags shall be permanently marked or stamped with letters not less than 1/4 inch in height as indicated. Two-color laminated plastic is acceptable. Plastic tags shall be dark colored with markings of light color to provide contrast so that identification can be easily read. Fastening material shall be of a type that will not deteriorate when exposed to water with a high saline content and to petroleum products.

2.3.3.6 Concrete Markers for Direct Buried Cable Systems

Concrete markers shall be as specified in Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

2.3.4 Ground Rods

Ground rods shall be sectional copper-clad steel with diameter adequate to permit driving to full length of the rod, but not less than 3/4 inch in diameter and not more than 10 feet long, unless indicated otherwise.

2.3.5 Lightning Arresters

These lightning arresters shall be in accordance with IEEE C62.11, IEEE C62.41.1 and IEEE C62.41.2 as applicable with ratings as indicated.

2.3.6 Surge Protection

Surge protection shall be metal oxide varistors (MOV) in accordance with NEMA LA 1 for power and signal circuits with ratings as recommended by the system manufacturer.

2.3.7 Cable Connectors and Splices

Cable connectors in accordance with FAA AC 150/5345-26, Item L-823 shall be

used for connections and splices appropriate for the type of cable. Other types of cable connectors and splices shall be of copper alloys for copper conductors, aluminum alloys for aluminum-composition conductors and a type designed to minimize galvanic corrosion for copper to aluminum-composition conductors. For FAA Type L-824 lighting cable, connectors shall be [FAA AC 150/5345-26](#), Type L-823.

2.3.8 Transformers

2.3.8.1 Encapsulated Isolation Transformers

These transformers shall be [FAA AC 150/5345-47](#), Type L-830. Each transformer shall be provided with rating as shown on the contract drawings.

2.3.8.2 Power Transformers

These transformers shall be in accordance with [IEEE C57.12.50](#) as indicated.

2.3.9 Light Bases

Light bases shall be [FAA AC 150/5345-42](#) Type L-867 or L-868. Steel bases, Class 1, Size B shall be provided as indicated or as required to accommodate the fixture or device installed thereon if diameter is not shown. Base plates, cover plates, and adapter plates shall be provided to accommodate various sizes of fixtures. Bolts shall be stainless steel.

2.3.10 Sealant for Fixtures and Wires in Drilled Holes or Saw Kerfs

The sealant shall be in accordance with [FAA AC 150/5370-10](#), Type P-606. Use [FAA AC 150/5370-10](#), Type P-606 sealant for use in asphaltic concrete (AC) or Portland cement concrete (PCC) pavement compatible with AC pavement and having a minimum elongation of 50 percent. Formulations of Type P-606 which are compatible with PCC pavement only are prohibited.

2.3.11 Constant Current Regulator

The regulator shall be [FAA AC 150/5345-10](#), Type L-829 with monitoring system and with ratings as indicated. Regulators shall operate on 60 Hz, have internal primary switch included, have input voltage of 240 and be controlled by 120-volt external control voltage. Five brightness steps shall be provided. Monitors shall be provided as indicated.

2.3.12 Lamps and Filters

Lamps shall be of size and type indicated, or as required by fixture manufacturer for each lighting fixture required under this contract. Filters shall be of colors as indicated and conforming to the specification for the light concerned or to the standard referenced.

2.3.13 Lighting Fixtures

Provide lighting fixtures for the airfield and heliport lighting as shown in the contract drawings or as required in other contract documents.

2.3.14 Painting

As specified in Section [32 17 24.00 10](#), PAVEMENT MARKINGS.

2.4 AIRFIELD AND HELIPORT MARKINGS

The airfield and heliport markings shall be installed as shown on the contract drawings.

2.5 RUNWAY LIGHTING SYSTEM

Runway lights include runway edge lights, mounting structures, controls, and the associated equipment and interconnecting wiring to provide complete systems as indicated and specified herein. In-pavement light fixtures shall be able to withstand a minimum static single wheel load of 50,000 pounds.

2.5.1 Runway Edge Lights

The runway edge light fixtures shall meet the requirements of Type L-850C, semiflush, high-intensity white lights.

2.6 TAXIWAY LIGHTING SYSTEMS

Taxiway lighting systems shall include edge lights. These systems shall also include the associated equipment, power supplies and controls, mounting devices, and interconnecting wiring to provide complete systems as specified.

2.6.1 Taxiway Edge Lights

Taxiway edge light shall emit aviation blue light provided by filters or globes for both airfields and heliports. The edge lights shall meet the requirements of FAA AC 150/5345-46, Type L-861, elevated lights.

2.7 FACTORY COATINGS

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaries not hot-dip galvanized or porcelain enamel finish shall be provided with corrosion-resistant finishes which shall withstand 200 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE 1, (Procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with zinc rich paint conforming to SSPC Paint 20 in accordance with ASTM A 780/A 780M.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

3.2 GENERAL INSTALLATION REQUIREMENTS

Circuits installed underground shall conform to the requirements of Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND, except as required herein. Steel conduits installed underground shall be installed

and protected from corrosion in conformance with the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section 31 00 00 EARTHWORK. Concrete work shall conform to the requirements of Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE.

3.3 CABLES, GENERAL REQUIREMENTS

The type of installation, size and number of cables shall be as indicated. Conductors larger than No. 8 AWG shall be stranded. Loads shall be divided as evenly as practicable on the various phases of the system. Furnish manufacturer's written recommendations for each type of splice and medium-voltage cable joint and termination, and for fireproofing application methods, approved before any work is done. Medium-voltage cable joints and terminations shall be the standard product of a manufacturer and shall be either of the factory preformed type or of the kit type containing tapes and other required parts. Medium-voltage cable joints shall be made by qualified cable splicers. Compounds and tapes shall be electrical grade suitable for the cable insulation provided and shall use design materials and techniques recommended by the manufacturer. Maximum length of cable pull and cable pulling tensions shall not exceed the cable manufacturer's recommendations.

3.3.1 Duct Line Installation

Install cables in duct lines where indicated. Cable splices in low-voltage cables shall be made in manholes and handholes only, except as otherwise noted. Neutral and ground conductors shall be installed in the same duct with their associated phase conductors. Counterpoise cable shall be installed in a separate duct or direct-burial not less than 6 inches above the uppermost duct containing electrical cable. Electrical metallic tubing shall not be installed underground or enclosed in concrete.

3.3.2 Direct-Burial Installation

Cables shall be buried directly in the earth as indicated. Minimum cover from the top of a cable to finished grade shall be 36 inches for medium-voltage cables but not less than the depth of the frost line. Counterpoise cable shall be not less than 6 inches above the uppermost electrical cable but not less than the depth of the frost line.

3.3.2.1 Trenching

Trenches for direct-burial cables shall be excavated to depths required to provide the minimum necessary cable cover. Bottoms of trenches shall be smooth and free of stones and sharp objects. Where bottoms of trenches comprise materials other than sand or stone-free earth, 3 inch layers of sand or stone-free earth shall be laid first and compacted to approximate densities of surrounding firm soil.

3.3.2.2 Cable Installation

Cables shall be unreeled along the sides of or in trenches and carefully placed on sand or earth bottoms. Pulling cables into direct-burial trenches from a fixed reel position will not be permitted, except as required to pull cables through conduits under paving or railroad tracks. Where cables cross or are installed in layers at different depths, a separation of at least 3 inches vertically and 2 inches horizontally shall be provided, unless each cable circuit is protected by a nonmetallic

conduit sleeve at the crossing. Where single-conductor cable is installed for three-phase circuits, all three phases and the neutral shall be installed in the same sleeve. Bend radius of any cable shall be not less than 10 times the diameter of the cable. In no case shall cables be left under longitudinal tension. The first 4 inch layer of backfill shall be of sand or stone-free earth. A 5 mil, brightly colored plastic tape not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers, or other approved dig-in warning indication, shall be placed approximately 12 inches below finished grade levels of trenches.

3.3.2.3 Other Requirements

Where direct-burial cables cross under roads or other paving exceeding 5 feet in width, such cables shall be installed in concrete-encased ducts. Where direct-burial cables cross under railroad tracks, such cables shall be installed in reinforced concrete encased ducts. Ducts shall extend at least 1 foot beyond each edge of any paving and at least 5 feet beyond each side of any railroad tracks. Cables may be pulled into conduit from a fixed reel where suitable rollers are provided in the trench. Direct-burial cables shall be centered in duct entrances. A suitable waterproof nonhardening mastic compound shall be used to facilitate such centering. If paving or railroad tracks are in place where cables are to be installed, coated rigid steel conduits driven under the paving or railroad tracks may be used in lieu of concrete-encased ducts. Damage to conduit coatings shall be prevented by providing ferrous pipe jackets or by suitable predrilling. Where cuts are made in any paving, the paving and sub-base shall be restored to their original condition.

3.3.2.4 Medium-Voltage Cable Joints or Low-Voltage Cable Splices

Cable joints or splices in direct-burial cables are not permitted in runs of 1000 feet or less, nor at intervals of less than 1000 feet in longer runs, except as required for taps. Locations of cable joints or splices in shorter intervals, where required to avoid obstructions or damage to cables, shall be approved. Cable joints or splices shall be installed in cable boxes, except that medium-voltage separable connectors or low-voltage sealed insulated connectors do not require cable boxes.

3.3.2.5 Surface Markers

Markers shall be located near the ends of cable runs, at each cable joint or splice, at approximately every 500 feet along cable runs, and at changes in direction of cable runs. Markers shall be constructed as indicated.

3.3.3 Connection to Buildings

Cables shall be extended into the various buildings as indicated, and shall be properly connected to the first applicable termination point in each building. Interfacing with building interior conduit systems shall be at conduit stubouts terminating 5 feet outside of a building and 2 feet below finished grade as specified and provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. After installation of cables, conduits shall be sealed with caulking compound to prevent entrance of moisture or gases into buildings.

3.4 MEDIUM-VOLTAGE CABLES

Medium-voltage cables shall be suitable for a rated circuit voltage of 5 kV. Other parts of the cable system such as joints and terminations shall have

ratings not less than the rating of the cables on which they are installed. Separable insulated connectors shall have nominal voltage ratings coordinated to associated apparatus ratings rather than cable ratings when used to connect cable to apparatus. Cables shall be provided with 133 percent insulation level. Neutral conductors of grounded neutral systems shall be of the same insulation material as phase conductors, except that a 600-volt insulation rating is acceptable.

3.4.1 Cable Joints

Shields shall be applied as required to continue the shielding system through each entire cable joint. Shields may be integrally molded parts of preformed joints. Shields shall be grounded at each joint.

3.4.1.1 Types

Separable insulated connectors of suitable construction or standard splice kits shall be used for single-conductor and two-conductor cables. The connectors shall be of FAA AC 150/5345-26 type. Cable joints for which acceptable separable connector kits are not available may use factory preformed splices if approved.

3.4.1.2 Requirements

Cable joints shall provide insulation and jacket equivalent to that of the associated cable. Lead sleeves shall be provided for lead-covered cables. Armored cable joints shall be enclosed in compound-filled, cast-iron or alloy, splice boxes equipped with stuffing boxes and armor clamps of a suitable type and size for the cable being installed.

3.4.2 Terminations

Terminations shall be IEEE 48, Class 1 or Class 2, of the molded elastomer, wet-process porcelain, prestretched elastomer, heat-shrinkable elastomer, or taped type. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations shall be of the outdoor type, except that where installed inside outdoor equipment housings which are sealed against normal infiltration of moisture and outside air, indoor, Class 2 terminations are acceptable. Class 3 terminations are not acceptable. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, and armor.

3.4.2.1 Factory Preformed Type

Molded elastomer, wet-process porcelain, prestretched, and heat-shrinkable terminations shall utilize factory preformed components to the maximum extent practicable rather than tape build-up. Terminations shall have basic impulse levels as required for the system voltage level. Leakage distances shall pass the wet withstand voltage test required by IEEE 48 for the next higher BIL level.

3.4.2.2 Taped Terminations

Taped terminations shall use standard termination kits providing suitable terminal connectors, field-fabricated stress cones, and rain hoods.

Terminations shall be at least 12-1/2 inches long from the end of the tapered cable jacket to the start of the terminal connector, or not less than the kit manufacturer's recommendations, whichever is greater.

3.5 LOW-VOLTAGE CABLES

Cable shall be rated 600 volts, except that secondaries of isolation transformer to in-pavement lights installed in pavement saw kerf and 48 volt DC control cables may be 300 volts. Other parts of cable systems such as splices and terminations shall be rated at not less than 600 volts. Splices in wires No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A-486B. Splices in wires No. 8 AWG single conductor cable shall be made with FAA AC 150/5345-26 Type L-823 connectors. Splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

3.6 DUCT LINES

Duct lines shall be concrete-encased, thin-wall type.

3.6.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 4 inches per 100 feet. Depending on the contour of the finished grade, the high point may be at a terminal, a manhole, a handhold, or between manholes or handholes. Manufactured 90 degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3 inches diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends as required, but the maximum curve shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells when duct lines terminate in manholes or handholes. Duct line markers shall be provided as indicated at the ends of long duct line stubouts or for other ducts whose locations are indeterminate because of duct curvature or terminations at completely below-grade structures. In lieu of markers, a 5 mil brightly colored plastic tape not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers with a continuous metallic backing and a corrosion-resistant 1 mil metallic foil core to permit easy location of the duct line, shall be placed approximately 12 inches below finished grade levels of such lines.

3.6.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. After a duct line is completed, a standard flexible mandrel shall be used for cleaning followed by a brush with stiff bristles. Mandrels shall be at least 12 inches long and shall have diameters 1/4 inch less than the inside diameter of the duct being cleaned. Pneumatic rodding may be used to draw in lead wires. A coupling recommended by the duct manufacturer shall be used when an existing duct is connected to a duct of different material or shape. Ducts shall be stored

to avoid warping and deterioration with ends sufficiently plugged to prevent entry of water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.6.3 Concrete Encasement

Each single duct shall be completely encased in concrete with a minimum of 3 inches of concrete around each duct, except that only 2 inches of concrete are required between adjacent electric power or adjacent communication ducts, and 4 inches of concrete shall be provided between adjacent electric power and communication ducts. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. At any point, except railroad crossings, tops of concrete encasements shall be not less than 18 inches below finished grade or paving. At railroad crossings, duct lines shall be encased with concrete, reinforced as indicated. Tops of concrete encasements shall be not less than 5 feet below tops of rails, unless otherwise indicated. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not further apart than 4 feet on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 6 inches vertically.

3.6.4 Non-encased Direct-Burial

Top of duct lines shall be below frost line but not less than 24 inches below finished grade. Ducts shall be buried below frost line but in the earth and shall be installed with a minimum of 3 inches of earth around each duct, except that between adjacent electric power and communication ducts, 12 inches of earth is required. Bottoms of trenches shall be graded toward manholes or handholes and shall be smooth and free of stones, soft spots, and sharp objects. Where bottoms of trenches comprise materials other than sand or stone-free earth, 3 inch layers of sand or stone-free earth shall be laid first and compacted to approximate densities of surrounding firm soil before installing ducts in direct-contact tiered fashion. Joints in adjacent tiers of duct shall be vertically staggered at least 6 inches. The first 4 inch layer of backfill cover shall be sand or stone-free earth compacted as previously specified. Duct banks may be held in alignment with earth. However, high-tiered banks shall use a wooden frame or equivalent form to hold ducts in alignment prior to backfilling. Selected earth at duct banks shall be thoroughly tamped in 4 to 6 inch layers.

3.6.5 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved. In the absence of specific recommendations, various types of duct joint couplings shall be made watertight as specified.

3.6.5.1 Bituminized-Fiber Ducts

To ensure a watertight joint, tapered ends or joints of the same material as the ducts shall be swabbed with bituminous or joint-sealing compound before couplings are applied. Plastic or nonmetallic couplings shall be tightly driven onto unswabbed ducts. Due to the brittleness of plastic couplings at low temperatures, such couplings shall not be installed when

temperatures are below 0 degrees F. Couplings shall be warmed in hot water or by another approved method when installed at temperatures below 32 degrees F.

3.6.5.2 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick one-quarter-turn twist to set the joint tightly.

3.7 MANHOLES AND HANDHOLES

The manholes and handholes shall be as specified in Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

3.8 WELDING

Perform the welding of supports and metallic ducts and welding or brazing of electrical connections by using qualified welders.

3.9 CABLE MARKERS

Provide cable markers or tags for each cable at duct entrances entering or leaving manholes or handholes and at each termination within the lighting vault. Cables in each manhole or handhole shall have not less than two tags per cable, one near each duct entrance hole. Immediately after cable installation, tags shall be permanently attached to cables and wires so that they cannot be accidentally detached.

3.10 FRANGIBLE REQUIREMENTS

Install frangible supports, couplings, and adapters as indicated or specified. At the 1000 foot cross bar and beyond, approach lights shall be mounted up to 6 feet above concrete foundation on threaded frangible couplings and 2 inch electrical metallic tubing (EMT). For mounting heights greater than 6 feet, approach lights shall be mounted on low-impact resistant frangible towers as indicated.

3.11 ELEVATED AIRFIELD AND HELIPORT LIGHTS

Elevated lights shall be frangibly mounted, not to exceed 14 inches in height except where higher mounting is permitted in snow accumulation areas. Equipment exceeding 14 inches in height shall be frangibly mounted as indicated.

3.12 SEMIFLUSH AIRFIELD AND HELIPORT LIGHTS

Remove water, debris, and other foreign substances prior to installing semiflush light base and light. Use positioning jigs to hold the light bases and/or lights to ensure correct orientation and leveling until the concrete, adhesive, or sealant can provide permanent support.

3.13 FIXTURES AND WIRES INSTALLATION

3.13.1 General

Sides and bottom of each light base shall be sandblasted immediately prior to installation. Inside faces of bored hole and bottom and sides of light

base shall be covered with a coating of sealant that will completely fill the void between concrete and base. A jig or holding device shall be used when installing each light fixture to ensure positioning to the proper elevation, alignment, level control, and azimuth control. Light fixture shall be oriented with the light beams parallel to the runway or taxiway centerline and facing in the required direction. Outermost edge of fixture shall be level with the surrounding pavement. Surplus sealant or flexible embedding material shall be removed. The holding device shall remain in place until sealant has reached its initial set. Fixture lead wires shall be properly arranged with respect to their connecting position. The wireway entrance into the light recess shall be blocked to retain the sealant material during curing.

3.13.2 Installation of Circuit Wires in Pavement

Place wires in saw kerfs and anchor them at bottom by means of rubber or plastic wedges or noncorrosive metal clips placed every 2 or 3 feet or as often as necessary to hold the wire down. Wires crossing existing joints shall be encased in a 24 inch length of flexible tubing of polyethylene material conforming to ASTM D 1248, Type II or Type III, to break the bond between the wires and the sealing material. Flexible tubing shall be centered on the joint and of sufficient size to accommodate the wires to allow for movement of the wires as the joint opens and closes. Ends of tubing shall be wrapped with tape to prevent entrance of sealing materials. The adjacent joint area shall be packed temporarily with roving material, such as hemp, jute, cotton or flax, to prevent sealing material from flowing into the open joint. Sealing materials shall be carefully mixed and applied in accordance with the manufacturer's instructions and at the recommended temperature. Surplus or spilled material shall be removed.

3.14 SPLICES FOR AIRFIELD AND HELIPORT LIGHTING CABLE

3.14.1 Connectors

Kit type connectors shall be used to splice 5 kV single-conductor series lighting cables. During installation and prior to covering with earth, mating surfaces of connectors shall be covered until connected and clean when plugged together. At joint where connectors come together, heat shrinkable tubing shall be installed with waterproof sealant with two half-lapped layers of tape over the entire joint. Joint shall prevent entrapment of air which might subsequently loosen the joint.

3.14.2 Splicing Fixtures to the Wires in Pavement Saw Kerfs

Splices shall have preinsulated watertight connector sleeves crimped with a tool that requires a complete crimp before tool can be removed. Splice shall be taped with plastic insulating tape.

3.15 GROUNDING SYSTEMS

3.15.1 Counterpoise Installation

Counterpoise wire shall be laid for entire length of circuits supplying airfield lighting. Wire shall be in one piece, except where distance exceeds the length usually supplied. Counterpoise shall be installed on top of the envelope of concrete-encased duct and approximately 6 inches above direct burial cables and duct lines. Where trenches or duct lines intersect, counterpoise wires shall be electrically interconnected by exothermic welding or brazing. Counterpoise to earth ground shall be

connected at every 1,000 feet of cable run, at lighting vault, and at feeder connection to light circuit by means of ground rods as specified. Counterpoise shall be installed in a separate duct under roads, railroads, and paved areas above the highest duct containing electrical or communications circuits.

3.15.2 Fixture Grounding

Each fixture or group of adjacent fixtures shall be grounded by a grounding circuit separate from the counterpoise system unless required otherwise or by driven ground rods if permitted. Fixtures, steel light bases or grounding bushings on steel conduits shall be connected to an independent ground rod by a No. 6 AWG bare stranded copper wire. Semiflush fixtures for direct mounting in pavement need not be grounded. Copper wire shall be connected to ground rods by exothermic weld or brazing.

3.16 ISOLATION TRANSFORMERS

Transformer lead connections shall conform to FAA AC 150/5345-26. Transformer secondary connectors shall plug directly into a mating connector on the transformer secondary leads. During installation, mating surfaces of connectors shall be covered until connected and clean when plugged together. At joint where connectors come together, heat shrinkable tubing shall be installed with waterproof sealant or with two half-lapped layers of tape over the entire joint. Joint shall prevent entrapment of air which might subsequently loosen the joint.

3.17 RUNWAY AND TAXIWAY LIGHTING SYSTEMS

3.17.1 Runway and Taxiway Edge Lights

Edge lights shall be elevated type lights except in paved areas where semiflush lights are required. Elevated lights shall be frangibly mounted and each light supplied power through an isolation transformer. The taxiway lights shall be omnidirectional and only require leveling. The runway lights require leveling and alignment of the beams for the correct toe-in of the beams.

3.18 FIELD QUALITY CONTROL

Notify the Contracting Officer five working days prior to each test. Deficiencies found shall be corrected and tests repeated. Field test reports shall be written, signed and provided as each circuit or installation item is completed. Field tests shall include resistance-to-ground and resistance between conductors, and continuity measurements for each circuit. For each series circuit the input voltage and output current of the constant current regulator at each intensity shall be measured. For multiple circuits the input and output voltage of the transformer for each intensity setting shall be measured. A visual inspection of the lights operation, or of the markings appearance, or of the installation of fixtures or units installed shall be reported.

3.18.1 Operating Test

Test each completed circuit installation for operation. Equipment shall be demonstrated to operate in accordance with the requirements of this Section. One day and one night test shall be conducted for the Contracting Officer.

3.18.2 Distribution Conductors, 600-Volt Class

Test shall verify that no short circuits or accidental grounds exist using an instrument which applies a voltage of approximately 500 volts providing a direct reading in resistance.

3.18.3 Counterpoise System Test and Inspection

Continuity of counterpoise system shall be checked by visual inspection at accessible locations. Continuity of counterpoise system to the vault grounding system shall be tested in manhole closest to the vault.

3.18.4 Progress Testing for Series Lighting Circuits

A megger test shall be conducted on each section of circuit or progressive combinations of sections as they are installed. Each section or progressive combination of sections shall be tested with a megohmmeter providing a voltage of approximately 1000 volts, a direct reading in resistance. Results shall be documented. Faults indicated by these tests shall be eliminated before proceeding with the circuit installation.

3.18.5 Electrical Acceptance Tests

Acceptance tests shall be performed for series and multiple airfield and heliport lighting circuits only on complete lighting circuits. Each series and multiple lighting circuit shall receive a high voltage insulation test.

3.18.5.1 Low-Voltage Continuity Tests

Each series circuit shall be tested for electrical continuity. Faults indicated by this test shall be eliminated before proceeding with the high-voltage insulation resistance test.

3.18.5.2 High-Voltage Insulation Resistance Tests

Each series lighting circuit shall be subjected to a high-voltage insulation resistance test by measurement of the insulation leakage current with a suitable high-voltage test instrument which has a steady, filtered direct current output voltage and limited current. High-voltage tester shall include an accurate voltmeter and microammeter for reading voltage applied to the circuit and resultant insulation leakage current. Voltages shall not exceed test values specified below.

- a. Test Procedure: Both leads shall be disconnected from regulator output terminals and support so that air gaps of several inches exist between bare conductors and ground. Cable sheaths shall be cleaned and dried for a distance of 1 foot from ends of cables and exposed insulation at ends of cables. Ends of both conductors of the circuit shall be connected together and to high-voltage terminals of test equipment, and test voltage applied as specified in the following tabulation between conductors and ground for a period of 5 minutes.

	Test Voltage, dc	
Series Lighting Circuits	First Test on New Circuits	Test on Existing Circuits
High Intensity Series		

Series	Test Voltage, dc	
	First Test on New Circuits	Test on Existing Circuits
Lighting Circuits Lighting Circuits (5,000 volt leads, 500 and 200 watt transformers)	9000	5000
Medium Intensity Series Lighting Circuits (5,000 volt leads, 30/45 watt transformers)	6000	3000
600-Volt Circuits	1800	600

When additions are made to existing circuits, only new sections shall be tested in accordance with "First Test on New Circuits" in table above. To ensure reliable operation, complete circuit shall be tested at reduced voltages indicated above.

b. Leakage Current: Insulation leakage current shall be measured and recorded for each circuit after a 1 minute application of the test voltage. If leakage current exceeds values specified below, the circuit shall be sectionalized and retested and the defective parts shall be repaired or replaced. Leakage current limits include allowances for the normal number of connectors and splices for each circuit as follows:

- (1) Three microamperes for each 1000 feet of cable.
- (2) Two microamperes for each 200 watt and each 500 watt 5,000-volt series transformer.
- (3) Two microamperes for each 30/45-Watt 5,000 volt series transformer.
- (4) If measured value of insulation leakage current exceeds calculated value, the circuit shall be sectionalized and tested as specified for each section. Defective components shall be repaired or replaced until repeated tests indicate an acceptable value of leakage current for the entire circuit.

3.18.6 Constant Current Regulators

Each constant current regulator shall be examined to ensure that porcelain bushings are not cracked, no shipping damage has occurred, internal and external connections are correct, switches and relays operate freely and are not tied or blocked, fuses, if required, are correct, and liquid level of liquid-filled regulators is correct. Relay panel covers shall be removed only for this examination; it is not necessary to open the main tank of liquid-filled regulators. The instructions on the plates attached to the regulators shall be followed. Covers shall be replaced tightly after completing examinations and tests.

3.18.7 Regulator Electrical Tests

Supply voltage and input tap shall correspond. With the loads disconnected, regulator shall be energized and the open circuit protector observed to ensure that it de-energizes the regulator within 3 seconds. After testing circuits for open circuit and ground fault and corrections, if any, and after determining that lamps are serviceable and in place, the loads shall be connected for each circuit or combination of circuits to be energized by the regulator and the voltage and current measured simultaneously for each brightness tap. Voltmeter and ammeter shall have an accuracy of plus or minus 1 percent of meter full scale. Readings shall be recorded during the day and night in order to obtain the average supply voltage. Output current on each brightness tap shall be within plus or minus 2 percent full scale of the nameplate values after making necessary correction in the supply voltage. Late model regulators have automatic supply voltage correction in lieu of input taps, and output current does not change as supply voltage varies. When output current on highest intensity setting deviates from nameplate value by more than 2 percent of meter full scale and the regulator is not overloaded, internal adjustment shall be checked as described on regulator instruction plate. Since adjustment may be rather delicate, a deviation of up to plus or minus 5 percent of meter full scale is allowed for lower intensity settings before attempting to readjust the regulator.

3.19 FINISHING

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall be as required in Section 09 90 00 PAINTS AND COATINGS.

3.20 TRAINING

Provide training on the proper [operation and maintenance procedures](#) for the system. Submit information describing training to be provided, training aids to be used, samples of training materials, and schedules. Training shall include a list of [special tools](#) and test equipment required for maintenance and testing of the products supplied by the Contractor; a [list of parts](#) and components for the system by manufacturer's name, part number, nomenclature, and stock level required for [maintenance and repair](#) necessary to ensure continued operation with minimal delays; instructions necessary to checkout, troubleshoot, repair, and replace components of the systems, including integrated electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting after acceptance of the system.

3.21 FINAL OPERATING TESTS

After completion of installations and the above tests, circuits, control equipment, and lights covered by the contract shall be demonstrated to be in acceptable operating condition. Each switch in the control tower lighting panels shall be operated so that each switch position is engaged at least twice. During this process, lights and associated equipment shall be observed to determine that each switch properly controls the corresponding circuit. Telephone or radio communication shall be provided between the operator and the observer. Tests shall be repeated from the alternate control station, from the remote control points, and again from the local control switches on the regulators. Each lighting circuit shall be tested by operating the lamps at maximum brightness for not less than 30 minutes. At the beginning and at the end of this test the correct number

of lights shall be observed to be burning at full brightness. One day and one night operating test shall be conducted for the Contracting Officer.

3.22 POSTED INSTRUCTIONS

Submit a typed copy of the proposed posted instructions showing wiring, control diagrams, complete layout and operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system.

-- End of Section --

SECTION 26 56 36.00 40

FLOOD LIGHTING

11/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E 2129 (2005) Standard Practice for Data Collection for Sustainability Assessment of Building Products

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IESNA HB-9 (2000; Errata 2004; Errata 2005; Errata 2006) IES Lighting Handbook

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2007; Errata 06-1; TIA 07-1; TIA 07-2; TIA 07-3; Errata 07-2; TIA 08-4; TIA 08-5; TIA 08-6; TIA 08-7; TIA 08-8; TIA 08-9; TIA 08-10; TIA 08-11; TIA 09-12; TIA 09-13; TIA 09-14; Errata 09-3; TIA 09-15; TIA 09-16; TIA 10-17) National Electrical Safety Code

IEEE Stds Dictionary (2009) IEEE Standards Dictionary: Glossary of Terms & Definitions

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI ANSLG C78.41 (2006) For Electric Lamps--Guidelines for Low-Pressure Sodium Lamps

ANSI ANSLG C78.42 (2009) For Electric Lamps: High-Pressure Sodium Lamps

ANSI C78.379 (2006) American National Standard for Electric Lamps--Classification of the Beam Patterns of Reflector Lamps

ANSI C78.389 (2004; R 2009) American National Standard for Electric Lamps - High Intensity Discharge (HID) - Methods of Measuring Characteristics

ANSI C82.4 (2002) American National Standard for Ballasts for High-Intensity-Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type)

NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 6	(1993; R 2006) Enclosures
NEMA LSD 25	(2008) Best Practices for Metal Halide Lighting Systems, Plus Questions and Answers about Lamp Ruptures in Metal Halide Lighting Systems
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 70	(2011; TIA 11-1; Errata 2011) National Electrical Code
U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)	
Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System
U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)	
21 CFR 1040	Performance Standards for Light-Emitting Products
UNDERWRITERS LABORATORIES (UL)	
UL 1029	(1994; Reprint May 2011) High-Intensity-Discharge Lamp Ballasts
UL 1598	(2008; Reprint Jan 2010) Luminaires

1.2 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Submit [Certificates](#) showing compliance with the following requirements:

Lighting-distribution curves for each type of fixture in accordance with the Illuminating Engineering Society and [ANSI C78.379](#).

Certification that [Floodlighting Fixtures](#) conform to structural, electrical, and photometric requirements.

Submit [Equipment and Performance Data](#) for floodlighting systems consisting of life, test, system functional flows, safety features, mechanical automated details, automatic interlocks, and such features as electrical system protective device ratings.

1.3 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in [IEEE Stds Dictionary](#).
- b. Average life is the time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Local/Regional Materials

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Energy Efficiency

Environmental Data

Equipment and Performance Data for floodlighting systems in accordance with paragraph entitled, "General Requirements," of this section.

Manufacturer's catalog data for the following **Luminaires**:

- Floodlighting Fixtures
- Floodlighting Luminaires
- FLUORESCENT FLOODLIGHTS, EXTERIOR
- High-Intensity-Discharge (HID) Luminaires
- Quartz-Iodine Luminaires
- Substation-Yard Lighting Luminaires
- Series Circuit Transformers
- Lamp Ballasts

SD-02 Shop Drawings

Installation Drawings for the **Floodlighting Systems** (including **luminaire drawings**) in accordance with the paragraph entitled "Installation," of this section.

SD-04 Samples

Luminaires; G

Submit one sample of each luminaire type, complete with lamp and ballast. Sample will be returned to the Contractor for installation in the project work.

SD-05 Design Data

Design Data for luminaires; G

SD-06 Test Reports

Test reports for **Operational Tests** on incandescent lighting

fixtures in accordance with the paragraph entitled, "Field Testing," of this section.

SD-07 Certificates

Certificates in accordance with paragraph entitled, "General Requirements," of this section.

Floodlighting Fixtures

SD-10 Operation and Maintenance Data

Operational Service

Submit documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

1.5 QUALITY ASSURANCE

1.5.1 Drawing Requirements

1.5.1.1 Luminaire Drawings

Include dimensions, effective projected area (EPA), accessories, and installation and construction details. Accompany shop drawings with photometric data, including zonal lumen data, average and minimum ratio, aiming diagram, and computerized candlepower distribution data.

1.5.2 Design Data for Luminaires

- a. Distribution data according to IESNA classification type as defined in **IESNA HB-9**.
- b. Computerized horizontal illumination levels in **footcandles** at ground level, taken every **10 feet**. Include average maintained **footcandle** level and maximum and minimum ratio.
- c. **Amount of shielding on luminaires.**

1.5.3 Standard Products

Provide materials and equipment, conforming to **IEEE C2**, that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship, which have been in satisfactory commercial or industrial use for 2 years prior to bid opening under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.3.1 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site are not allowed, unless specified otherwise.

1.6 SUSTAINABLE DESIGN REQUIREMENTS

1.6.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources.

1.6.2 Environmental Data

Submit Table 1 of ASTM E 2129 for the following products: components of luminaires and luminaire poles.

1.6.3 Energy Efficiency

Comply with National Energy Policy Act and Energy Star requirements for lighting products. Submit documentation for Energy Star qualifications for equipment provided under this section. Submit data indicating lumens per watt efficiency and color rendition index of light source.

1.7 WARRANTY

Provide support for the equipment items by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

2.2 PRODUCT STANDARDS

Floodlighting fixtures shall conform to IESNA HB-9.

Provide floodlighting fixtures complete with wiring, enclosures conforming to NEMA ICS 6, and mounting devices ready for installation at the locations. Equip all fixtures with the proper lamps.

2.3 FLOODLIGHTING LUMINAIRES

Provide floodlighting luminaires which are enclosed and gasketed vaportight fixtures in accordance with IESNA HB-9 and UL 1029.

2.4 HIGH-INTENSITY-DISCHARGE (HID) LUMINAIRES

Include with HID luminaires, with base-down vertical-lamp burning positions, a housing with glass lens and cover, reflector, lampholder, ballast compartment, terminal block, fuses, fuseholders, and fixture mounting devices in a completely sealed optical system.

Provide cast aluminum housing with hinged cast-aluminum cover, heat-resistant clear plain glass lens not less than 3/16-inch thick, gasket, and cover clamps. Include with housing a weatherproof seal against moisture and foreign material, and an integral cast-aluminum ballast

compartment with built-in ballast and terminal block.

Provide detachable reflector, formed anodized sheet aluminum with diffuse or specular finish designed for a rectangular wide-beam spread.

2.4.1 Mounting Devices

Include with fixture mounting devices a galvanized-steel trunnion adaptable to pole, wall, pipe, or crossarm mounting as indicated and required, with fixture positioning devices that will permit horizontal and vertical adjustment over a 180-degree range.

2.4.2 Focusing, Fusing, and Connecting

Provide fixture with lamp focusing adjustments, fixture aiming and leveling devices, fuses, and fuseholders accessible from the outside of the fixture, and replaceable lamps from the top or front.

Make electrical connections with Type AFS cord.

2.5 QUARTZ-IODINE LUMINAIRES, SPECIAL PURPOSE

When providing quartz-iodine lamp luminaires, Class HD, with horizontal lamp-burning position, include a housing with glass lens and cover, reflector, lampholders, fuses, fuseholders, lamp, and fixture mounting devices in a completely sealed optical system for pole-top mounting, with concealed wiring in floodlighting luminaires.

2.5.1 Housing, Reflectors, and Lamps

Provide cast aluminum housing with hinged cast-aluminum cover, heat-resistant plain glass lens, gasket, and cover clamps, sealed against moisture and foreign material.

Provide formed anodized sheet aluminum reflectors in a parabolic shape with diffuse or specular finish for a rectangular beam spread with narrow, medium, or wide light distribution. Beam spread is not to be less than 10 percent of the maximum [candlepower](#). Provide fixture with lamp focusing, positioning, and leveling adjustments that permits horizontal and vertical adjustment over a 180-degree range, fixture leveling and aiming devices, and fuses with fuseholders accessible from the outside of the fixture, and replaceable lamp from the front and rear.

Design the fixture to accommodate the appropriate lamp.

2.6 LAMP BALLASTS

Provide [lamp ballasts](#) which maintain correct lamp operation over a voltage-input range of plus or minus 13 percent of rated voltage, with capacitors providing a power-factor lamp load of not less than 95 percent. Provide ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type) conforming to [ANSI C82.4](#)

Provide ballasts voltage rated for operation on 277-volt, single-phase, 60-hertz lighting-distribution systems.

Design ballasts for a minimum lamp starting temperature of minus 20 degrees F and a maximum ambient temperature of 105 degrees F.

2.7 LAMPS

2.7.1 HID Lamps

Provide automatically self-extinguishing High Intensity Discharge (HID) lamps conforming to 21 CFR 1040, Section 30, ANSI C78.379, and ANSI C78.389 when used in a populated area.

2.7.2 Low-Pressure Sodium

Provide Low-Pressure Sodium (LPS) lamps conforming to ANSI ANSLG C78.41.

2.7.3 High-Pressure Sodium

Provide High-Pressure Sodium (HPS) lamps conforming to ANSI ANSLG C78.42.

2.7.4 Metal Halide

Provide Metal Halide lamps conforming to NEMA LSD 25.

2.8 EQUIPMENT IDENTIFICATION

2.8.1 Manufacturer's Nameplate

Provide each item of equipment with a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.8.2 Labels

Provide labeled luminaires in accordance with UL 1598 requirements, clearly marked for operation of specific lamps and ballasts according to proper lamp type. Note the following lamp characteristics in the format "Use Only b":

- a. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
- b. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
- c. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.
- d. ANSI ballast type (M98, M57, etc.) for HID luminaires.
- e. Correlated color temperature (CCT) and color rendering index (CRI) for all luminaires.

Make markings related to lamp type clear and locate to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place. Provide ballasts with clear markings indicating multi-level outputs and indicate proper terminals for the various outputs.

2.9 FACTORY APPLIED FINISH

Factory apply painting system to electrical equipment which as a minimum,

meets the requirements of [NEMA 250](#) corrosion-resistance test.

PART 3 EXECUTION

3.1 INSTALLATION

Install floodlighting fixtures in accordance with [NFPA 70](#), with lamps of the proper type, voltage, and wattage in each fixture.

Install new lamps immediately prior to completion of the project. Install lamps with the light center at the focal point in the reflector and in the proper burning position. Aim fixtures at night to provide optimum light coverage.

Submit [Installation Drawings](#) for [Floodlighting Systems](#). Indicate on drawings overall physical features, dimensions, ratings, service requirements, and weights of equipment.

3.2 FIELD TESTING

Demonstrate that floodlighting fixtures installation operates satisfactorily in the presence of the Contracting Officer.

Perform [Operational Tests](#) in accordance with referenced standards in this section. Provide written documentation and point of contact for [operational service](#).

-- End of Section --

SECTION 27 10 00

BUILDING TELECOMMUNICATIONS CABLING SYSTEM

01/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 709 (2001; R 2007) Laminated Thermosetting Materials

ELECTRONIC COMPONENTS ASSOCIATION (ECA)

ECA EIA/ECA 310 (2005) Cabinets, Racks, Panels, and Associated Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100 (2000; Archived) The Authoritative Dictionary of IEEE Standards Terms

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011) National Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA J-STD-607 (2002a) Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

TIA-526-7 (2002; R 2008) OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant

TIA-568-2 (2009c; Errata 2010) Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted Pair Cable Components

TIA-568-C.1 (2009) Commercial Building Telecommunications Cabling Standard

TIA-568-C.3 (2008; Corrections 2008) Optical Fiber Cabling Components Standard

TIA-569 (2004b; Add 1 2009) Commercial Building Standard for Telecommunications Pathways and Spaces

TIA/EIA-606 (2002a; Errata 2007; R 2007; Adm 1 2008) Administration Standard for the

Telecommunications Infrastructure

UNDERWRITERS LABORATORIES (UL)

- UL 467 (2007) Grounding and Bonding Equipment
- UL 50 (2007) Enclosures for Electrical Equipment, Non-environmental Considerations

1.2 RELATED REQUIREMENTS

Section 33 82 00 TELECOMMUNICATIONS, OUTSIDE PLANT, apply to this section with additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in TIA-568-C.1, TIA-568-2, TIA-568-C.3, TIA-569, TIA/EIA-606 and IEEE 100 and herein.

1.3.1 Campus Distributor (CD)

A distributor from which the campus backbone cabling emanates. (International expression for main cross-connect (MC).)

1.3.2 Building Distributor (BD)

A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. (International expression for intermediate cross-connect (IC).)

1.3.3 Floor Distributor (FD)

A distributor used to connect horizontal cable and cabling subsystems or equipment. (International expression for horizontal cross-connect (HC).)

1.3.4 Telecommunications Room (TR)

An enclosed space for housing telecommunications equipment, cable, terminations, and cross-connects. The room is the recognized cross-connect between the backbone cable and the horizontal cabling.

1.3.5 Entrance Facility (EF) (Telecommunications)

An entrance to the building for both private and public network service cables (including antennae) including the entrance point at the building wall and continuing to the entrance room or space.

1.3.6 Entrance Room (ER) (Telecommunications)

A centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.

1.3.7 Open Cable

Cabling that is not run in a raceway as defined by NFPA 70. This refers to cabling that is "open" to the space in which the cable has been installed and is therefore exposed to the environmental conditions associated with

that space.

1.3.8 Open Office

A floor space division provided by furniture, moveable partitions, or other means instead of by building walls.

1.3.9 Pathway

A physical infrastructure utilized for the placement and routing of telecommunications cable.

1.4 SYSTEM DESCRIPTION

The building telecommunications cabling and pathway system shall include permanently installed service entrance facilities, for splicing, terminating, and interconnecting cabling.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Telecommunications drawings; G

In addition to Section 01 33 00 SUBMITTAL PROCEDURES, provide shop drawings in accordance with paragraph SHOP DRAWINGS.

SD-03 Product Data

Telecommunications cabling (backbone and horizontal); GEquipment support frame; G

Connector blocks; G

Submittals shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Include performance and characteristic curves. Submittals shall also include applicable federal, military, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified in paragraph REGULATORY REQUIREMENTS and as required in Section 01 33 00 SUBMITTAL PROCEDURES.

SD-07 CertificatesTelecommunications Contractor Qualifications; GKey Personnel Qualifications; GManufacturer Qualifications; GTest plan; GSD-09 Manufacturer's Field ReportsFactory reel tests; GSD-10 Operation and Maintenance Data

Telecommunications cabling and pathway system Data Package 5; G

SD-11 Closeout Submittals

Record Documentation; G

1.6 QUALITY ASSURANCE

1.6.1 Shop Drawings

In exception to Section 01 33 00, SUBMITTAL PROCEDURES, submit shop drawings a minimum of 14 by 20 inches in size using a minimum scale of 1/8 inch per foot, except as specified otherwise. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

1.6.1.1 Telecommunications Drawings

Provide registered communications distribution designer (RCDD) approved, drawings in accordance with TIA/EIA-606. The identifier for each termination and cable shall appear on the drawings. Drawings shall depict final telecommunications installed wiring system infrastructure in accordance with TIA/EIA-606. The drawings should provide details required to prove that the distribution system shall properly support connectivity from the EF telecommunications and ER telecommunications, CD's, BD's, and FD's to the telecommunications work area outlets. Provide a plastic laminated schematic of the as-installed telecommunications cable system showing cabling, CD's, BD's, FD's, and the EF and ER for telecommunications keyed to floor plans by room number. Mount the laminated schematic in the EF telecommunications space as directed by the Contracting Officer. The following drawings shall be provided as a minimum:

- a. T1 - Layout of complete building per floor - Building Area/Serving Zone Boundaries, Backbone Systems, and Horizontal Pathways. Layout of complete building per floor. The drawing indicates location of building areas, serving zones, vertical backbone diagrams, telecommunications rooms, access points, pathways, grounding system, and other systems that need to be viewed from the complete building perspective.
- b. T2 - Serving Zones/Building Area Drawings - Drop Locations and Cable Identification (ID'S). Shows a building area or serving zone. These drawings show drop locations, telecommunications rooms, access points and detail call outs for common equipment rooms and other congested areas.
- c. T4 - Typical Detail Drawings - Faceplate Labeling, Firestopping, Americans with Disabilities Act (ADA), Safety, Department of Transportation (DOT). Detailed drawings of symbols and typicals such as faceplate labeling, faceplate types, faceplate population installation procedures, detail racking, and raceways.

1.6.2 Telecommunications Qualifications

Work under this section shall be performed by and the equipment shall be provided by the approved telecommunications contractor and key personnel. Qualifications shall be provided for: the telecommunications system contractor, the telecommunications system installer, and the supervisor (if different from the installer). A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

1.6.2.1 Telecommunications Contractor

The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems within the past 3 years. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor.

1.6.2.2 Key Personnel

Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.

Supervisors and installers assigned to the installation of this system or any of its components shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification for each of the key personnel.

In lieu of BICSI certification, supervisors and installers assigned to the installation of this system or any of its components shall have a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this solicitation. Include specific experience in installing and testing telecommunications systems and provide the names and locations of at least two project installations successfully completed using optical fiber and copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this solicitation. Provide the name and role of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and

construction complexity.

Indicate that all key persons are currently employed by the telecommunications contractor, or have a commitment to the telecommunications contractor to work on this project. All key persons shall be employed by the telecommunications contractor at the date of issuance of this solicitation, or if not, have a commitment to the telecommunications contractor to work on this project by the date that the bid was due to the Contracting Officer.

Note that only the key personnel approved by the Contracting Officer in the successful proposal shall do work on this solicitation's telecommunications system. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the telecommunications contractor's key personnel requires approval from The Contracting Officer.

1.6.2.3 Minimum [Manufacturer Qualifications](#)

Cabling, equipment and hardware manufacturers shall have a minimum of 3 years experience in the manufacturing, assembly, and factory testing of components which comply with [TIA-568-C.1](#), [TIA-568-2](#) and [TIA-568-C.3](#).

1.6.3 [Test Plan](#)

Provide a complete and detailed test plan for the telecommunications cabling system including a complete list of test equipment for the UTP and optical fiber components and accessories 60 days prior to the proposed test date. Include procedures for certification, validation, and testing.

1.6.4 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of [NFPA 70](#) unless more stringent requirements are specified or indicated.

1.6.5 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6.5.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than

6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.5.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.7 DELIVERY AND STORAGE

Provide protection from weather, moisture, extreme heat and cold, dirt, dust, and other contaminants for telecommunications cabling and equipment placed in storage.

1.8 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, noncondensing.

1.9 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.10 MAINTENANCE

1.10.1 Operation and Maintenance Manuals

Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance of products provided as a part of the telecommunications cabling and pathway system. Submit operations and maintenance data in accordance with Section 01 78 23, OPERATION AND MAINTENANCE DATA and as specified herein not later than 2 months prior to the date of beneficial occupancy. In addition to requirements of Data package 5, include the requirements of paragraphs TELECOMMUNICATIONS DRAWINGS, TELECOMMUNICATIONS SPACE DRAWINGS, and RECORD DOCUMENTATION.

1.10.2 Record Documentation

Provide T5 drawings including documentation on cables and termination hardware in accordance with TIA/EIA-606. T5 drawings shall include schedules to show information for cut-overs and cable plant management, patch panel layouts and cover plate assignments, cross-connect information and connecting terminal layout as a minimum. T5 drawings shall be provided in hard copy format. Provide the following T5 drawing documentation as a minimum:

- a. Termination Hardware - A record of installed patch panels, cross-connect points, distribution frames, terminating block arrangements and type, and outlets shall be provided in accordance with TIA/EIA-606. Documentation shall include the required data fields as a minimum in accordance with TIA/EIA-606.

PART 2 PRODUCTS

2.1 COMPONENTS

UL or third party certified. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations, submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard. Provide a complete system of telecommunications cabling and pathway components using star topology. Provide support structures and pathways, complete with outlets, cables, connecting hardware and telecommunications cabinets/racks. Cabling and interconnecting hardware and components for telecommunications systems shall be UL listed or third party independent testing laboratory certified, and shall comply with [NFPA 70](#) and conform to the requirements specified herein.

2.2 TELECOMMUNICATIONS CABLING

2.3 TELECOMMUNICATIONS SPACES

Provide connecting hardware and termination equipment in the telecommunications entrance facility to facilitate installation as shown on design drawings for terminating and cross-connecting permanent cabling. Provide telecommunications interconnecting hardware color coding in accordance with [TIA/EIA-606](#).

2.3.1 Backboards

Provide void-free, interior grade plywood $3/4$ inch thick 4 by 8 feet as indicated. Backboards shall be fire rated. Backboards shall be provided on a minimum of two walls in the telecommunication spaces. Do not cover the fire stamp on the backboard.

2.3.2 Equipment Support Frame

Provide in accordance with [ECA EIA/ECA 310](#) and [UL 50](#).

- b. Racks, floor mounted modular type, 16 gauge steel or 11 gauge aluminum construction, minimum, treated to resist corrosion. Provide rack with vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug. Rack shall be compatible with 19 inches panel mounting.

2.3.3 Connector Blocks

Provide insulation displacement connector (IDC) Type 110 for Category 5e and higher systems. Provide blocks for the number of horizontal and backbone cables terminated on the block plus 25 percent spare.

2.3.4 Cable Guides

Provide cable guides specifically manufactured for the purpose of routing

cables, wires and patch cords horizontally and vertically on 19 / 23 inches equipment racks and telecommunications backboards. Cable guides of ring or bracket type devices mounted on rack panels, backboard for horizontal cable management and individually mounted for vertical cable management. Mount cable guides with screws, and / or nuts and lockwashers.

2.3.5 Optical Fiber Distribution Panel

Rack mounted optical fiber distribution panel (OFDP) shall be constructed in accordance with ECA EIA/ECA 310 utilizing 16 gauge steel or 11 gauge aluminum minimum. Panel shall be divided into two sections, distribution and user. Distribution section shall have strain relief, routing guides, splice tray and shall be lockable, user section shall have a cover for patch cord protection. Each panel shall provide single-mode pigtails and adapters. Provide adapters as duplex SC with zirconia ceramic alignment sleeves. Provide dust covers for adapters. Provide patch cords as specified in the paragraph PATCH PANELS.

2.4 GROUNDING AND BONDING PRODUCTS

Provide in accordance with UL 467, TIA J-STD-607, and NFPA 70. Components shall be identified as required by TIA/EIA-606. Provide ground rods, bonding conductors, and grounding busbars.

2.5 FIRESTOPPING MATERIAL

Provide as specified in Section 07 84 00, FIRESTOPPING.

2.6 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.7 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inches thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inches high normal block style.

2.8 TESTS, INSPECTIONS, AND VERIFICATIONS

2.8.1 Factory Reel Tests

Provide documentation of the testing and verification actions taken by manufacturer to confirm compliance with TIA-526-7 for single mode optical fiber cables.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Service Entrance Conduit, Underground

Provide service entrance underground as specified in Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

3.1.2 Telecommunications Space Termination

Install termination hardware required for optical fiber system. An insulation displacement tool shall be used for terminating copper cable to insulation displacement connectors.

3.1.2.1 Connector Blocks

Connector blocks shall be wall mounted in orderly rows and columns. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks. Install in accordance with industry standard wire routing guides in accordance with TIA-569.

3.1.2.2 Patch Panels

Patch panels shall be mounted in equipment racks with sufficient ports to accommodate the installed cable plant.

- a. Fiber Optic Patch Panel. Fiber optic cable loop shall be 3 feet in length provided as recommended by the manufacturer. The outer jacket of each cable entering a patch panel shall be secured to the panel to prevent movement of the fibers within the panel, using clamps or brackets specifically manufactured for that purpose.

3.1.2.3 Equipment Support Frames

Install in accordance with TIA-569:

- a. Racks, floor mounted modular type. Permanently anchor rack to the floor in accordance with manufacturer's recommendations.

3.1.3 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings as specified in Section 07 84 00, FIRESTOPPING.

3.1.4 Grounding and Bonding

Provide in accordance with TIA J-STD-607, NFPA 70.

3.2 LABELING

3.2.1 Labels

Provide labeling in accordance with TIA/EIA-606. Handwritten labeling is unacceptable. Stenciled lettering for voice and data circuits shall be provided using thermal ink transfer process.

3.2.2 Cable

Cables shall be labeled using color labels on both ends with identifiers in accordance with TIA/EIA-606.

3.2.3 Termination Hardware

Workstation outlets and patch panel connections shall be labeled using color coded labels with identifiers in accordance with TIA/EIA-606.

3.3 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.4 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

-- End of Section --

SECTION 31 00 00

EARTHWORK
08/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO T 180 (2010) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

AASHTO T 224 (2010) Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600 (2010) Installation of Ductile-Iron Water Mains and Their Appurtenances

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2010) Structural Welding Code - Steel

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C2 (2003) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes

AWPA P5 (2009) Standard for Waterborne Preservatives

ASTM INTERNATIONAL (ASTM)

ASTM A139/A139M (2004; R 2010) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)

ASTM A252 (2010) Standard Specification for Welded and Seamless Steel Pipe Piles

ASTM C 136 (2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

ASTM C 33/C 33M (2011) Standard Specification for Concrete Aggregates

ASTM D 1140	(2000; R 2006) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2009) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³) (2700 kN-m/m ³)
ASTM D 2167	(2008) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(2010) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2937	(2010) Density of Soil in Place by the Drive-Cylinder Method
ASTM D 422	(1963; R 2007) Particle-Size Analysis of Soils
ASTM D 4318	(2010) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D 698	(2007e1) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes
EPA SW-846.3-3	(1999, Third Edition, Update III-A) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods

1.2 DEFINITIONS

1.2.1 Satisfactory Materials

Satisfactory materials comprise any materials classified by [ASTM D 2487](#) as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SM, SW-SM, SC, SW-SC, SP-SM, SP-SC, CL, ML, CL-ML, . Satisfactory materials for grading comprise stones less than **8 inches**, except for fill material for pavements and railroads which comprise stones less than **3 inches** in any dimension.

1.2.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. Notify the Contracting Officer when encountering any contaminated materials.

1.2.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in [ASTM D 2487](#) as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Perform testing, required for classifying materials, in accordance with [ASTM D 4318](#), [ASTM C 136](#), [ASTM D 422](#), and [ASTM D 1140](#).

1.2.4 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in [ASTM D 1557](#) abbreviated as a percent of laboratory maximum density. Since [ASTM D 1557](#) applies only to soils that have 30 percent or less by weight of their particles retained on the [3/4 inch](#) sieve, express the degree of compaction for material having more than 30 percent by weight of their particles retained on the [3/4 inch](#) sieve as a percentage of the maximum density in accordance with [AASHTO T 180](#) and corrected with [AASHTO T 224](#). To maintain the same percentage of coarse material, use the "remove and replace" procedure as described in NOTE 8 of Paragraph 7.2 in [AASHTO T 180](#).

1.2.5 Topsoil

Material suitable for topsoils obtained from offsite areas and excavations is defined as: Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than [one inch](#) diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

1.2.6 Hard/Unyielding Materials

Hard/Unyielding materials comprise weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" with stones greater than [3 inch](#) in any dimension or as defined by the pipe manufacturer, whichever is smaller. These materials usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.2.7 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding [1/2 cubic yard](#) in volume. Removal of hard material will not be considered rock excavation

because of intermittent drilling and blasting that is performed merely to increase production.

1.2.8 Unstable Material

Unstable materials are too wet to properly support the utility pipe, conduit, or appurtenant structure.

1.2.9 Select Granular Material

1.2.9.1 General Requirements

Select granular material consist of materials classified as GW, GP, SW, SP, or by [ASTM D 2487](#) where indicated. The liquid limit of such material must not exceed 35 percent when tested in accordance with [ASTM D 4318](#). The plasticity index must not be greater than 12 percent when tested in accordance with [ASTM D 4318](#), and not more than 35 percent by weight may be finer than No. 200 sieve when tested in accordance with [ASTM D 1140](#).

1.2.10 Initial Backfill Material

Initial backfill consists of select granular material or satisfactory materials free from rocks 3 inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, free the initial backfill material of stones larger than 3 inches in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

1.2.11 Expansive Soils

Expansive soils are defined as soils that have a plasticity index equal to or greater than 13% when tested in accordance with [ASTM D 4318](#).

1.3 SYSTEM DESCRIPTION

Subsurface soil boring logs are shown on the drawings . These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.3.1 Classification of Excavation

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

1.3.1.1 Common Excavation

Include common excavation with the satisfactory removal and disposal of all materials not classified as rock excavation.

1.3.1.2 Rock Excavation

Include rock excavation with blasting, excavating, grading, disposing of material classified as rock, and the satisfactory removal and disposal of boulders 1/2 cubic yard or more in volume; solid rock; rock material that is in ledges, bedded deposits, and unstratified masses, which cannot be removed without systematic drilling and blasting; firmly cemented conglomerate deposits possessing the characteristics of solid rock impossible to remove without systematic drilling and blasting; and hard materials (see Definitions). Include the removal of any concrete or

masonry structures, except pavements, exceeding 1/2 cubic yard in volume that may be encountered in the work in this classification. If at any time during excavation, including excavation from borrow areas, the Contractor encounters material that may be classified as rock excavation, uncover such material and notify the Contracting Officer. Do not proceed with the excavation of this material until the Contracting Officer has classified the materials as common excavation or rock excavation and has taken cross sections as required. Failure on the part of the Contractor to uncover such material, notify the Contracting Officer, and allow ample time for classification and cross sectioning of the undisturbed surface of such material will cause the forfeiture of the Contractor's right of claim to any classification or volume of material to be paid for other than that allowed by the Contracting Officer for the areas of work in which such deposits occur.

1.3.2 Blasting

Blasting will not be permitted.

1.3.3 Dewatering Work Plan

Submit procedures for accomplishing dewatering work.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Shoring; G

Dewatering Work Plan; G

Blasting; G

Submit 15 days prior to starting work.

SD-03 Product Data

Utilization of Excavated Materials; G

Rock Excavation

Opening of any Excavation or Borrow Pit

Shoulder Construction

Procedure and location for disposal of unused satisfactory material. Proposed source of borrow material. Notification of encountering rock in the project. Advance notice on the opening of excavation or borrow areas. Advance notice on shoulder construction for rigid pavements.

SD-06 Test Reports

Testing

Borrow Site Testing

Within 24 hours of conclusion of physical tests, 5 copies of test results, including calibration curves and results of calibration tests. Results of testing at the borrow site.

SD-07 Certificates

Testing

Qualifications of the Corps validated commercial testing laboratory or the Contractor's validated testing facilities.

PART 2 PRODUCTS

2.1 REQUIREMENTS FOR OFFSITE SOILS

Test offsite soils brought in for use as backfill for Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and full Toxicity Characteristic Leaching Procedure (TCLP) including ignitability, corrosivity and reactivity. Backfill shall contain a maximum of 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and a maximum of 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall pass the TCPL test. Determine TPH concentrations by using EPA 600/4-79/020 Method 418.1. Determine BTEX concentrations by using EPA SW-846.3-3 Method 5030/8020. Perform TCLP in accordance with EPA SW-846.3-3 Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Do not bring material onsite until tests have been approved by the Contracting Officer.

2.2 BURIED WARNING AND IDENTIFICATION TAPE

Provide metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inches minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Provide permanent color and printing, unaffected by moisture or soil.

Warning Tape Color Codes

Red:	Electric
Yellow:	Gas, Oil; Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Water Systems
Green:	Sewer Systems
White:	Steam Systems
Gray:	Compressed Air

2.2.1 Warning Tape for Metallic Piping

Provide acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.003 inch and a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.2.2 Detectable Warning Tape for Non-Metallic Piping

Provide polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.004 inch, and a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Manufacture tape with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.3 DETECTION WIRE FOR NON-METALLIC PIPING

Insulate a single strand, solid copper detection wire with a minimum of 12 AWG.

2.4 MATERIAL FOR RIP-RAP

Provide Filter fabric and rock conforming to Kentucky DOT for construction indicated.

2.4.1 Bedding Material

Provide bedding material consisting of sand, gravel, or crushed rock, well graded, with a maximum particle size of 2 inches. Compose material of tough, durable particles. Allow fines passing the No. 200 standard sieve with a plasticity index less than six.

2.4.2 Grout

Provide durable grout composed of cement, water, an air-entraining admixture, and sand mixed in proportions of one part portland cement to two parts of sand, sufficient water to produce a workable mixture, and an amount of admixture which will entrain sufficient air, as determined by the Contracting Officer. Mix grout in a concrete mixer. Allow a sufficient mixing time to produce a mixture having a consistency permitting gravity flow into the interstices of the rip-rap with limited spading and brooming.

2.4.3 Rock

Provide rock fragments sufficiently durable to ensure permanence in the structure and the environment in which it is to be used. Use rock fragments free from cracks, seams, and other defects that would increase the risk of deterioration from natural causes. Provide fragments sized so that no individual fragment exceeds a weight of 150 pounds and that no more than 10 percent of the mixture, by weight, consists of fragments weighing 2 pounds or less each. Provide rock with a minimum specific gravity of 2.50. Do not permit the inclusion of more than trace 1 percent quantities of dirt, sand, clay, and rock fines.

2.5 CAPILLARY WATER BARRIER

Provide capillary water barrier of clean, poorly graded crushed rock, crushed gravel, or uncrushed gravel placed beneath a building slab with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below. Conform to ASTM C 33/C 33M for fine aggregate grading with a maximum of 3 percent by weight passing ASTM D 1140, No. 200 sieve, or coarse aggregate Size 57, 67, or 77.

2.6 PIPE CASING

2.6.1 Casing Pipe

ASTM A139/A139M, Grade B, or ASTM A252, Grade 2, smooth wall pipe. Match casing size to the outside diameter and wall thickness as indicated. Protective coating is not required on casing pipe.

2.6.2 Wood Supports

Treated Yellow Pine or Douglas Fir, rough, structural grade. Provide wood with nonleaching water-borne pressure preservative (ACA or CCA) and treatment conforming to AWPA P5 and AWPA C2, respectively. Secure wood supports to carrier pipe with stainless steel or zinc-coated steel bands.

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Where indicated or directed, strip topsoil to a depth of 4 inches. Spread topsoil on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inches in diameter, and other materials that would interfere with planting and maintenance operations. Stockpile in approved locations any surplus of topsoil from excavations and gradings.

3.2 GENERAL EXCAVATION

Perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Perform the grading in accordance with the typical sections shown and the tolerances specified in paragraph FINISHING. Transport satisfactory excavated materials and place in fill or embankment within the limits of the work. Excavate unsatisfactory materials encountered within the limits of the work below grade and replace with satisfactory materials as directed. Include such excavated material and the satisfactory material ordered as replacement in excavation. Dispose surplus satisfactory excavated material not required for fill or embankment in areas approved for surplus material storage or designated waste areas. Dispose unsatisfactory excavated material in designated waste or spoil areas. During construction, perform excavation and fill in a manner and sequence that will provide proper drainage at all times. Excavate material required for fill or embankment in excess of that produced by excavation within the grading limits from the borrow areas indicated or from other approved areas selected by the Contractor as specified.

3.2.1 Ditches, Gutters, and Channel Changes

Finish excavation of ditches, gutters, and channel changes by cutting accurately to the cross sections, grades, and elevations shown on the drawings. Do not excavate ditches and gutters below grades shown. Backfill the excessive open ditch or gutter excavation with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Dispose excavated material as shown or as directed, except in no case allow material be deposited a maximum 4 feet from edge of a ditch. Maintain excavations free from detrimental quantities of leaves, brush,

sticks, trash, and other debris until final acceptance of the work.

3.2.2 Drainage Structures

Make excavations to the lines, grades, and elevations shown, or as directed. Provide trenches and foundation pits of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Clean rock or other hard foundation material of loose debris and cut to a firm, level, stepped, or serrated surface. Remove loose disintegrated rock and thin strata. Do not disturb the bottom of the excavation when concrete or masonry is to be placed in an excavated area. Do not excavate to the final grade level until just before the concrete or masonry is to be placed. Where pile foundations are to be used, stop the excavation of each pit at an elevation **1 foot** above the base of the footing, as specified, before piles are driven. After the pile driving has been completed, remove loose and displaced material and complete excavation, leaving a smooth, solid, undisturbed surface to receive the concrete or masonry.

3.2.3 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. Construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

3.2.4 Dewatering

Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. Do not permit French drains, sumps, ditches or trenches within **3 feet** of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Take control measures by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, maintain the water level continuously, at least **2 feet** below the working level. Operate dewatering system continuously until construction work below existing water levels is complete. Submit performance records weekly.

3.2.5 Trench Excavation Requirements

Excavate the trench as recommended by the manufacturer of the pipe to be installed. Slope trench walls below the top of the pipe, or make vertical, and of such width as recommended in the manufacturer's printed installation manual. Provide vertical trench walls where no manufacturer's printed installation manual is available. Shore trench walls as necessary to meet OSHA requirements. Excavate trench walls which are cut back to at least

the angle of repose of the soil. Give special attention to slopes which may be adversely affected by weather or moisture content. Do not exceed the trench width below the pipe top of **24 inches** plus pipe outside diameter (O.D.) for pipes of less than **24 inches** inside diameter, and do not exceed **36 inches** plus pipe outside diameter for sizes larger than **24 inches** inside diameter. Where recommended trench widths are exceeded, provide redesign, stronger pipe, or special installation procedures by the Contractor. The Contractor is responsible for the cost of redesign, stronger pipe, or special installation procedures without any additional cost to the Government.

3.2.5.1 Bottom Preparation

Grade the bottoms of trenches accurately to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Excavate bell holes to the necessary size at each joint or coupling to eliminate point bearing. Remove stones of **1 inch** or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, to avoid point bearing.

3.2.5.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, remove such material **6 inch** below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.2.5.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, remove such material to the depth directed and replace it to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the Contractor is responsible for excavating the resulting material and replacing it without additional cost to the Government.

3.2.5.4 Excavation for Appurtenances

Provide excavation for manholes, catch-basins, inlets, or similar structures sufficient to leave at least **12 inches** clear between the outer structure surfaces and the face of the excavation or support members. Clean rock or loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Remove loose disintegrated rock and thin strata. Specify removal of unstable material. When concrete or masonry is to be placed in an excavated area, take special care not to disturb the bottom of the excavation. Do not excavate to the final grade level until just before the concrete or masonry is to be placed.

3.2.5.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, provide excavation by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

3.2.6 Underground Utilities

The Contractor is responsible for movement of construction machinery and equipment over pipes and utilities during construction. Perform work

adjacent to non-Government utilities as indicated in accordance with procedures outlined by utility company. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

3.2.7 Structural Excavation

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement. Excavate to bottom of pile cap prior to placing or driving piles, unless authorized otherwise by the Contracting Officer. Backfill and compact over excavations and changes in grade due to pile driving operations to 95 percent of [ASTM D 698](#) maximum density.

3.3 SELECTION OF BORROW MATERIAL

Select borrow material to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Obtain borrow material from the borrow areas within the limits of the project site, selected by the Contractor or from approved private sources. Unless otherwise provided in the contract, the Contractor is responsible for obtaining the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling from the owners. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specifically provided, do not obtain borrow within the limits of the project site without prior written approval. Consider necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon related operations to the borrow excavation.

3.4 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS

Notify the Contracting Officer sufficiently in advance of the [opening of any excavation or borrow pit](#) to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, [excavate borrow pits and other](#) excavation areas providing adequate drainage. Transport overburden and other spoil material to designated spoil areas or otherwise dispose of as directed. [Provide neatly trimmed and drained borrow pits after the excavation is completed.](#) Ensure that excavation of any area, [operation of borrow pits](#), or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.5 SHORING

3.5.1 General Requirements

Submit a Shoring and Sheet piling plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheet piling of excavations. Finish shoring, including sheet piling, and install as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Remove shoring, bracing, and sheet piling as excavations are backfilled, in a manner to prevent caving.

3.5.2 Geotechnical Engineer

Hire a Professional Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer is responsible for performing pre-construction and

periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer is responsible for updating the excavation, sheeting and dewatering plans as construction progresses to reflect changing conditions and submit an updated plan if necessary. Submit a monthly written report, informing the Contractor and Contracting Officer of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. The Contracting Officer is responsible for arranging meetings with the Geotechnical Engineer at any time throughout the contract duration.

3.6 GRADING AREAS

Where indicated, divide work into grading areas within which satisfactory excavated material will be placed in embankments, fills, and required backfills. Do not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing. Place and grade stockpiles of satisfactory and unsatisfactory and wasted materials as specified. Keep stockpiles in a neat and well drained condition, giving due consideration to drainage at all times. Clear, grub, and seal by rubber-tired equipment, the ground surface at stockpile locations; separately stockpile excavated satisfactory and unsatisfactory materials. Protect stockpiles of satisfactory materials from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, remove and replace such material with satisfactory material from approved sources.

3.7 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Do not excavate to final grade until just before concrete is to be placed. Only use excavation methods that will leave the foundation rock in a solid and unshattered condition. Roughen the level surfaces, and cut the sloped surfaces, as indicated, into rough steps or benches to provide a satisfactory bond. Protect shales from slaking and all surfaces from erosion resulting from ponding or water flow.

3.8 GROUND SURFACE PREPARATION

3.8.1 General Requirements

Remove and replace unsatisfactory material with satisfactory materials, as directed by the Contracting Officer, in surfaces to receive fill or in excavated areas. Scarify the surface to a depth of 6 inches before the fill is started. Plow, step, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that the fill material will bond with the existing material. When subgrades are less than the specified density, break up the ground surface to a minimum depth of 6 inches, pulverizing, and compacting to the specified density. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion to a depth of 12 inches and compact it as specified for the adjacent fill.

3.8.2 Frozen Material

Do not place material on surfaces that are muddy, frozen, or contain frost. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Moisten material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction

with the equipment used.

3.9 UTILIZATION OF EXCAVATED MATERIALS

Dispose unsatisfactory materials removing from excavations into designated waste disposal or spoil areas. Use satisfactory material removed from excavations, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. Do not waste any satisfactory excavated material without specific written authorization. Dispose of satisfactory material, authorized to be wasted, in designated areas approved for surplus material storage or designated waste areas as directed. Clear and grub newly designated waste areas on Government-controlled land before disposal of waste material thereon. Stockpile and use coarse rock from excavations for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. Do not dispose excavated material to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

3.10 BURIED TAPE AND DETECTION WIRE

3.10.1 Buried Warning and Identification Tape

Provide buried utility lines with utility identification tape. Bury tape **12 inches** below finished grade; under pavements and slabs, bury tape **6 inches** below top of subgrade.

3.10.2 Buried Detection Wire

Bury detection wire directly above non-metallic piping at a distance not to exceed **12 inches** above the top of pipe. Extend the wire continuously and unbroken, from manhole to manhole. Terminate the ends of the wire inside the manholes at each end of the pipe, with a minimum of **3 feet** of wire, coiled, remaining accessible in each manhole. Furnish insulated wire over it's entire length. Install wires at manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, terminate the wire in the valve pit at the pump station end of the pipe.

3.11 BACKFILLING AND COMPACTION

Place backfill adjacent to any and all types of structures, and compact to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials, to prevent wedging action or eccentric loading upon or against the structure. Prepare ground surface on which backfill is to be placed and provide compaction requirements for backfill materials in conformance with the applicable portions of paragraphs GROUND SURFACE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.11.1 Trench Backfill

Backfill trenches to the grade shown.

3.11.1.1 Replacement of Unyielding Material

Replace unyielding material removed from the bottom of the trench with

select granular material or initial backfill material.

3.11.1.2 Replacement of Unstable Material

Replace unstable material removed from the bottom of the trench or excavation with select granular material placed in layers not exceeding 6 inches loose thickness.

3.11.1.3 Bedding and Initial Backfill

Provide bedding of the type and thickness shown. Place initial backfill material and compact it with approved tampers to a height of at least one foot above the utility pipe or conduit. Bring up the backfill evenly on both sides of the pipe for the full length of the pipe. Take care to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Compact backfill to top of pipe to 95 percent of ASTM D 698 maximum density. Provide plastic piping with bedding to spring line of pipe. Provide materials as follows:

- a. Class I: Angular, 0.25 to 1.5 inch, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.
- b. Class II: Coarse sands and gravels with maximum particle size of 1.5 inch, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D 2487.
- c. Clean, coarse-grained sand classified as in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL.
- d. Clean, coarsely graded natural gravel, crushed stone or a combination thereof identified as in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL, or having a classification of GW or GP in accordance with ASTM D 2487 for as indicated. Do not exceed maximum particle size of 3 inches.

3.11.1.4 Final Backfill

Fill the remainder of the trench, except for special materials for roadways, railroads and airfields, with satisfactory material. Place backfill material and compact as follows:

- a. Roadways, Railroads, and Airfields: Place backfill up to the required elevation as specified. Do not permit water flooding or jetting methods of compaction.
- b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Deposit backfill in layers of a maximum of 12 inches loose thickness, and compact it to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Apply this requirement to all other areas not specifically designated above.

3.11.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been

constructed and the concrete has been allowed to cure for 5 days, place backfill in such a manner that the structure is not be damaged by the shock of falling earth. Deposit the backfill material, compact it as specified for final backfill, and bring up the backfill evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.12 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.12.1 Gas Distribution

Excavate trenches to a depth that will provide a minimum 18 inches of cover in rock excavation and a minimum 24 inch of cover in other excavation.

3.12.2 Water Lines

Excavate trenches to a depth that provides a minimum cover of 3 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

3.12.3 Heat Distribution System

Free initial backfill material of stones larger than 1/4 inch in any dimension.

3.12.4 Electrical Distribution System

Provide a minimum cover of 24 inches from the finished grade to direct burial cable and conduit or duct line, unless otherwise indicated.

3.12.5 Sewage Absorption Trenches or Pits

3.12.5.1 Porous Fill

Provide backfill material consisting of clean crushed rock or gravel having a gradation conforming to the requirements of gradation No. 4 for coarse aggregate in ASTM C 33/C 33M.

3.12.5.2 Cover

Filter fabric as indicated.

3.12.6 Pipeline Casing

Provide new smooth wall steel pipeline casing under existing pavement by the boring and jacking method of installation. Provide each new pipeline casing, where indicated and to the lengths and dimensions shown, complete and suitable for use with the new piped utility as indicated. Install pipeline casing by dry boring and jacking method as follows:

3.12.6.1 Bore Holes

Mechanically bore holes and case through the soil with a cutting head on a continuous auger mounted inside the casing pipe. Weld lengths of pipe together in accordance with AWS D1.1/D1.1M. Do not use water or other fluids in connection with the boring operation.

3.12.6.2 Cleaning

Clean inside of the pipeline casing of dirt, weld splatters, and other foreign matter which would interfere with insertion of the piped utilities by attaching a pipe cleaning plug to the boring rig and passing it through the pipe.

3.12.6.3 End Seals

After installation of piped utilities in pipeline casing, provide watertight end seals at each end of pipeline casing between pipeline casing and piping utilities. Provide watertight segmented elastomeric end seals.

3.12.7 Rip-Rap Construction

Construct rip-rap on filter fabric in accordance with Kentucky DOT State Standard in the areas indicated. Trim and dress indicated areas to conform to cross sections, lines and grades shown within a tolerance of 0.1 foot.

3.12.7.1 Bedding Placement

Spread filter fabric bedding material uniformly to a thickness of at least 3 inches on prepared subgrade as indicated. Compaction of bedding is not required. Finish bedding to present even surface free from mounds and windrows.

3.12.7.2 Stone Placement

Place rock for rip-rap on prepared bedding material to produce a well graded mass with the minimum practicable percentage of voids in conformance with lines and grades indicated. Distribute larger rock fragments, with dimensions extending the full depth of the rip-rap throughout the entire mass and eliminate "pockets" of small rock fragments. Rearrange individual pieces by mechanical equipment or by hand as necessary to obtain the distribution of fragment sizes specified above.

3.12.7.3 Grouting

3.13 EMBANKMENTS

3.13.1 Earth Embankments

Construct earth embankments from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 3 inches. Place the material in successive horizontal layers of loose material not more than 12 inches in depth. Spread each layer uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, plow, disk, or otherwise break up each layer; moisten or aerate as necessary; thoroughly mix; and compact to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements are identical with those requirements specified in paragraph SUBGRADE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.14 SUBGRADE PREPARATION

3.14.1 Proof Rolling

Finish proof rolling on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After stripping, proof roll the existing subgrade of the apron with six passes of a dump truck loaded with 4 cubic yards of soil. Operate the truck in a systematic manner to ensure the number of passes over all areas, and at speeds between 2-1/2 to 3-1/2 mph. When proof rolling, provide one-half of the passes made with the roller in a direction perpendicular to the other passes. Notify the Contracting Officer a minimum of 3 days prior to proof rolling. Perform proof rolling in the presence of the Contracting Officer. Undercut rutting or pumping of material as directed by the Contracting Officer and replace with fill and backfill material.

3.14.2 Construction

Shape subgrade to line, grade, and cross section, and compact as specified. Include plowing, disking, and any moistening or aerating required to obtain specified compaction for this operation. Remove soft or otherwise unsatisfactory material and replace with satisfactory excavated material or other approved material as directed. Excavate rock encountered in the cut section to a depth of 6 inches below finished grade for the subgrade. Bring up low areas resulting from removal of unsatisfactory material or excavation of rock to required grade with satisfactory materials, and shape the entire subgrade to line, grade, and cross section and compact as specified. After rolling, the surface of the subgrade for roadways shall not show deviations greater than 1/2 inch when tested with a 12-foot straightedge applied both parallel and at right angles to the centerline of the area. After rolling, do not show deviations for the surface of the subgrade for airfields greater than 1/2 inch when tested with a 16 foot straightedge applied both parallel and at right angles to the centerline of the area. Do not vary the elevation of the finish subgrade more than 0.05 foot from the established grade and cross section.

3.14.3 Compaction

Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas and railroads, compact each layer of the embankment to at least 95 percent of laboratory maximum density.

3.14.3.1 Subgrade for Railroads

Compact subgrade for railroads to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials.

3.14.3.2 Subgrade for Pavements

Compact subgrade for pavements to at least 95 percentage laboratory maximum density for the depth below the surface of the pavement shown. When more than one soil classification is present in the subgrade, thoroughly blend, reshape, and compact the top 6 inch of subgrade.

3.14.3.3 Subgrade for Shoulders

Compact subgrade for shoulders to at least 90 percentage laboratory maximum density for the full depth of the shoulder.

3.14.3.4 Subgrade for Airfield Pavements

Compact top 24 inches below finished pavement or top 12 inches of subgrades, whichever is greater, to 100 percent of ASTM D 1557; compact fill and backfill material to 100 percent of ASTM D 1557.

3.15 SHOULDER CONSTRUCTION

Construct shoulders of satisfactory excavated or borrow material or as otherwise shown or specified. Construct shoulders immediately after adjacent paving is complete. In the case of rigid pavements, do not construct shoulders until permission of the Contracting Officer has been obtained. Compact the entire shoulder area to at least the percentage of maximum density as specified in paragraph SUBGRADE PREPARATION above, for specific ranges of depth below the surface of the shoulder. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Finish shoulder construction in proper sequence in such a manner that adjacent ditches will be drained effectively and that no damage of any kind is done to the adjacent completed pavement. Align the completed shoulders true to grade and shaped to drain in conformity with the cross section shown.

3.16 FINISHING

Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. Provide the degree of finish for graded areas within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades specified in paragraph SUBGRADE PREPARATION. Finish gutters and ditches in a manner that will result in effective drainage. Finish the surface of areas to be turfed from settlement or washing to a smoothness suitable for the application of turfing materials. Repair graded, topsoiled, or backfilled areas prior to acceptance of the work, and re-established grades to the required elevations and slopes.

3.16.1 Subgrade and Embankments

During construction, keep embankments and excavations shaped and drained. Maintain ditches and drains along subgrade to drain effectively at all times. Do not disturb the finished subgrade by traffic or other operation. Protect and maintain the finished subgrade in a satisfactory condition until ballast, subbase, base, or pavement is placed. Do not permit the storage or stockpiling of materials on the finished subgrade. Do not lay subbase, base course, ballast, or pavement until the subgrade has been checked and approved, and in no case place subbase, base, surfacing, pavement, or ballast on a muddy, spongy, or frozen subgrade.

3.16.2 Capillary Water Barrier

Place a capillary water barrier under concrete floor and area-way slabs grade directly on the subgrade and compact with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.16.3 Grading Around Structures

Construct areas within 5 feet outside of each building and structure line true-to-grade, shape to drain, and maintain free of trash and debris until final inspection has been completed and the work has been accepted.

3.17 PLACING TOPSOIL

On areas to receive topsoil, prepare the compacted subgrade soil to a 2 inches depth for bonding of topsoil with subsoil. Spread topsoil evenly to a thickness of 4 inch and grade to the elevations and slopes shown. Do not spread topsoil when frozen or excessively wet or dry. Obtain material required for topsoil in excess of that produced by excavation within the grading limits from areas indicated.

3.18 TESTING

Perform testing by a Corps validated commercial testing laboratory or the Contractor's validated testing facility. If the Contractor elects to establish testing facilities, do not permit work requiring testing until the Contractor's facilities have been inspected, Corps validated and approved by the Contracting Officer. Determine field in-place density in accordance with ASTM D 2167. ASTM D 2937, use the Drive Cylinder Method only for soft, fine-grained, cohesive soils. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, remove the material, replace and recompact to meet specification requirements. Perform tests on recompacted areas to determine conformance with specification requirements. Appoint a registered professional civil engineer to certify inspections and test results. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

3.18.1 Fill and Backfill Material Gradation

One test per 1,000 cubic yards stockpiled or in-place source material. Determine gradation of fill and backfill material in accordance with ASTM C 136.

3.18.2 In-Place Densities

- a. One test per 200 linear feet, or fraction thereof, of each lift of embankment or backfill for airfields.

3.18.3 Check Tests on In-Place Densities

If ASTM D 6938 is used, check in-place densities by ASTM D 1556 as follows:

- a. One check test per lift for each 1,000 linear feet, or fraction thereof, of embankment or backfill for airfields.

3.18.4 Moisture Contents

In the stockpile, excavation, or borrow areas, perform a minimum of two tests per day per type of material or source of material being placed during stable weather conditions. During unstable weather, perform tests as dictated by local conditions and approved by the Contracting Officer.

3.18.5 Optimum Moisture and Laboratory Maximum Density

Perform tests for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 1,000 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.18.6 Tolerance Tests for Subgrades

Perform continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION during construction of the subgrades.

3.18.7 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to the finished grade surface, inspect the pipe to determine whether significant displacement has occurred. Conduct this inspection in the presence of the Contracting Officer. Inspect pipe sizes larger than 36 inches, while inspecting smaller diameter pipe by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgment of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, replace or repair the defects as directed at no additional cost to the Government.

3.19 DISPOSITION OF SURPLUS MATERIAL

Provide surplus material or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber as removed from Government property as directed by the Contracting Officer.

-- End of Section --

SECTION 31 11 00

CLEARING AND GRUBBING
08/08

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Nonsaleable Materials; G

Written permission to dispose of such products on private property shall be filed with the Contracting Officer.

SD-04 Samples

Tree wound paint
Herbicide

Samples in cans with manufacturer's label.

1.2 DELIVERY, STORAGE, AND HANDLING

Deliver materials to store at the site, and handle in a manner which will maintain the materials in their original manufactured or fabricated condition until ready for use.

PART 2 PRODUCTS

2.1 TREE WOUND PAINT

Bituminous based paint of standard manufacture specially formulated for tree wounds.

2.2 HERBICIDE

. Comply with Federal Insecticide, Fungicide, and Rodenticide Act (Title 7 U.S.C. Section 136) for requirements on Contractor's licensing, certification and record keeping. Contact the command Pest Control Coordinator prior to starting work.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Roads and Walks

Keep roads and walks free of dirt and debris at all times.

3.1.2 Trees, Shrubs, and Existing Facilities

Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.

3.1.3 Utility Lines

Protect existing utility lines that are indicated to remain from damage. Notify the Contracting Officer immediately of damage to or an encounter with an unknown existing utility line. The Contractor is responsible for the repairs of damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations. When utility lines which are to be removed are encountered within the area of operations, notify the Contracting Officer in ample time to minimize interruption of the service. Refer to Section 01 30 00, ADMINISTRATIVE REQUIREMENTS and Section 01 57 19.00 20, TEMPORARY ENVIRONMENTAL CONTROLS for additional utility protection.

3.2 CLEARING

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the areas to be cleared. Clearing shall also include the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct the work. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 1-1/2 inches or more in diameter and shall be trimmed of all branches the heights indicated or directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 1-1/2 inches in diameter shall be painted with an approved tree-wound paint. Apply herbicide in accordance with the manufacturer's label to the top surface of stumps designated not to be removed.

3.3 TREE REMOVAL

Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

3.4 PRUNING

Trim trees designated to be left standing within the cleared areas of dead branches 1 1/2 inches or more in diameter; and trim branches to heights and in a manner as indicated. Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branches. Paint cuts more than 1 1/4 inches in diameter with an approved tree wound paint.

3.5 GRUBBING

Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas. Material to be grubbed, together with logs and other organic or

metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

3.6 DISPOSAL OF MATERIALS

3.6.1 Saleable Timber

2. The Government shall, by separate contract, harvest all saleable timber from the project site. All remaining timber, limbs, tops, stumps, and debris shall be cleared and disposed of by the Contractor as specified.

3. All timber removed from the project site shall become the property of the Contractor. Reimburse the Government for the value of the timber (which the Government has appraised at \$[_____]). Submit payment to the Contracting Officer by cashier's or certified check in the amount of \$[_____], made payable to the U.S. Treasury. Payment shall be made within 30 days of the Notice to Proceed. The Contracting Officer shall deposit the check into the [_____] account.

4.

3.6.2 Nonsaleable Materials

Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, except for salable timber, shall be disposed of outside the limits of Government-controlled land at the Contractor's responsibility, except when otherwise directed in writing. Such directive will state the conditions covering the disposal of such products and will also state the areas in which they may be placed. Burn refuse to be burned at specified locations and in a manner to prevent damage to existing structures and appurtenances, construction in progress, trees, and other vegetation. Comply with all Federal and State laws and regulations and with reasonable practice relative to the building of fires. Burning or other disposal of refuse and debris and any accidental loss or damage attendant thereto shall be the Contractor's responsibility.

-- End of Section --

SECTION 31 21 13

RADON MITIGATION

08/11

PART 1 GENERAL

1.1 SUMMARY

Provide all work necessary to reduce and maintain radon concentration levels below 4.0 picoCuries per liter (pCi/L) in various buildings specified herein. Perform pre-mitigation diagnostic testing and analysis, provide mitigation system design and installation, and perform post-mitigation testing and monitoring for radon. Building floor plans and radon readings are provided in the RFP solicitation.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 210 (2007) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

ASTM INTERNATIONAL (ASTM)

ASTM C 920 (2011) Standard Specification for Elastomeric Joint Sealants

ASTM D 2665 (2010) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings

INTERNATIONAL CODE COUNCIL (ICC)

ICC IMC (2009) International Mechanical Code

ICC UMC (1997; Errata 2 & 3 1997) Uniform Mechanical Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2009) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011; TIA 11-1; Errata 2011) National Electrical Code

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1378 (1995) Thermoplastic Duct (PVC) Construction Manual, 2nd Edition

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 402-R-92-004	(1992) Indoor Radon and Radon Decay Product Measurement Device Protocols
EPA 402-R-92-014	(1993) Radon Measurement in Schools
EPA 402-R-93-003	(1993) Protocols for Radon and Radon Decay Product Measurements in Homes
EPA 402-R-93-078	(1993; R 1994) Radon Mitigation Standards
EPA 625-R-92-016	(1993; Am 1994) Radon Prevention in Design and Construction of Schools and Other Large Buildings
EPA 625-R-93-011	(1993) Radon Reduction Technique for Existing Detached Houses: Technical Guidance for Active Soil Depressurization Systems

1.3 DEFINITIONS

1.3.1 Design

Documents which include design drawings, design narrative (basis of design and calculations) and product data prepared and assembled by or under the direct supervision of a United States Environmental Protection Agency (USEPA) Radon Contractor Proficiency (RCP) listed mitigation contractor and State listed mitigation contractor and proposed by the Contractor to meet the contract requirements. Listing in the State of [Kentucky](#) is required.

1.3.2 Design Drawings

Documentation showing in graphic and quantitative form the extent, design, arrangement, location, relationships, and dimensions of the construction to be provided by the Contractor.

1.3.3 Designer

USEPA RCP listed mitigation contractor and State listed mitigation contractor associated with the Contractor who is responsible for the design and has the qualifications and experience specified. Listing in the State of [Kentucky](#) is required.

1.3.4 Long Term Radon Detectors

Alpha track, electret ion chamber, or approved equivalent. Devices capable of sensing and recording the presences of radon during a time period of 91 days to 12 months which when analyzed provide a numeric value, measured in [pCi/L](#), for radon concentrations during the time exposed.

1.3.5 Short Term Radon Detectors

Charcoal, electret ion chamber, or approved equivalent. Devices capable of sensing and recording the presences of radon during a time period of 48 hours to 90 days which when analyzed provide a numeric value, measured in [pCi/L](#), for radon concentrations during the time exposed.

1.3.6 Suction Hole

Location at which vacuum is created for sub-slab communication testing.

1.3.7 Suction Point

Vertical standpipe penetrating into the soil gas environment containing radon and serving as the conduit to exhaust radon gas to the atmosphere.

1.3.8 Test Hole

Location at which pressure readings are taken during sub-slab communication testing. Readings are used to evaluate potential effectiveness of a sub-slab depressurization system.

1.4 SYSTEM DESCRIPTION AND REQUIREMENTS

1.4.1 Performance Requirements

Radon mitigation systems shall reduce and maintain radon concentration levels below 4.0 pCi/L (148 Bq/cu m) in various buildings specified herein. Test, design and construct radon mitigation systems in accordance with EPA 402-R-93-078, EPA 402-R-93-003, EPA 402-R-92-004 and as specified herein. Additional guidance for testing, designing and constructing radon mitigation systems is contained in EPA 625-R-92-016 and EPA 625-R-93-011.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Radon mitigation systems; G, RO

Radon mitigation systems enclosures; G, RO

SD-03 Product Data

Radon mitigation systems components

Radon mitigation systems enclosure components

Radon diagnostic testing devices; G, RO

SD-05 Design Data

Radon mitigation systems design narrative; G, RO

SD-06 Test Reports

Post mitigation testing; G, RO

SD-07 Certificates

Contractor qualifications; G, RO

Contractor experience; G, RO

Worker protection plan; G, RO

SD-08 Manufacturer's Instructions

Radon mitigation systems components

Radon mitigation systems enclosure components

SD-10 Operation and Maintenance Data

Radon Mitigation Systems, Data Package 2; G, RO

Submit in accordance with Section 01 78 08.00 10 CLOSEOUT SUBMITTALS..

SD-11 Closeout Submittals

Radon Detector Location Log; G, RO

Testing laboratory certification; G, RO

Proof of current calibration for testing devices; G, RO

1.6 DESIGN REQUIREMENTS

Prepare designs in accordance with the requirements of EPA 402-R-93-078 except that when the contract specification requirements are more stringent, the contract specification shall take precedence. The Contractor shall:

- a. Prepare design drawings and assemble and provide product data for construction of multiple radon mitigation systems;
- b. Prepare design narrative supporting the design shown;
- c. Coordinate all elements of the design to ensure there are no conflicts;
- d. For each building, present information 100 percent complete in a single submission and in sufficient detail to permit a complete review by the Government. The Government's review is to check the design for conformance with the requirements contained in the contract documents. Design approval shall not be construed as a waiver from performing requirements contained in the contract which may have been omitted from the Contractor prepared design documents.
- e. Provide six copies of the complete design documents.

1.6.1 Design Drawing Requirements

Prepare, organize, and present drawings in the format considered standard industry practice for radon mitigation work and as described herein. Provide drawings complete, accurate and explicit enough to show compliance with the contract requirements and to permit construction. Drawings illustrating systems proposed to meet the requirements of the contract specification shall reflect proper detailing for each system to assure appropriate use, proper fit, compatibility of components and coordination

with the design narrative and the contract specification. Coordinate drawings to ensure there are no conflicts between design disciplines and between drawings and the contract specification. Title block shall be the same as that used in the project drawings provided in the project specification. Each Contractor prepared drawing shall bear the certification number and signature of the RCP listed individual responsible for the work portrayed on that drawing and proposed to meet the contract requirements.

1.6.1.1 Radon Mitigation Systems Enclosures (Format and Content)

Prepare drawings not smaller than 11 by 17 inches portraying the proposed method for enclosing each radon mitigation system in occupied spaces. All spaces shall be considered to be occupied spaces except for mechanical and electrical rooms, warehouses, storerooms, janitor closets, crawl spaces, and attic spaces. Enclosures are not required for portions of systems installed above suspended acoustical ceilings.

Drawings shall indicate methods and materials to be used in constructing the enclosures and accesses for all operating components. Drawings showing typical enclosures and installations are acceptable (i.e. corner installation, mid-wall installation, etc.).

1.6.2 Design Narrative

1.6.2.1 Format

The design narrative shall include a cover page indicating the project title, location, construction contract number and preparer, a table of contents and tabbed or colored page separations for quick reference. Submit design narrative prepared on 8 1/2 by 11 inch white paper. The design narrative shall be bound in one volume.

1.6.2.2 Content

The design narrative shall include a basis of design and calculations. Specific requirements relative to the technical content to be provided are specified in this specification section. The design narrative shall be a presentation of facts to demonstrate that the project requirements are fully understood and that the design is based on sound engineering. The design narrative shall include and address the following:

- a. Executive summary.
- b. Scope of work.
- c. Building description.
- d. Potential problems which may be caused by active (fan-powered) radon mitigation systems, if any.
- e. Conclusions and recommendations.
- f. Radon mitigation method chosen to reduce radon concentrations levels below 4.0 pCi/L (148 Bq/cu m) and reasons for choosing the method.
- g. Data and calculations to verify negative pressure exists throughout the soil gas environment containing radon sufficient to exhaust the soil gas to the atmosphere under all weather and building operating

conditions.

- h. Statement of compliance with applicable laws, ordinances, criteria, rules, and regulations of Federal, State, regional and local authorities regarding radon mitigation.
- i. Appendices (to include design drawings, forms and logs, laboratory analysis sheets, etc.).

1.6.3 Design Review and Approval

The design will be reviewed and approved by the Government prior to start of construction. The Government's review is to check the design for conformance with the contract requirements. Design approval does not relieve the Contractor of the responsibility of meeting the requirements of the contract and providing radon mitigation systems which, while active, reduce and maintain radon concentration levels below 4.0 pCi/L (148 Bq/cu m). The design of the radon mitigation systems and enclosures shall be approved prior to submission of construction submittals for the materials to be used in the construction of the systems and enclosures.

Contract completion time includes 30 days for review and approval of the design. Partial or incomplete design submissions will not be reviewed and will be immediately returned to the Contractor for completion and resubmission. Design submissions found to be not in compliance with the contract requirements will be returned to the Contractor for correction and resubmission. The Contractor shall make such modifications as may be necessary to bring the design into compliance at no change in contract price and schedule. Under either of these circumstances, the Government will have a 30-day review period adjusted to commence upon receipt of the revised design documents with no increase in the total contract completion time provided.

1.7 RADON DETECTOR LOCATION LOG

Prepare and provide to the Contracting Officer a Radon Detector Location Log for each building detailing the identity and location of each short term and long term radon detector. Prepare the log using copies of the "Device Placement Log" contained in EPA 402-R-92-014, and provide the appropriate information as line items. In addition to the log, on a copy of the building floor plans, locate and identify each short term and long term detector.

1.8 WORKER HEALTH AND SAFETY

Provide in accordance with EPA 402-R-93-078. Prepare a worker protection plan in accordance with EPA 402-R-93-078.

1.9 QUALITY ASSURANCE

1.9.1 Contractor Qualifications and Experience

Within 15 days after award, submit written evidence or data demonstrating that the Contractor and/or one or more subcontractors employed by the Contractor possess the qualifications and experience specified below.

1.9.1.1 Contractor Qualifications

The person responsible for diagnostic testing, design, construction and

on-site supervision, as required by the specifications, shall have successfully completed the requirements of and shall be maintaining a current listing in the USEPA RCP Program. Alternatively, in a State with legislation requiring mandatory credentialing for this work, compliance with the State legislation is acceptable. Evidence showing successful completion of the requirements of the USEPA National RCP Program shall include copy of current, valid USEPA RCP photo identification card or equivalent documentation issued by the State.

1.9.1.2 Contractor Experience

Submit written evidence demonstrating that the Contractor has successfully designed and installed at least two radon mitigation systems of the same or similar to the type required herein. Experience proof shall include but not be limited to:

- a. The contract name and number, completion dates of the project and the total cost of the project;
- b. The names, telephone numbers and fax number of the facility or installation for whom the radon mitigation system design, construction and/or testing were performed;
- c. The name, telephone number and fax number of a supervisory level point of contact at each facility or installation who has knowledge of the Contractor's performance.

1.9.2 Testing Laboratory

Submit [testing laboratory certification](#) as proof that the testing laboratory performing radon detector analysis has successfully completed the requirements of the USEPA Radon Measurement Proficiency (RMP) Program and is qualified and authorized to perform such analysis. Alternatively, in a State with legislation requiring mandatory credentialing for this work, compliance with the State legislation is acceptable.

1.9.3 Diagnostic Testing Equipment

Submit [proof of current calibration for testing devices](#) used in performing diagnostic testing.

1.9.4 On-Site Supervision

No work at the site will be permitted without the presence of a person possessing the qualifications specified elsewhere in this section, namely USEPA RCP listing or the State equivalent, where applicable .

1.10 DELIVERY, STORAGE AND HANDLING

1.10.1 Delivery of Products

Deliver materials to the site in an undamaged condition. Deliver proprietary items in manufacture's original unopened and undamaged containers of packages with manufacture's name and brand and other pertinent data such as specification number, type, and class, date of manufacture. Schedule deliveries of materials to coincide with scheduled installation.

1.10.2 Storage and Handling

Carefully store materials off the ground to provide proper ventilation, drainage and protection against weather and dampness. Protect materials from marring, staining, rust, damage and overload and from contaminants such as grease, oil and dirt. Store materials at temperatures recommended by the manufacturer. Handle material to avoid damage such as chipping and breaking. Replace damaged material.

1.11 PROJECT CONDITIONS

1.11.1 Project Drawings

Building floor plans are provided in [Appendix J of the RFP solicitation](#).

1.11.2 Existing Conditions

The [site has been tested for radon and test results are included in Appendix A of the RFP Solicitation](#).

PART 2 PRODUCTS

2.1 RADON MITIGATION SYSTEMS

2.1.1 System Performance

Radon mitigation systems shall reduce and maintain radon concentration levels below 4.0 pCi/L ([148 Bq/cu m](#)) after activation of the mitigation systems.

2.1.1.1 System Piping

Route radon mitigation systems piping so as not to interfere with the daily operations and functions of the building occupants. Keep visibility of the systems to a minimum. Enclose each radon mitigation system in occupied spaces, however, all operating components shall be accessible for maintenance and repair. All spaces shall be considered to be occupied spaces except for mechanical and electrical rooms, warehouses, storerooms, janitor closets, crawl spaces, and attic spaces. Enclosures are not required for portions of systems installed above suspended acoustical ceilings.

2.1.1.2 System Outlet Location

Mitigation system discharge points shall be as specified in [EPA 402-R-93-078](#). Prevent foreign objects from entering the outlet. Maintain water tight seal through all penetrations to the building exterior.

2.1.1.3 System Failure Warning Monitor

Provide a means to detect and announce each radon mitigation system failure. System failure is defined as:

- a. System blockage: foreign debris.
- b. Mechanical failure: fan or other mechanical failure.
- c. System leakage: pipe breakage or crack.

Provide an audio or visual annunciator device to indicate system failure and locate the annunciator device in an occupied space. Conform to the requirements of [EPA 402-R-93-078](#).

2.1.1.4 Air Cleaners

Air cleaners shall NOT be used as a radon reduction method.

2.1.1.5 Ventilation Devices

Devices which reduce radon solely by increasing ventilation to the occupied space shall NOT be used.

2.1.1.6 Back Drafting

Radon mitigation system shall NOT cause back drafting of building chimneys.

2.1.2 Radon Mitigation Systems Components

Mechanical and electrical materials, fabrication, construction and installation shall conform to the following industry standards:

- a. Poly(vinyl chloride) (PVC) Piping: [ASTM D 2665](#), Schedule 40.
- b. In-line Tubular Centrifugal Fans: [AMCA 210](#) and UL listed.
- c. Electrical Work: [NFPA 70](#), [NEMA MG 1](#) and [EPA 402-R-93-078](#), No. 12 AWG minimum wire size, solid copper installed in EMT or surface metal raceway.
- d. Mechanical Work: [ICC IMC](#), [ICC UMC](#), [SMACNA 1378](#) and [EPA 402-R-93-078](#).
- e. Sealants: [ASTM C 920](#), polyurethane, Type S, Grade P for horizontal application, Grade NS for vertical application, Class 25, Use T.
- f. Crawl space soil-gas retarder membrane shall be minimum 40 mils thick.

2.2 RADON MITIGATION SYSTEMS ENCLOSURES

[Radon mitigation systems enclosure components](#), materials, fabrication, construction and installation for concrete, wood studs and furring, metal studs and furring, gypsum wallboard, sealants and painting shall conform to the requirements specified in the respective specification sections addressing this work contained in the project specification.

PART 3 EXECUTION

3.1 RADON TESTING

Perform radon testing in accordance with [EPA 402-R-93-003](#) and [EPA 402-R-92-004](#). The Contractor shall arrange that all laboratory test results are sent from the testing laboratory directly to the Contracting Officer with one copy to the Contractor.

3.2 DESIGN RADON MITIGATION SYSTEMS AND SYSTEMS ENCLOSURES

Design radon mitigation systems as required to achieve radon detection test results below 4.0 pCi/L ([148 Bq/cu m](#)) based on radon diagnostic test results, [EPA 402-R-93-078](#) and the information provided herein. Design the

systems enclosures to accommodate the radon mitigation systems configurations and the adjacent or surrounding walls, partitions, ceilings and roof construction.

3.3 RADON MITIGATION SYSTEMS INSTALLATION

3.3.1 Installation

Provide radon mitigation systems as indicated in the approved design drawings, as specified in EPA 402-R-93-078 and as required by the specifications and standards referenced herein for the respective materials using workmen skilled in the trades involved. Install piping plumb and parallel to existing walls, partitions and ceilings as appropriate, slope horizontal runs to drain, and secure in place in a rigid and substantial manner.

Seal new and existing floor slab penetrations in accordance with EPA 402-R-93-078 and as specified herein. Prevent entry of soil gas into the building and exhausting of conditioned air via the radon mitigation system. Seal cracks and openings around floor slab penetrations with polyurethane sealant. Provide backer rod or comparable filler material as required. Insure that all penetrations to the building exterior are weathertight.

Lay work out in advance. Exercise care where cutting, channeling, chasing or drilling floors, walls, partitions, ceilings or other surfaces as necessary for proper installation, support or anchorage. Patch and repair damage to buildings, piping and equipment using workmen skilled in the trades involved.

Coordinate all work with the Contracting Officer.

3.3.2 Supervision

Installation of the radon mitigation systems shall be supervised by the RCP listed individual responsible for the design of the systems.

3.3.3 Electrical Work

NFPA 70 and EPA 402-R-93-078, No. 12 AWG minimum wire size, solid copper installed in EMT or surface metal raceway.

3.3.4 Mechanical Work

ICC IMC, ICC UMC, SMACNA 1378 and EPA 402-R-93-078.

3.3.5 System Identification

Label all components of the radon mitigation systems including, but not limited to, piping (every ten feet), enclosures, fans, electrical conduit (every ten feet) and circuit breakers. Labels shall read:

Radon Reduction System. Do Not Turn Off.
Public Works Office Phone _____

or as specified by the Contracting Officer.

3.4 RADON MITIGATION SYSTEM ENCLOSURES INSTALLATION

Provide enclosures as indicated in the approved design drawings and as required by the specifications and standards referenced herein for the respective materials using workmen skilled in the trades involved. Install enclosures plumb, level and parallel to existing walls, partitions and ceilings as appropriate, and secure in place in a rigid and substantial manner.

3.5 FIELD QUALITY CONTROL

3.5.1 Radon Mitigation System Inspection

Each system shall be inspected and approved in writing by the RCP listed individual responsible for the design of the system. Verify the presence of fire stops. Deficiencies shall be corrected by the Contractor at no additional cost to the Government.

3.5.2 Post Mitigation Testing and Monitoring

Perform post mitigation radon testing in the buildings as specified in EPA 402-R-93-078 and herein.

3.5.2.1 Short Term

Test each radon mitigation system for effectiveness no sooner than 24 hours nor later than 15 days after activation of the radon mitigation system. Provide short term radon detectors (charcoal, electret ion chamber or approved equivalent) at the rate of one detector per 2,000 square feet but not less than one detector per enclosed space, except for closets. On copies of the building floor plans, locate and identify each short term detector and provide short term detector data on copies of the "Device Placement Log" contained in EPA 402-R-92-014.

At the end of the testing period, the Contractor shall collect the detectors and send the detectors to the testing laboratory for analysis. Provide radon test results of the effectiveness of the mitigation systems not later than 30 days after collecting the detectors. Radon test results shall be sent from the testing laboratory directly to the Contracting Officer with one copy to the Contractor. Complete the line item information on the "Device Placement Log."

Radon test results above 4.0 pCi/L (148 Bq/cu m) shall require system redesign and installation modifications as necessary to achieve radon test results below 4.0 pCi/L (148 Bq/cu m). Submit design modifications to the Government for review and approval. After approval of the design modifications, provide installation modifications to the radon mitigation system and retest for effectiveness. Repeat this short term test procedure until test results below 4.0 pCi/L (148 Bq/cu m) are achieved.

System modifications (as-built systems installations) shall be reflected in the Contractor's design documents (drawings and design narrative).

3.5.2.2 Long Term

After acceptance of the radon mitigation systems, provide for long term testing (8 to 12 months). Provide long term radon detectors (alpha track, electret ion chamber or approved equivalent) at the rate of one detector per 2,000 square feet but not less than one detector per enclosed space,

except for closets. Locate and identify each detector on copies of the building floor plans and in the Radon Detector Location Log. After installing the detectors, furnish the completed detector documentation and mailers to the Contracting Officer.

At the end of the testing period, the Contracting Officer will collect and send the detectors to the testing laboratory for analysis. Radon test results shall be sent from the testing laboratory directly to the Contracting Officer with one copy to the Contractor.

Radon test results above 4.0 pCi/L ([148 Bq/cu m) shall require system redesign and installation modifications as necessary to achieve radon test results below 4.0 pCi/L (148 Bq/cu m). Submit design modifications to the Government for review and approval. After approval of the design modifications, provide installation modifications to the radon mitigation system and retest for effectiveness. Repeat the short term and long term test procedures specified herein until test results below 4.0 pCi/L (148 Bq/cu m) are achieved.

Final system modifications (as-built systems installations) shall be reflected in the Contractor's design documents (drawings and design narrative).

-- End of Section --

SECTION 31 31 16

SOIL TREATMENT FOR SUBTERRANEAN TERMITE CONTROL
08/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

7 USC Section 136

Federal Insecticide, Fungicide, and
Rodenticide Act

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Termiticide Application Plan; G

Termiticide application plan with proposed sequence of treatment work with dates and times. Include the termiticide trade name, EPA registration number, chemical composition, formulation, concentration of original and diluted material, application rate of active ingredients, method of application, area/volume treated, amount applied; and the name and state license number of the state certified applicator.

Termiticides

Manufacturer's label and Material Safety Data Sheet (MSDS) for termiticides proposed for use.

Foundation Exterior

Written verification that other site work will not disturb the treatment.

Utilities and Vents

Written verification that utilities and vents have been located.

Crawl and Plenum Air Spaces

Written verification that crawl spaces and plenum air spaces have been located.

Verification of Measurement

Written verification that the volume of termiticide used meets the application rate.

Application Equipment

A listing of equipment to be used.

Warranty

Copy of Contractor's warranty.

SD-04 Samples

Termiticides

Samples of the pesticides used in this work. The Contracting Officer may draw, at any time and without prior notice, from stocks at the job site; should analysis, performed by the Government, indicate such samples to contain less than the amount of active ingredient specified on the label, work performed with such products shall be repeated, with pesticides conforming to this specification, at no additional cost to the Government.

SD-06 Test Reports

Equipment Calibration and Tank Measurement

Certification of calibration tests conducted on the equipment used in the termiticide application.

Soil Moisture

Quality Assurance

Pest Management Report and copies of daily records signed by an officer of the Contractor.

SD-07 Certificates

Qualifications

1.3 QUALITY ASSURANCE

Comply with **7 USC Section 136** for requirements on Contractor's licensing, certification, and record keeping. Maintain daily records using Pest Management Maintenance Record, DD Form 1532-1 and submit copies of records when requested by the Contracting Officer. These forms may be obtained from the main web site:

<http://www.dtic.mil/whs/directives/infomgt/forms/ddforms1500-1999.htm>

Upon completion of this work, submit Pest Management Report DD Form 1532 identifying target pest, type of operation, brand name and manufacturer of pesticide, formulation, concentration or rate of application used.

1.3.1 Qualifications

For the application of pesticides, use the services of a subcontractor whose principal business is pest control. The subcontractor shall be licensed and certified in the state where the work is to be performed. Termiticide applicators shall also be certified in the U.S. Environmental Protection Agency (EPA) pesticide applicator category which includes structural pest control. Submit the qualifications and state license number of the termiticide applicator.

1.3.2 Safety Requirements

Formulate, treat, and dispose of termiticides and their containers in accordance with label directions. Draw water for formulating only from sites designated by the Contracting Officer, and fit the filling hose with a backflow preventer meeting local plumbing codes or standards. The filling operation shall be under the direct and continuous observation of a contractor's representative to prevent overflow. Secure pesticides and related materials under lock and key when unattended. Ensure that proper protective clothing and equipment are worn and used during all phases of termiticide application. Dispose of used pesticide containers off Government property.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery

Deliver termiticide material to the site in the original unopened containers bearing legible labels indicating the EPA registration number and manufacturer's registered uses. All other materials, to be used on site for the purpose of termite control, shall be delivered in new or otherwise good condition as supplied by the manufacturer or formulator.

1.4.2 Inspection

Inspect termiticides upon arrival at the job site for conformity to type and quality in accordance with paragraph TERMITICIDES. Each label shall bear evidence of registration under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended or under appropriate regulations of the host county. Other materials shall be inspected for conformance with specified requirements. Remove unacceptable materials from the job site.

1.4.3 Storage

Store materials in designated areas and in accordance with manufacturer's labels. Termiticides and related materials shall be kept under lock and key when unattended.

1.4.4 Handling

Observe manufacturer's warnings and precautions. Termiticides shall be handled in accordance with manufacturer's labels, preventing contamination by dirt, water, and organic material. Protect termiticides from sunlight as recommended by the manufacturer.

1.5 SITE CONDITIONS

The following conditions will determine the time of application.

1.5.1 Soil Moisture

Soils to be treated shall be tested immediately before application. Test soil moisture content to a minimum depth of 3 inches. The soil moisture shall be as recommended by the termiticide manufacturer. The termiticide will not be applied when soil moisture exceeds manufacturer's recommendations because termiticides do not adhere to the soil particles in saturated soils.

1.5.2 Runoff and Wind Drift

Do not apply termiticide during or immediately following heavy rains. Applications shall not be performed when conditions may cause runoff or create an environmental hazard. Applications shall not be performed when average wind speed exceeds 10 miles per hour. The termiticide shall not be allowed to enter water systems, aquifers, or endanger humans or animals.

1.5.2.1 Vapor Barriers and Waterproof Membranes

Termiticide shall be applied prior to placement of a vapor barrier or waterproof membrane.

1.5.2.2 Utilities and Vents

Prior to application, HVAC ducts and vents located in treatment area shall be turned off and blocked to protect people and animals from termiticide.

1.5.3 Placement of Concrete

Place concrete covering treated soils as soon as the termiticide has reached maximum penetration into the soil. Time for maximum penetration shall be as recommended by the manufacturer.

1.6 WARRANTY

Provide a 5 -year written warranty against infestations or reinfestations by subterranean termites of the buildings or building additions constructed under this contract. Warranty shall include annual inspections of the buildings or building additions. If live subterranean termite infestation or subterranean termite damage is discovered during the warranty period, and the soil and building conditions have not been altered in the interim:

- a. Retreat the soil and perform other treatment as may be necessary for elimination of subterranean termite infestation;
- b. Repair damage caused by termite infestation; and
- c. Reinspect the building approximately 180 days after the retreatment.

PART 2 PRODUCTS

2.1 TERMITICIDES

Provide termiticides currently registered by the EPA or approved for such use by the appropriate agency of the host county. Select non-repellant termiticide for maximum effectiveness and duration after application. The selected termiticide shall be suitable for the soil and climatic conditions at the project site.

PART 3 EXECUTION

3.1 VERIFICATION OF MEASUREMENT

Once termiticide application has been completed, measure tank contents to determine the remaining volume. The total volume measurement of used contents for the application shall equal the established application rate for the project site conditions. Provide written verification of the measurements.

3.2 TECHNICAL REPRESENTATIVE

The certified installation pest management coordinator shall be the technical representative, shall be present at all meetings concerning treatment measures for subterranean termites, and may be present during treatment application. The command Pest Control Coordinator shall be contacted prior to starting work.

3.3 SITE PREPARATION

Site preparation shall be in accordance with Sections 31 11 00 CLEARING AND GRUBBING, 31 00 00 EARTHWORK, 32 92 19 SEEDING, 32 92 23 SODDING, 32 92 26 SPRIGGING, and 32 93 00 EXTERIOR PLANTS. Work related to final grades, landscape plantings, foundations, or any other alterations to finished construction which might alter the condition of treated soils, shall be coordinated with this specification.

3.3.1 Ground Preparation

Food sources shall be eliminated by removing debris from clearing and grubbing and post construction wood scraps such as ground stakes, form boards, and scrap lumber from the site, before termiticide application begins.

3.3.2 Verification

Before work starts, verify that final grades are as indicated and smooth grading has been completed in accordance with Section 31 00 00 EARTHWORK. Soil particles shall be finely graded with particles no larger than 1 inch and compacted to eliminate soil movement to the greatest degree.

3.3.3 Foundation Exterior

Provide written verification that final grading and landscape planting operations will not disturb treatment of the soil on the exterior sides of foundation walls, grade beams, and similar structures.

3.3.4 Utilities and Vents

Provide written verification that the location and identity of HVAC ducts and vents, water and sewer lines, and plumbing have been accomplished prior to the termiticide application.

3.3.5 Crawl and Plenum Air Spaces

Provide written verification that the location and identity of crawl and plenum air spaces have been accomplished prior to the termiticide application.

3.3.6 Application Plan

Submit a [Termiticide Application Plan](#) for approval before starting the specified treatment.

3.4 TERMITICIDE TREATMENT

3.4.1 [Equipment Calibration and Tank Measurement](#)

Immediately prior to commencement of termiticide application, calibration tests shall be conducted on the application equipment to be used and the application tank shall be measured to determine the volume and contents. These tests shall confirm that the [application equipment](#) is operating within the manufacturer's specifications and will meet the specified requirements. Provide written certification of the equipment calibration test results within 1 week of testing.

3.4.2 Mixing and Application

Formulating, mixing, and application shall be performed in the presence of the Contracting Officer or the technical representative. A closed system is recommended as it prevents the termiticide from coming into contact with the applicator or other persons. Water for formulating shall only come from designated locations. Filling hoses shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Prior to each day of use, the equipment used for applying termiticides shall be inspected for leaks, clogging, wear, or damage. Any repairs are to be performed immediately.

3.4.3 Treatment Method

For areas to be treated, establish complete and unbroken vertical and/or horizontal soil poison barriers between the soil and all portions of the intended structure which may allow termite access to wood and wood related products. Application shall not be made to areas which serve as crawl spaces or for use as a plenum air space.

3.4.3.1 Surface Application

Use surface application for establishing horizontal barriers. Surface applicants shall be applied as a coarse spray and provide uniform distribution over the soil surface. Termiticide shall penetrate a minimum of [1 inch](#) into the soil, or as recommended by the manufacturer.

3.4.3.2 Rodding and Trenching

Use rodding and trenching for establishing vertical soil barriers. Trenching shall be to the depth of the foundation footing. Width of trench shall be as recommended by the manufacturer, or as indicated. Rodding or other approved method may be implemented for saturating the base of the trench with termiticide. Immediately after termiticide has reached maximum penetration as recommended by the manufacturer, backfilling of the trench shall commence. Backfilling shall be in [6 inch](#) rises or layers. Each rise shall be treated with termiticide.

3.4.4 Sampling

The Contracting Officer may draw from stocks at the job site, at any time and without prior notice, take samples of the termiticides used to

determine if the amount of active ingredient specified on the label is being applied.

3.5 CLEAN UP, DISPOSAL, AND PROTECTION

Once application has been completed, proceed with clean up and protection of the site without delay.

3.5.1 Clean Up

The site shall be cleaned of all material associated with the treatment measures, according to label instructions, and as indicated. Excess and waste material shall be removed and disposed off site.

3.5.2 Disposal of Termiticide

Dispose of residual termiticides and containers off Government property, and in accordance with label instructions and EPA criteria.

3.5.3 Protection of Treated Area

Immediately after the application, the area shall be protected from other use by erecting barricades and providing signage as required or directed. Signage shall be in accordance with Section 10 14 01 EXTERIOR SIGNAGE. Signage shall be placed inside the entrances to crawl spaces and shall identify the space as treated with termiticide and not safe for children and animals.

3.6 CONDITIONS FOR SATISFACTORY TREATMENT

3.6.1 Equipment Calibrations and Measurements

Where results from the equipment calibration and tank measurements tests are unsatisfactory, re-treatment will be required.

3.6.2 Testing

Should an analysis, performed by a third party, indicate that the samples of the applied termiticide contain less than the amount of active ingredient specified on the label, and/or if soils are treated to a depth less than specified or approved, re-treatment will be required.

3.6.3 Disturbance of Treated Soils

Soil and fill material disturbed after treatment shall be re-treated before placement of slabs or other covering structures.

3.6.4 Termites Found Within the Warranty Period

If live subterranean termite infestation or termite damage is discovered during the warranty period, re-treat the site.

3.7 RE-TREATMENT

Where re-treatment is required, comply with the requirements specified in paragraph WARRANTY.

-- End of Section --

SECTION 31 32 11

SOIL SURFACE EROSION CONTROL

08/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 1248	(2005) Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
ASTM D 1560	(2009a) Resistance to Deformation and Cohesion of Bituminous Mixtures by Means of Hveem Apparatus
ASTM D 1777	(1996; R 2007) Thickness of Textile Materials
ASTM D 2028	(2010) Cutback Asphalt (Rapid-Curing Type)
ASTM D 2844	(2007e1) Resistance R-Value and Expansion Pressure of Compacted Soils
ASTM D 3776/D 3776M	(2009a) Standard Test Method for Mass Per Unit Area (Weight) of Fabric
ASTM D 3787	(2007) Bursting Strength of Textiles - Constant-Rate-of-Traversal (CRT), Ball Burst Test
ASTM D 3884	(2009) Abrasion Resistance of Textile Fabrics (Rotary Platform, Double-Head Method)
ASTM D 4355	(2007) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
ASTM D 4491	(1999a; R 2009) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(2004; R 2009) Trapezoid Tearing Strength of Geotextiles
ASTM D 4595	(2009) Tensile Properties of Geotextiles by the Wide-Width Strip Method
ASTM D 4632	(2008) Grab Breaking Load and Elongation

	of Geotextiles
ASTM D 4751	(2004) Determining Apparent Opening Size of a Geotextile
ASTM D 4833	(2007) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 4972	(2001; R 2007) pH of Soils
ASTM D 5034	(2009) Breaking Strength and Elongation of Textile Fabrics (Grab Test)
ASTM D 5035	(2011) Breaking Force and Elongation of Textile Fabrics (Strip Method)
ASTM D 5268	(2007) Topsoil Used for Landscaping Purposes
ASTM D 648	(2007) Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position
ASTM D 698	(2007e1) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))
ASTM D 977	(2005) Emulsified Asphalt
	U.S. DEPARTMENT OF AGRICULTURE (USDA)
AMS Seed Act	(1940; R 1988; R 1998) Federal Seed Act
	U.S. GREEN BUILDING COUNCIL (USGBC)
LEED	(2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 SYSTEM DESCRIPTION

The work consists of furnishing and installing soil surface erosion control materials, including fine grading, blanketing, stapling, mulching and miscellaneous related work, within project limits and in areas outside the project limits where the soil surface is disturbed from work under this contract at the designated locations. This work includes all necessary materials, labor, supervision and [equipment](#) for installation of a complete system. Coordinate this section with the requirements of Section 31 00 00 EARTHWORK and Section 32 92 19 SEEDING, and Section 32 92 23 SODDING. Complete backfilling the openings in synthetic grid systems and articulating cellular concrete block systems a maximum 7 days after placement to protect the material from ultraviolet radiation.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation;

submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Work sequence schedule; G
Erosion control plan; G; (LEED)

SD-02 Shop Drawings

Layout;
Obstructions Below Ground;
Erosion Control;

Scale drawings defining areas to receive recommended materials as required by federal, state or local regulations.

Seed Establishment Period

Calendar time period for the seed establishment period. When there is more than one seed establishment period, the boundaries of the seeded area covered for each period shall be described.

Maintenance Record

Record of maintenance work performed, of measurements and findings for product failure, recommendations for repair, and products replaced.

SD-03 Product Data

Geosynthetic Binders;
Recycled Plastic
Wood Cellulose Fiber
Paper Fiber
Mulch Control Netting and Filter Fabric
Hydraulic Mulch;
Erosion Control Blankets Type XI
Geotextile Fabrics; G:
Aggregate
Synthetic Grid Systems;
Articulating Cellular Concrete Block Systems;

Manufacturer's literature including physical characteristics, application and installation instructions.

Equipment

A listing of equipment to be used for the application of erosion control materials.

Finished Grade
Erosion Control Blankets

Condition of finish grade status prior to installation; location of underground utilities and facilities.

SD-04 Samples

Materials

- a. Geosynthetic and synthetic binding material; 1 quart.
- b. Standard mulch; 2 pounds.
- c. Hydraulic mulch; 2 pounds.
- d. Geotextile fabrics; 6 inch square.
- e. Erosion control blankets; 6 inch square.
- f. Synthetic grid systems; One sample grid.
- g. Articulating cellular concrete block systems; 100 square feet area.
- h. Two color charts displaying the colors and finishes for the articulating cellular block system.

SD-06 Test Reports

Geosynthetic Binders

Hydraulic Mulch

Geotextile Fabrics

Erosion Control Blankets

Synthetic Grid Systems

Articulating Cellular Concrete Block Systems

Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

Sand

Gravel

Sieve test results. Sand shall be uniformly graded.

SD-07 Certificates

Fill Material

Mulch

Hydraulic Mulch

Geotextile Fabrics

Prior to delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following.

For items listed in this section:

- a. Certification of recycled content or,
- b. Statement of recycled content.

c. Certification of origin including the name, address and telephone number of manufacturer.

[Geosynthetic Binders](#)
[Synthetic Soil Binders](#)

Certification for binders showing EPA registered uses, toxicity levels, and application hazards.

[Installer's Qualification](#)

The installer's company name and address; training and experience and or certification.

[Recycled Plastic](#)

Individual component and assembled unit structural integrity test; creep tolerance; deflection tolerance; and vertical load test results. Life-cycle durability.

[Seed](#)

Classification, botanical name, common name, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, and date tested.

[Asphalt Adhesive
Tackifier](#)

Composition.

[Wood By-Products](#)

Composition, source, and particle size. Products shall be free from toxic chemicals or hazardous material.

[Wood Cellulose Fiber](#)

Certification stating that wood components were obtained from managed forests.

[SD-10 Operation and Maintenance Data](#)

[Maintenance Instructions](#)

Instruction for year-round care of installed material. Include manufacturer supplied spare parts.

[SD-11 Closeout Submittals](#)

[Local/Regional Materials; \(LEED\)](#)

LEED documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

[Recycled Plastic; \(LEED\)](#)

Wood Cellulose Fiber; (LEED)

Paper Fiber; (LEED)

Mulch Control Netting and Filter Fabric; (LEED)

Hydraulic Mulch; G (LEED)

Erosion Control Blankets Type XI; (LEED)

Geotextile Fabrics; G (LEED)

Aggregate; (LEED)

LEED documentation relative to recycled content credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.4 QUALITY ASSURANCE

1.4.1 Installer's Qualification

The installer shall be certified by the manufacturer for training and experience installing the material.

1.4.2 Substitutions

Substitutions will not be allowed without written request and approval from the Contracting Officer.

1.4.3 SUSTAINABLE DESIGN REQUIREMENTS

1.4.3.1 Local/Regional Materials

See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Erosion control materials may be locally available.

1.5 DELIVERY, STORAGE, AND HANDLING

Store materials in designated areas and as recommended by the manufacturer protected from the elements, direct exposure, and damage. Do not drop containers from trucks. Material shall be free of defects that would void required performance or warranty. Deliver geosynthetic binders and synthetic soil binders in the manufacturer's original sealed containers and stored in a secure area.

a. Furnish erosion control blankets and geotextile fabric in rolls with suitable wrapping to protect against moisture and extended ultraviolet exposure prior to placement. Label erosion control blanket and geotextile fabric rolls to provide identification sufficient for inventory and quality control purposes.

b. All synthetic grids, synthetic sheets, and articulating cellular concrete block grids shall be sound and free of defects that would interfere with the proper placing of the block or impair the strength or permanence of the construction. Minor cracks in synthetic grids and concrete cellular block, incidental to the usual methods of manufacture, or resulting from standard methods of handling in shipment and delivery, will not be deemed grounds for rejection.

c. Inspect seed upon arrival at the jobsite for conformity to species and quality. Seed that is wet, moldy, or bears a test date five months or older, shall be rejected.

1.6 WARRANTY

Erosion control material shall have a warranty for use and durable condition for project specific installations. Temporary erosion control materials shall carry a minimum eighteen month warranty. Permanent erosion control materials shall carry a minimum three year warranty.

PART 2 PRODUCTS

2.1 RECYCLED PLASTIC

Recycled plastic shall contain a minimum 85 percent of recycled post-consumer product. Recycled material shall be constructed or manufactured with a maximum 1/4 inch deflection or creep in any member, according to [ASTM D 648](#) and [ASTM D 1248](#). The components shall be molded of ultraviolet (UV) and color stabilized polyethylene. The material shall consist of a minimum 75 percent plastic profile of high-density polyethylene, low-density polyethylene, and polypropylene raw material. The material shall be non-toxic and have no discernible contaminants such as paper, foil, or wood. The material shall contain a maximum 3 percent air voids and shall be free of splinters, chips, peels, buckling, and cracks. Material shall be resistant to deformation from solar heat gain.

2.2 BINDERS

2.2.1 Synthetic Soil Binders

Calcium chloride, or other standard manufacturer's spray on adhesives designed for dust suppression.

2.2.2 Geosynthetic Binders

Geosynthetic binders shall be manufactured in accordance with [ASTM D 1560](#), [ASTM D 2844](#); and shall be referred to as products manufactured for use as modified emulsions for the purpose of erosion control and soil stabilization. Emulsions shall be manufactured from all natural materials and provide a hard durable finish.

2.3 MULCH

Mulch shall be free from weeds, mold, and other deleterious materials. Mulch materials shall be native to the region.

2.3.1 Straw

Straw shall be stalks from oats, wheat, rye, barley, or rice, furnished in air-dry condition and with a consistency for placing with commercial mulch-blowing equipment.

2.3.2 Hay

Hay shall be native hay, sudan-grass hay, broomsedge hay, or other herbaceous mowings, furnished in an air-dry condition suitable for placing with commercial mulch-blowing equipment.

2.3.3 Wood Cellulose Fiber

Wood cellulose fiber shall be 100 percent recycled material and shall not contain any growth or germination-inhibiting factors and shall be dyed with non-toxic, biodegradable dye an appropriate color to facilitate placement during application. Composition on air-dry weight basis: a minimum 9 to a maximum 15 percent moisture, and between a minimum 4.5 to a maximum 6.0 pH. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. This item may contain post-consumer or post-industrial recycled content.

2.3.4 Paper Fiber

Paper fiber mulch shall be 100 percent post-consumer recycled news print that is shredded for the purpose of mulching seed. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements.

2.3.5 Shredded Bark

Locally shredded material shall be treated to retard the growth of mold and fungi.

2.3.6 Wood By-Products

Wood locally chipped or ground bark shall be treated to retard the growth of mold and fungi. Gradation: A maximum 2 inch wide by 4 inch long.

2.3.7 Coir

Coir shall be manufactured from 100 percent coconut fiber cured in fresh water for a minimum of 6 months.

2.3.8 Asphalt Adhesive

Asphalt adhesive shall conform to the following: Emulsified asphalt, conforming to ASTM D 977, Grade SS-1; and cutback asphalt, conforming to ASTM D 2028, Designation RC-70.

2.3.9 Mulch Control Netting and Filter Fabric

Mulch control netting and filter fabric may be constructed of lightweight recycled plastic, cotton, or paper or organic fiber. The recycled plastic shall be a woven or nonwoven polypropylene, nylon, or polyester containing stabilizers and/or inhibitors to make the fabric resistant to deterioration from UV, and with the following properties:

- a. Minimum grab tensile strength (TF 25 #1/ASTM D 4632), 180 pounds.
- b. Minimum Puncture (TF 25 #4/ASTM D 3787), 75 psi in the weakest direction.
- c. Apparent opening sieve size of a minimum 40 and maximum 80 (U.S. Sieve Size).
- d. Minimum Trapezoidal tear strength (TF 25 #2/ASTM D 4533), 50 pounds.

2.3.10 Hydraulic Mulch

Hydraulic mulch shall be made of 100 percent recycled material. Wood shall be naturally air-dried to a moisture content of 10.0 percent, plus or minus 3.0 percent. A minimum of 50 percent of the fibers shall be equal to or greater than 0.15 inch in length and a minimum of 75 percent of the fibers shall be retained on a 28 mesh screen. No reprocessed paper fibers shall be included in the hydraulic mulch. Hydraulic mulch shall have the following mixture characteristics:

CHARACTERISTIC (typical)	VALUE
pH	5.4 ± 0.1
Organic Matter (oven dried basis),	percent 99.3 within ± 0.2
Inorganic Ash (oven dried basis),	percent 0.7 within ± 0.2
Water Holding Capacity,	percent 1,401

2.3.11 Tackifier

Tackifier shall be a blended polyacrylimide material with non-ionic galactomannan of Gramineae endosperm in powder and crystalline form with molecular weights over 250,000. Tackifier shall be pre-packaged in the hydraulic mulch at the rate of 0.5 ounces per lb of wood fiber.

2.3.12 Dye

Dye shall be a water-activated, green color. Pre-package dye in water dissolvable packets in the hydraulic mulch.

2.4 GEOTEXTILE FABRICS

Geotextile fabrics shall be woven of polypropylene filaments formed into a stable network so that the filaments retain their relative position to each other. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Geotextile fabric may contain post-consumer or post-industrial recycled content. Sewn seams shall have strength equal to or greater than the geotextile itself. Install fabric to withstand maximum velocity flows as recommended by the manufacturer. The geotextile shall conform to the following minimum average roll values:

Property	Performance	Test Method
Weight		ASTM D 3776/D 3776M
Thickness		ASTM D 1777
Permeability		ASTM D 4491
Abrasion Resistance,	58 percent X	
Type (percent strength retained)	81 percent	ASTM D 3884
Tensile Grab Strength	1,467 N X 1, 933 N	ASTM D 4632
Grab Elongation	15percent X 20percent	ASTM D 4632
Burst Strength	5,510 kN/m ²	ASTM D 3787
Puncture Strength	733 N	ASTM D 4833
Trapezoid Tear	533 N X 533 N	ASTM D 4533
Apparent Opening Size	40 US Std Sieve	ASTM D 4751
UV Resistance @ 500 hrs	90 percent	ASTM D 4355

2.5 EROSION CONTROL BLANKETS

2.5.1 Erosion Control Blankets Type I

Use Type I blankets for erosion control and vegetation establishment on roadside embankments, abutments, berms, shoulders, and median swales where natural vegetation will provide long term stabilization. Erosion control blankets shall be a machine-produced mat of 100% straw. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. Cover the blanket on the top side with a photodegradable polypropylene netting having an approximate 1/2 by 1/2 inch mesh and be sewn together on a maximum 1.5 inch centers with degradable thread. The erosion control blanket shall have the following properties:

Material Content

Straw	100 percent with approximately 0.50 lb/yd ² weight
Netting	One side only, lightweight photodegradable with approximately 1.64 lb/1,000 ft ² weight.
Thread	Degradable

Note 1: Photodegradable life a minimum of 2 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 3:1 gradient.

2.5.2 Erosion Control Blankets Type II

Erosion control blankets shall be a machine-produced mat of 100 percent straw. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. Cover the blanket on the top side with a polypropylene netting having an approximate 1/2 by 1/2 inch mesh with photodegradable accelerators to provide breakdown of the netting within approximately 45 days, depending upon geographic location and elevation. Sew the blanket together on a maximum 1.5 inch centers with degradable thread. The erosion control blanket shall have the following properties:

Material Content

Straw	100 percent with approximately 0.50 lb/yd ² weight.
Netting	One side only, photodegradable with photo accelerators and approximately 1.64 lb/1,000 ft ² weight.
Thread	Degradable

NOTE: Photodegradable life a minimum of 10 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 3:1 gradient.

2.5.3 Erosion Control Blankets Type III

Type III blankets shall be used for erosion control and vegetation establishment on roadside embankments, abutments, berms, shoulders, and median swales where natural vegetation will provide long term stabilization. Erosion control blanket shall be a machine-produced mat consisting of 70 percent straw and 30 percent coconut fiber. The blanket shall be of consistent thickness with the straw and coconut fiber evenly distributed over the entire area of the mat. Cover the blanket on the top side with heavyweight photodegradable polypropylene netting having UV additives to delay breakdown and an approximate $5/8$ by $5/8$ inch mesh, and on the bottom side with a lightweight photodegradable polypropylene netting with an approximate $1/2$ by $1/2$ inch mesh. Sew the blanket together on 1.5 inch centers with degradable thread. The erosion control blanket shall have the following properties:

Material Content

Straw	70 percent by approximately 0.35 lb/yd ² .
Coconut Fiber	30 percent by approximately 0.15 lb/yd ² weight.
Netting	Top side heavyweight photodegradable with UV additives and approximately 3 lb/1,000 ft ² weight Bottom side lightweight photodegradable with approximately 1.64 lb/1,000 ft ² weight.

NOTE: Photodegradable life a minimum of 10 months with a minimum 90 percent light penetration. Apply to slopes with a gradient less than 1.5:1.

2.5.4 Erosion Control Blankets Type IV

Erosion control blanket shall be a machine-produced mat of 100 percent straw. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. Cover the blanket on the top and bottom sides with lightweight photodegradable polypropylene netting having an approximate $1/2$ by $1/2$ inch mesh. Sew the blanket together on 1.5 inch centers with degradable thread. The erosion control blanket shall have the following properties:

Material Content

Straw	100 percent with approximately 0.5 lb/yd ² weight.
Netting	Both sides lightweight photodegradable with approximately 1.64 lb/1,000 ft ² weight.
Thread	Degradable

Material Content

NOTE: Photodegradable life a minimum of 2 months with a minimum 90 percent light penetration. Apply to slopes with a gradient of less than 1.5:1.

2.5.5 Erosion Control Blankets Type V

Erosion control blanket shall be a machine-produced mat of 100 percent straw. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. Cover the blanket on the top side with polypropylene netting having an approximate 1/2 by 1/2 inch mesh with photodegradable accelerators to provide breakdown of the netting within approximately 45 days, depending upon geographic location and elevation. Cover the bottom with a polypropylene netting having an approximate 1/2 by 1/2 inch mesh with photo accelerators. Sew the blanket together on 1.5 inch centers with degradable thread. The erosion control blanket shall have the following properties:

Material Content

Straw	100 percent with approximately 0.5 lb/yd ² weight.
Netting	Top side lightweight photodegradable with photo accelerators with approximately 1.64 lb/1,000 ft ² weight.
Thread	Bottom side lightweight photodegradable with photo accelerators and approximately 1.64 lb/1,000 ft ² weight.

NOTE: Photodegradable life a minimum of 10 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 2:1 gradient.

2.5.6 Erosion Control Blankets Type VI

Erosion control blanket shall be a machine-produced 100 percent biodegradable mat with a 100 percent straw fiber matrix. The blanket shall be of consistent thickness with the straw fiber evenly distributed over the entire area of the mat. Cover the blanket on the top side with a 100 percent biodegradable woven natural organic fiber netting. The netting shall consist of machine directional strands formed from two intertwined yarns with cross directional strands interwoven through the twisted machine strands (commonly referred to as a Leno weave) to form an approximate 1/2 by 1/2 inch mesh. Sew the blanket together with biodegradable thread on 1.5 inch centers. The erosion control blanket shall have the following properties:

Material Content

Matrix	100 percent straw fiber with approximately 0.50 lb/yd ² weight
Netting	One side only, Leno woven 100% biodegradable natural organic fiber

Material Content

Weight approximately 9.3 lb/1,000 ft.

Thread Biodegradable

NOTE: Photodegradable life a minimum of 10 months with a minimum 90 Percent light penetration. Apply to slopes up to a maximum 2:1 gradient.

2.5.7 Erosion Control Blankets Type VII

Erosion control blanket shall be a machine-produced 100 percent biodegradable mat with an herbaceous straw fiber matrix. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. Cover the blanket on the top and bottom sides with 100 percent biodegradable woven natural fiber netting. The netting shall consist of machine directional strands formed from two intertwined yarns with cross directional strands interwoven through the twisted machine strands (commonly referred to as a Leno weave) to form an approximate 1/2 by 1/2 inch mesh. Sew the blanket together with biodegradable thread on 1.5 inch centers. The blanket shall have the following properties:

Material Content

Straw 100 percent straw fiber with approximately 0.5 lb/yd² weight.

Netting Top and bottom sides, Leno woven 100% biodegradable natural organic fiber with approximately 9.3 lb/1,000ft² weight.

Thread Biodegradable

Note: Photodegradable life a minimum of 18 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 1.5:1 gradient.

2.5.8 Erosion Control Blankets Type VIII

Erosion control blanket shall be a machine-produced 100 percent biodegradable mat with a 70 percent herbaceous straw and 30 percent coconut fiber blend matrix. The blanket shall be of consistent thickness with the straw and coconut fiber evenly distributed over the entire area of the mat. Cover the blanket on the top and bottom sides with 100 percent biodegradable woven natural organic fiber netting. The netting shall consist of machine directional strands formed from two intertwined yarns with cross directional strands interwoven through the twisted machine strands (commonly referred to as a Leno weave) to form an approximate 1/2 by 1/2 inch mesh. Sew the blanket together with biodegradable thread on 1.5 inch centers. Straw/Coconut fiber erosion control blanket shall have the following properties:

Material Content

Matrix 70 percent straw fiber with approximately 0.35 lb/yd² weight. 30 percent coconut fiber cured in fresh water with approximately

0.15 lb/yd² weight.

Netting Both sides woven 100% biodegradable natural organic fiber with approximately 9.3 lbs/1,000 ft² weight.

Thread Biodegradable

NOTE: Photodegradable life a minimum of 24 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 1.5:1 gradient.

2.5.9 Erosion Control Blankets Type IX (Turf Reinforcement Mat)

Permanent erosion control/turf reinforcement mat is constructed of 100 percent coconut fiber stitch bonded between a heavy duty UV stabilized bottom net, and a heavy duty UV stabilized cusped (crimped) middle netting overlaid with a heavy duty UV stabilized top net. The cusped netting forms prominent closely spaced ridges across the entire width of the mat. The three nettings are stitched together on 1.5 inch centers with UV stabilized polypropylene thread to form a permanent three dimensional structure. The following list contains further physical properties of the turf erosion control mat.

Property	Test Method	Value	Units
Ground Cover	Image Analysis	93	percent
Thickness	ASTM D 1777		0.63 in
Mass Per Unit Area	ASTM D 3776/D 3776M		0.92 lb/sy
Tensile Strength	ASTM D 5035		480 lb/ft
Elongation	ASTM D 5035		percent
Tensile Strength	ASTM D 5035		960 lb/ft
Elongation	ASTM D 5035	31	percent
Tensile Strength	ASTM D 5034		177 lbs
Elongation	ASTM D 5034		22 percent
Resiliency	ASTM D 1777	greater than 80	percent
UV Stability*	ASTM D 4355	86	percent
Color(permanent net)		UV Black	
Porosity(permanent net)Calculated		greater than 95	percent
Minimum Filament Measured Diameter (permanent net)			0.03 in

NOTE 1: *ASTM D 5034 Tensile Strength and percent Strength Retention of material after 1000 hours of exposure in Xenon-Arc Weatherometer

NOTE 2: Photodegradable life a minimum of 36 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 1:1 gradient.

2.5.10 Erosion Control Blankets Type X (Turf Reinforcement Mat)

Permanent erosion control/turf reinforcement mat shall be constructed of 100 percent UV stabilized high denier polypropylene fiber sewn between a black UV stabilized 1/2 inch mesh polypropylene netting on the top 5 lbs/1000 square ft and a black UV stabilized 5/8 inch mesh polypropylene netting on the bottom 3 lbs/1000 square ft with polypropylene thread. The mat shall be resistant to photo and chemical degradation. The following list contains further physical properties of the turf reinforcement mat.

Property	Test Method	Value	Units
Thickness	ASTM D 1777		0.56 in
Resiliency	100 PSI-3 cycles	94	percent
Mass Per Unit Area	ASTM D 3776/D 3776M		11.2 oz/sq yd
Tensile Strength	ASTM D 4632		35.2 lbs
Elongation	ASTM D 4632	25.5	percent
Tensile Strength	ASTM D 4595		259.2 lbs/ft
Elongation	ASTM D 4595	20.9	percent
Tensile Strength	ASTM D 5035		300 lbs/ft
Elongation	ASTM D 5035	51	percent
Tensile Strength	ASTM D 5034		89 lbs
Elongation	ASTM D 5034		21 percent
UV Stability*	ASTM D 4355		81* lbs
		90*	percent

NOTE 1: *ASTM D 5034 Tensile Strength and percent Strength Retention of material after 1000 hours of exposure in Xenon-Arc Weatherometer.

NOTE 2: Photodegradable life a minimum of 36 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 1:1 gradient.

2.5.11 Erosion Control Blankets Type XI (Re-vegetation Mat)

Seed-incorporated blanket option shall consist of 2-ply 100 percent recycled, unbleached, cellulose tissue. Uniformly distribute a seed mix upon the bottom ply of cellulose tissue and fully overlaid with a top cellulose ply to provide complete envelopment of the seed layer. Sew the seed-incorporated cellulose medium to the bottom side of the specified erosion control blanket.

Material Content

Top ply 1-ply 100 percent recycled unbleached cellulose tissue with approximately 4.3 lbs/1,000 ft² weight.

Seed 0.033 lbs/yd² (160 lbs/acre)

0.017 lbs/yd² (80 lbs/acre)

Bottom ply 1-ply recycled unbleached cellulose issue with approximately 4.3 lbs/(1,000 ft²) weight.

Material Content

NOTE: Photodegradable life a minimum of 36 months with a minimum 90 percent light penetration. Apply to slopes up to a minimum 1:1 gradient.

2.5.12 Seed

2.5.12.1 Seed Classification

State-certified native seed mix of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Conform labels to the [AMS Seed Act](#) and applicable state seed laws. Submit the [Seed Establishment Period](#) information as specified in the Submittals paragraph.

2.5.12.2 Permanent Seed Species and Mixtures

Proportion permanent seed species and mixtures by weight shall be as per Kentucky Department of Transportation Standards.

2.5.12.3 Quality

Weed seed shall be a maximum 1 percent by weight of the total mixture.

2.5.13 Staking

Stakes shall be 100 percent biodegradable manufactured from recycled plastic or wood and shall be designed to safely and effectively secure erosion control blankets for temporary or permanent applications. The biodegradable stake shall be fully degradable by biological activity within a reasonable time frame. The bio-plastic resin used in production of the biodegradable stake shall consist of polylactide, a natural, completely biodegradable substance derived from renewable agricultural resources. The biodegradable stake must exhibit ample rigidity to enable being driven into hard ground, with sufficient flexibility to resist shattering. Serrate the biodegradable stake on the leg to increase resistance to pull-out from the soil.

2.5.14 Staples

Staples shall be as recommended by the manufacturer.

2.6 WATER

Unless otherwise directed, water is the responsibility of the Contractor. Water shall be potable or supplied by an existing irrigation system.

PART 3 EXECUTION

3.1 WEATHER CONDITIONS

Perform erosion control operations under favorable weather conditions; when excessive moisture, frozen ground or other unsatisfactory conditions prevail, the work shall be stopped as directed. When special conditions warrant a variance to earthwork operations, submit a revised construction schedule for approval. Do not apply erosion control materials in adverse weather conditions which could affect their performance.

3.1.1 Finished Grade

Verify that finished grades are as indicated on the drawings; complete finish grading and compaction in accordance with Section 31 00 00 EARTHWORK, prior to the commencement of the work. Verify and mark the location of underground utilities and facilities in the area of the work. Repair damage to underground utilities and facilities at the Contractor's expense.

3.1.2 Placement of Erosion Control Blankets

Before placing the erosion control blankets, ensure the subgrade has been graded smooth; has no depressed, void areas; is free from obstructions, such as tree roots, projecting stones or other foreign matter. Vehicles will not be permitted directly on the blankets.

3.1.3 Synthetic Grid

Before placing the grid system, ensure that the subgrade has been properly grubbed of large roots and rocks; compacted; has been graded smooth; has no depressed, void, soft or uncompacted areas; is free from obstructions, such as tree roots, projecting stones or other foreign matter; and has been seeded.

3.1.4 Concrete Cellular Block

Before placing geotextile fabric under cellular block, ensure that the subgrade has been properly compacted; has been graded smooth; has no depressed, void, soft or uncompacted areas; is free from obstructions, such as tree roots, projecting stones or other foreign matter; and has been seeded. Compact subgrade compaction to at least 90 percent of the maximum dry density at optimum moisture content, as determined by ASTM D 698, with a tolerance of plus or minus 1 inch of the design elevation.

3.2 SITE PREPARATION

3.2.1 Soil Test

Test soil in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size and mechanical analysis. Sample collection onsite shall be random over the entire site. The test shall determine the soil particle size as compatible for the specified material.

3.2.2 Layout

Erosion control material locations may be adjusted to meet field conditions. When soil tests result in unacceptable particle sizes, a shop drawing shall be submitted indicating the corrective measures.

3.2.3 Protecting Existing Vegetation

When there are established lawns in the work area, the turf shall be covered and/or protected or replaced after construction operations. Identify existing trees, shrubs, plant beds, and landscape features that are to be preserved on site by appropriate tags and barricade with reusable, high-visibility fencing along the dripline. Mitigate damage to existing trees at no additional cost to the Government. Damage shall be assessed by a state certified arborist or other approved professional using

the National Arborist Association's tree valuation guideline.

3.2.4 Obstructions Below Ground

When obstructions below ground affect the work, submit shop drawings showing proposed adjustments to placement of erosion control material for approval.

3.3 INSTALLATION

3.3.1 Seeding

When seeding is required prior to installing mulch on synthetic grid systems verify that seeding will be completed in accordance with Sections 31 00 00 EARTHWORK and 32 92 19 SEEDING.

3.3.2 Mulch Installation

install mulch in the areas indicated. Apply mulch evenly at the rate of 65 to 80 pounds of wood mulch per 1,000 square feet.

3.3.3 Mulch Control Netting

Netting may be stapled over mulch according to manufacturer's recommendations.

3.3.4 Mechanical Anchor

Mechanical anchor shall be a V-type-wheel land packer; a scalloped-disk land packer designed to force mulch into the soil surface; or other suitable equipment.

3.3.5 Asphalt Adhesive Tackifier

Asphalt adhesive tackifier shall be sprayed at a rate between 10 to 13 gallons/1000 square feet. Do not completely exclude sunlight from penetrating to the ground surface.

3.3.6 Non-Asphaltic Tackifier

Apply hydrophilic colloid at the rate recommended by the manufacturer, using hydraulic equipment suitable for thoroughly mixing with water. Apply a uniform mixture over the area.

3.3.7 Asphalt Adhesive Coated Mulch

Hay or straw mulch may be spread simultaneously with asphalt adhesive applied at a rate between 10 to 13 gallons/1000 square feet, using power mulch equipment equipped with suitable asphalt pump and nozzle. Apply the adhesive-coated mulch evenly over the surface. Do not completely exclude sunlight from penetrating to the ground surface.

3.3.8 Wood Cellulose Fiber, Paper Fiber, and Recycled Paper

Apply wood cellulose fiber, paper fiber, or recycled paper as part of the hydraulic mulch operation.

3.3.9 Hydraulic Mulch Application

3.3.9.1 Unseeded Area

Install hydraulic mulch as indicated and in accordance with manufacturer's recommendations. Mix hydraulic mulch with water at the rate recommended by the manufacturer for the area to be covered. Mixing shall be done in equipment manufactured specifically for hydraulic mulching work, including an agitator in the mixing tank to keep the mulch evenly disbursed.

3.3.9.2 Seeded Area

For drill or broadcast seeded areas, apply hydraulic mulch evenly at the rate of 65 to 80 pounds of wood mulch per 1,000 square feet . For hydraulic seeded areas, apply mulch at the rate of 30 pounds of wood mulch per 1,000 square feet with the seed and fertilizer, and at the rate of 30 pounds of wood mulch per 1,000 square feet in a second application of mulch only.

3.3.10 Erosion Control Blankets

- a. Install erosion control blankets as indicated and in accordance with manufacturer's recommendations. The extent of erosion control blankets shall be as shown on drawings.
- b. Orient erosion control blankets in vertical strips and anchored with staples, as indicated. Abut adjacent strips to allow for installation of a common row of staples. Overlap horizontal joints between erosion control blankets sufficiently to accommodate a common row of staples with the uphill end on top.
- c. Where exposed to overland sheet flow, locate a trench at the uphill termination. Staple the erosion control blanket to the bottom of the trench. Backfill and compact the trench as required.
- d. Where terminating in a channel containing an installed blanket, the erosion control blanket shall overlap installed blanket sufficiently to accommodate a common row of staples.

3.4 CLEAN-UP

Dispose of excess material, debris, and waste materials offsite at an approved landfill or recycling center. Clear adjacent paved areas. Immediately upon completion of the installation in an area, protect the area against traffic or other use by erecting barricades and providing signage as required, or as directed. Signage shall be in accordance with Section 10 14 01 EXTERIOR SIGNAGE .

3.5 WATERING SEED

Start watering immediately after installing erosion control blanket type XI (revegetation mat). Apply water to supplement rainfall at a sufficient rate to ensure moist soil conditions to a minimum 1 inch depth. Prevent run-off and puddling. Do no drive watering trucks over turf areas, unless otherwise directed. Prevent watering of other adjacent areas or plant material.

3.6 MAINTENANCE RECORD

Furnish a record describing the maintenance work performed, record of measurements and findings for product failure, recommendations for repair, and products replaced.

3.6.1 Maintenance

Maintenance shall include eradicating weeds; protecting embankments and ditches from surface erosion; maintaining the performance of the erosion control materials and mulch; protecting installed areas from traffic.

3.6.2 Maintenance Instructions

Furnish written instructions containing drawings and other necessary information, describing the care of the installed material; including, when and where maintenance should occur, and the procedures for material replacement.

3.6.3 Patching and Replacement

Unless otherwise directed, material shall be placed, seamed or patched as recommended by the manufacturer. Remove material not meeting the required performance as a result of placement, seaming or patching from the site. Replace the unacceptable material at no additional cost to the Government.

3.7 SATISFACTORY STAND OF GRASS PLANTS

When erosion control blanket type XI (revegetation mat) is installed, evaluate the grass plants for species and health when the grass plants are a minimum 1 inch high. A satisfactory stand of grass plants from the revegetation mat area shall be a minimum 10 grass plants per square foot. The total bare spots shall not exceed 2 percent of the total revegetation mat area.

-- End of Section --

SECTION 32 01 16.17

COLD MILLING OF BITUMINOUS PAVEMENTS
08/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 136 (2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

1.2 SYSTEM DESCRIPTION

Maintain in a satisfactory working condition equipment, tools, and machines used in the performance of the work.

1.2.1 Cold-Milling Machine

Provide a cold-milling machine which is self-propelled, capable of milling the pavement to a specified depth and smoothness and of establishing grade control; with means of controlling transverse slope and dust produced during the pavement milling operation. The machine shall have the ability to remove the millings or cuttings from the pavement and load them into a truck. The milling machine shall not cause damage to any part of the pavement structure that is not to be removed.

1.2.2 Cleaning Equipment

Provide cleaning equipment suitable for removing and cleaning loose material from the pavement surface.

1.2.3 Straightedge

Furnish and maintain at the site, in good condition, one 12 foot straightedge or other suitable device for each milling machine, for testing the finished surface. Make straightedge available for Government use. Straightedges shall be constructed of aluminum or other lightweight metal, with blades of box or box-girder cross section with flat bottom reinforced to insure rigidity and accuracy. Straightedges shall have handles to facilitate movement on the pavement.

1.3 QUALITY ASSURANCE

1.3.1 Grade

Conform the finished milled surfaces to the lines, grades, and cross sections indicated. The finished milled-pavement surfaces shall vary not more than 1/4 inch from the established plan grade line and elevation. Finished surfaces at a juncture with other pavements shall coincide with the finished surfaces of the abutting pavements. The deviations from the

plan grade line and elevation will not be permitted in areas of pavements where closer conformance with planned grade and elevation is required for the proper functioning of appurtenant structures involved.

1.3.2 Surface Smoothness

Finished surfaces shall not deviate from the testing edge of a straightedge more than **1/4 inch** in the transverse or longitudinal direction.

1.3.3 Traffic Control

Provide all necessary traffic controls during milling operations.

1.4 ENVIRONMENTAL REQUIREMENTS

Milling shall not be performed when there is accumulation of snow or ice on the pavement surface.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 PREPARATION OF SURFACE

Clean the pavement surface of excessive dirt, clay, or other foreign material immediately prior to milling the pavement.

3.2 MILLING OPERATION

A minimum of seven days notice is required, prior to start work, for the Contracting Officer to coordinate the milling operation with other activities at the site. Make sufficient passes so that the designated area is milled to the grades and cross sections indicated. The milling shall proceed with care and in depth increments that will not damage the pavement below the designated finished grade. Repair or replace, as directed, items damaged during milling such as manholes, valve boxes, utility lines, pavement that is torn, cracked, gouged, broken, or undercut. The milled material shall be removed from the pavement and loaded into trucks. Removed material shall have a minimum of 95 percent by weight passing a 1" sieve when tested in accordance with **ASTM C 136**.

3.3 GRADE AND SURFACE-SMOOTHNESS TESTING

3.3.1 Grade-Conformance Tests

Test the finished milled surface of the pavement for conformance with the plan-grade requirements and for acceptance by the Contracting Officer by running lines of levels at intervals of **25 feet** longitudinally and **25 feet** transversely to determine the elevation of the completed pavement. Correct variations from the designated grade line and elevation in excess of the plan-grade requirements as directed. Skin patching for correcting low areas will not be permitted. Remove and replace the deficient low area. Remove sufficient material to allow at least **1 inch** of asphalt concrete to be placed.

3.3.2 Surface-Smoothness Tests

After completion of the final milling, the finished milled surface will be tested by the Government with a straightedge. Other approved devices may

be used, provided that when satisfactorily and properly operated, such devices reveal all surface irregularities exceeding the tolerances specified. Correct surface irregularities that depart from the testing edge by more than $1/4$ inch. Skin patching for correcting low areas will not be permitted. Remove and replace the deficient low area. Remove sufficient material to allow at least 1 inch of asphalt concrete to be placed.

3.4 REMOVAL OF MILLED MATERIAL

Material that is removed shall become the property of the Contractor and removed from the site.

-- End of Section --

SECTION 32 01 19

FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS
08/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

- ASTM C 509 (2006) Elastomeric Cellular Preformed Gasket and Sealing Material
- ASTM D 6690 (2007) Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
- ASTM D 7116 (2005) Standard Specification for Joint Sealants, Hot Applied, Jet Fuel Resistant Types, for Portland Cement Concrete Pavement
- ASTM D 789 (2007e1) Determination of Relative Viscosity and Moisture Content of Polyamide (PA)
- ASTM D5893/D5893M (2010) Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements

U.S. ARMY CORPS OF ENGINEERS (USACE)

- COE CRD-C 525 (1989) Corps of Engineers Test Method for Evaluation of Hot-Applied Joint Sealants for Bubbling Due to Heating

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

- FS SS-S-200 (Rev E; Am 1; Notice 1) Sealant, Joint, Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement

1.2 SYSTEM DESCRIPTION

Machines, tools, and [equipment](#) used in the performance of the work required by this section shall be approved before the work is started maintained in satisfactory condition at all times.

1.2.1 Joint Cleaning Equipment

1.2.1.1 Tractor-Mounted Routing Tool

Provide a routing tool, used for removing old sealant from the joints, of such shape and dimensions and so mounted on the tractor that it will not damage the sides of the joints. The tool shall be designed so that it can be adjusted to remove the old material to varying depths as required. The use of V-shaped tools or rotary impact routing devices will not be permitted. Hand-operated spindle routing devices may be used to clean and enlarge random cracks.

1.2.1.2 Concrete Saw

Provide a self-propelled power saw, with water-cooled diamond or abrasive saw blades, for cutting joints to the depths and widths specified or for refacing joints or cleaning sawed joints where sandblasting does not provide a clean joint.

1.2.1.3 Waterblasting Equipment

Include with the waterblasting equipment a trailer-mounted water tank, pumps, high-pressure hose, wand with safety release cutoff control, nozzle, and auxiliary water resupply equipment. Provide water tank and auxiliary resupply equipment of sufficient capacity to permit continuous operations. The nozzle shall have an adjustable guide that will hold the nozzle aligned with the joint approximately 1 inch above the pavement surface. Adjust the height, angle of inclination and the size of the nozzle as necessary to obtain satisfactory results. A pressure gauge mounted at the pump shall show at all times the pressure in psi at which the equipment is operating.

1.2.1.4 Hand Tools

Hand tools may be used, when approved, for removing defective sealant from a crack and repairing or cleaning the crack faces.

1.2.2 Sealing Equipment

1.2.2.1 Hot-Poured Sealing Equipment

The unit applicators used for heating and installing ASTM D 6690 joint sealant materials shall be mobile and shall be equipped with a double-boiler, agitator-type kettle with an oil medium in the outer space for heat transfer; a direct-connected pressure-type extruding device with a nozzle shaped for inserting in the joint to be filled; positive temperature devices for controlling the temperature of the transfer oil and sealant; and a recording type thermometer for indicating the temperature of the sealant. The applicator unit shall be designed so that the sealant will circulate through the delivery hose and return to the inner kettle when not in use.

1.2.2.2 Two-Component, Cold-Applied, Machine Mix Sealing Equipment

Provide equipment used for proportioning, mixing, and installing FS SS-S-200 Type M joint sealants designed to deliver two semifluid components through hoses to a portable mixer at a preset ratio of 1 to 1 by volume using pumps with an accuracy of plus or minus 5 percent for the quantity of each component. The reservoir for each component shall be equipped with mechanical agitation devices that will maintain the components in a uniform

condition without entrapping air. Incorporate provisions to permit thermostatically controlled indirect heating of the components, when required. However, immediately prior to proportioning and mixing, the temperature of either component shall not exceed 90 degrees F. Provide screens near the top of each reservoir to remove any foreign particles or partially polymerized material that could clog fluid lines or otherwise cause misproportioning or improper mixing of the two components. Provide equipment capable of thoroughly mixing the two components through a range of application rates of 10 to 60 gallons per hour and through a range of application pressures from 50 to 1500 psi as required by material, climatic, or operating conditions. Design the mixer for the easy removal of the supply lines for cleaning and proportioning of the components. The mixing head shall accommodate nozzles of different types and sizes as may be required by various operations. The dimensions of the nozzle shall be such that the nozzle tip will extend into the joint to allow sealing from the bottom of the joint to the top. Maintain the initially approved equipment in good working condition, serviced in accordance with the supplier's instructions, and unaltered in any way without obtaining prior approval.

1.2.2.3 Two-Component, Cold-Applied, Hand-Mix Sealing Equipment

Mixing equipment for FS SS-S-200 Type H sealants shall consist of a slow-speed electric drill or air-driven mixer with a stirrer in accordance with the manufacturer's recommendations.

1.2.2.4 Cold-Applied, Single-Component Sealing Equipment

The equipment for installing ASTM D5893/D5893M single component joint sealants shall consist of an extrusion pump, air compressor, following plate, hoses, and nozzle for transferring the sealant from the storage container into the joint opening. The dimension of the nozzle shall be such that the tip of the nozzle will extend into the joint to allow sealing from the bottom of the joint to the top. Maintain the initially approved equipment in good working condition, serviced in accordance with the supplier's instructions, and unaltered in any way without obtaining prior approval. Small hand-held air-powered equipment (i.e., caulking guns) may be used for small applications.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Manufacturer's Recommendations; G.

Printed copies of manufacturer's recommendations, 14 days prior to use on the project, where installation procedures, or any part thereof, are required to be in accordance with those recommendations. Installation of the material will not be allowed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

Equipment.

List of proposed equipment to be used in performance of construction work including descriptive data, 14 days prior to use on the project.

SD-04 Samples

Materials; G.

Samples of the materials (sealant, primer if required, and backup material), in sufficient quantity for testing and approval 14 days prior to the beginning of work. No material will be allowed to be used until it has been approved.

SD-06 Test Reports

Certified copies of the test reports; G.

1.4 QUALITY ASSURANCE

1.4.1 Safety

Do not place joint sealant within 25 feet of any liquid oxygen (LOX) equipment, LOX storage, or LOX piping. Thoroughly clean joints in this area and leave them unsealed.

1.4.2 Test Requirements

Test the joint sealant and backup or separating material for conformance with the referenced applicable material specification. Perform testing of the materials in an approved independent laboratory and submit certified copies of the test reports for approval 14 days prior to the use of the materials at the job site. Samples will be retained by the Government for possible future testing should the materials appear defective during or after application. Conformance with the requirements of the laboratory tests specified will not constitute final acceptance of the materials. Final acceptance will be based on the performance of the in-place materials.

1.4.3 Trial Joint Sealant Installation

Prior to the cleaning and sealing of the joints for the entire project, prepare a test section at least 200 feet long using the specified materials and approved equipment, so as to demonstrate the proposed joint preparation and sealing of all types of joints in the project. Following the completion of the test section and before any other joint is sealed, inspect the test section to determine that the materials and installation meet the requirements specified. If it is determined that the materials or installation do not meet the requirements, remove the materials, and reclean and reseal the joints at no cost to the Government. When the test section meets the requirements, it may be incorporated into the permanent work and paid for at the contract unit price per linear foot for sealing items scheduled. Prepare and seal all other joints in the manner approved for sealing the test section.

1.5 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the job site for defects, unload, and store them with a minimum of handling to avoid damage. Provide storage facilities at the job site for maintaining materials at the temperatures

and conditions recommended by the manufacturer.

1.6 ENVIRONMENTAL REQUIREMENTS

The ambient air temperature and the pavement temperature within the joint wall shall be a minimum of 50 degrees F and rising at the time of application of the materials. Do not apply sealant if moisture is observed in the joint.

PART 2 PRODUCTS

2.1 SEALANTS

Materials for sealing cracks in the various paved areas indicated on the drawings shall be as follows:

Area	Sealing Material
roadways and storage areas and COE CRD-C 525	ASTM D 6690, Type II
[aircraft apron] \	\ASTM D 7116 and COE CRD-C 525\ \

2.2 PRIMERS

When primers are recommended by the manufacturer of the sealant, use them in accordance with the recommendation of the manufacturer.

2.3 BACKUP MATERIALS

Provide backup material that is a compressible, nonshrinking, nonstaining, nonabsorbing material, nonreactive with the joint sealant. The material shall have a melting point at least 5 degrees F greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D 789. The material shall have a water absorption of not more than 5 percent of the sample weight when tested in accordance with ASTM C 509. The backup material shall be 25 plus or minus 5 percent larger in diameter than the nominal width of the crack.

2.4 BOND BREAKING TAPES

Provide a bond breaking tape or separating material that is a flexible, nonshrinkable, nonabsorbing, nonstaining, and nonreacting adhesive-backed tape. The material shall have a melting point at least 5 degrees F greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D 789. The bond breaker tape shall be approximately 1/8 inch wider than the nominal width of the joint and shall not bond to the joint sealant.

PART 3 EXECUTION

3.1 PREPARATION OF JOINTS

Immediately before the installation of the sealant, thoroughly clean the joints to remove all laitance, curing compound, filler, protrusions of hardened concrete, and old sealant from the sides and upper edges of the

joint space to be sealed.

3.1.1 Existing Sealant Removal

Cut loose the in-place sealant from both joint faces and to the depth shown on the drawings, using the concrete saw as specified in paragraph EQUIPMENT. Depth shall be sufficient to accommodate any separating or backup material that is required to maintain the depth of new sealant to be installed. Prior to further cleaning operations, remove all loose old sealant remaining in the joint opening by blowing with compressed air. Hand tools may be required to remove sealant from random cracks. Chipping, spalling, or otherwise damaging the concrete will not be allowed.

3.1.2 Sawing

3.1.2.1 Refacing of Joints

Accomplish refacing of joints using a concrete saw as specified in paragraph EQUIPMENT to remove all residual old sealant and a minimum of concrete from the joint face to provide exposure of newly cleaned concrete, and, if required, to enlarge the joint opening to the width and depth shown on the drawings. Stiffen the blade with a sufficient number of suitable dummy (used) blades or washers. Thoroughly clean, immediately following the sawing operation, the joint opening using a water jet to remove all saw cuttings and debris.

3.1.2.2 Refacing of Random Cracks

Accomplish sawing of the cracks using a power-driven concrete saw as specified in paragraph EQUIPMENT. The saw blade shall be 6 inches or less in diameter to enable the saw to follow the trace of the crack. Stiffen the blade, as necessary, with suitable dummy (or used) blades or washers. Immediately following the sawing operation, thoroughly clean the crack opening using a water jet to remove all saw cuttings and debris.

3.1.3 Sandblasting

The newly exposed concrete joint faces and the pavement surfaces extending a minimum of 1/2 inch from the joint edges shall be sandblasted clean. Use a multiple-pass technique until the surfaces are free of dust, dirt, curing compound, filler, old sealant residue, or any foreign debris that might prevent the bonding of the sealant to the concrete. After final cleaning and immediately prior to sealing, blow out the joints with compressed air and leave them completely free of debris and water.

3.1.4 Back-Up Material

When the joint opening is of a greater depth than indicated for the sealant depth, plug or seal off the lower portion of the joint opening using a back-up material to prevent the entrance of the sealant below the specified depth. Take care to ensure that the backup material is placed at the specified depth and is not stretched or twisted during installation.

3.1.5 Bond Breaking Tape

Where inserts or filler materials contain bitumen, or the depth of the joint opening does not allow for the use of a backup material, insert a bond breaker separating tape to prevent incompatibility with the filler materials and three-sided adhesion of the sealant. Securely bond the tape

to the bottom of the joint opening so it will not float up into the new sealant.

3.1.6 Rate of Progress of Joint Preparation

Limit the stages of joint preparation, which include sandblasting, air pressure cleaning and placing of the back-up material to only that lineal footage that can be sealed during the same day.

3.2 PREPARATION OF SEALANT

3.2.1 Hot-Poured Sealants

Sealants conforming to [ASTM D 6690](#) shall not be heated in excess of the safe heating temperature recommended by the manufacturer as shown on the sealant containers. Withdraw and waste sealant that has been overheated or subjected to application temperatures for over 4 hours or that has remained in the applicator at the end of the day's operation.

3.2.2 Type M Sealants

Inspect the [FS SS-S-200](#) Type M sealant components and containers prior to use. Reject any materials that contain water, hard caking of any separated constituents, nonreversible jell, or materials that are otherwise unsatisfactory. Settlement of constituents in a soft mass that can be readily and uniformly remixed in the field with simple tools will not be cause for rejection. Prior to transfer of the components from the shipping containers to the appropriate reservoir of the application equipment, thoroughly mix the materials to ensure homogeneity of the components and incorporation of all constituents at the time of transfer. When necessary for remixing prior to transfer to the application equipment reservoirs, warm the components to a temperature not to exceed [90 degrees F](#) by placing the components in heated storage or by other approved methods but in no case shall the components be heated by direct flame, or in a single walled kettle, or a kettle without an oil bath.

3.2.3 Type H Sealants

Mix the [FS SS-S-200](#) Type H sealant components either in the container furnished by the manufacturer or a cylindrical metal container of volume approximately 50 percent greater than the package volume. Thoroughly mix the base material in accordance with the manufacturer's instructions. The cure component shall then be slowly added during continued mixing until a uniform consistency is obtained.

3.2.4 Single-Component, Cold-Applied Sealants

Inspect the [ASTM D5893/D5893M](#) sealant and containers prior to use. Reject any materials that contain water, hard caking of any separated constituents, nonreversible jell, or materials that are otherwise unsatisfactory. Settlement of constituents in a soft mass that can be readily and uniformly remixed in the field with simple tools will not be cause for rejection.

3.3 INSTALLATION OF SEALANT

3.3.1 Time of Application

Seal joints immediately following final cleaning of the joint walls and

following the placement of the separating or backup material. Open joints, that cannot be sealed under the conditions specified, or when rain interrupts sealing operations shall be recleaned and allowed to dry prior to installing the sealant.

3.3.2 Sealing Joints

Immediately preceding, but not more than 50 feet ahead of the joint sealing operations, perform a final cleaning with compressed air. Fill the joints from the bottom up to 1/8 inch plus or minus 1/16 inch below the pavement surface. Remove and discard excess or spilled sealant from the pavement by approved methods. Install the sealant in such a manner as to prevent the formation of voids and entrapped air. In no case shall gravity methods or pouring pots be used to install the sealant material. Traffic shall not be permitted over newly sealed pavement until authorized by the Contracting Officer. When a primer is recommended by the manufacturer, apply it evenly to the joint faces in accordance with the manufacturer's instructions. Check the joints frequently to ensure that the newly installed sealant is cured to a tack-free condition within the time specified.

3.4 INSPECTION

3.4.1 Joint Cleaning

Inspect joints during the cleaning process to correct improper equipment and cleaning techniques that damage the concrete pavement in any manner. Cleaned joints will be approved prior to installation of the separating or back-up material and joint sealant.

3.4.2 Joint Sealant Application Equipment

Inspect the application equipment to ensure conformance to temperature requirements, proper proportioning and mixing (if two-component sealant) and proper installation. Evidences of bubbling, improper installation, failure to cure or set will be cause to suspend operations until causes of the deficiencies are determined and corrected.

3.4.3 Joint Sealant

Inspect the joint sealant for proper rate of cure and set, bonding to the joint walls, cohesive separation within the sealant, reversion to liquid, entrapped air and voids. Sealants exhibiting any of these deficiencies at any time prior to the final acceptance of the project shall be removed from the joint, wasted, and replaced as specified herein at no additional cost to the Government.

3.5 CLEAN-UP

Upon completion of the project, remove all unused materials from the site and leave the pavement in a clean condition.

-- End of Section --

SECTION 32 05 33

LANDSCAPE ESTABLISHMENT

02/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 2103 (2010) Standard Specification for Polyethylene Film and Sheeting

TREE CARE INDUSTRY ASSOCIATION (TCIA)

TCIA Z133.1 (2006) American National Standard for Arboricultural Operations - Pruning, Repairing, Maintaining, and Removing Trees, and Cutting Brush - Safety Requirements

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED (2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 DEFINITIONS

1.2.1 Pesticide

Any substance or mixture of substances, including biological control agents, that may prevent, destroy, repel, or mitigate pests and are specifically labeled for use by the U.S. Environmental Protection Agency (EPA). Also, any substance used as a plant regulator, defoliant, disinfectant, or biocide. Examples of pesticides include fumigants, herbicides, insecticides, fungicides, nematicides, molluscicides and rodenticides.

1.2.2 Stand of Turf

100 percent ground cover of the established species.

1.2.3 Planter Beds

A planter bed is defined as an area containing one or a combination of the following plant types: shrubs, vines, wildflowers, annuals, perennials, ground cover, and a mulch topdressing excluding turf. Trees may also be found in planter beds.

1.3 RELATED REQUIREMENTS

Section 32 92 19 SEEDING and Section 32 92 23 SODDING applies to this section for installation of seed and sod requirements, with additions and modifications herein.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Integrated Pest Management Plan; G,

SD-03 Product Data

Fertilizer; G,

Hose; (LEED)

Mulches Topdressing; (LEED)

Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

Organic Mulch Materials

Submit documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.

SD-07 Certificates

Maintenance inspection report

Plant quantities; G,

SD-10 Operation and Maintenance Data

Maintenance

SD-11 Closeout Submittals

Tree, staking and guying removal

1.5 DELIVERY, STORAGE AND HANDLING

1.5.1 Delivery

Deliver fertilizer, gypsum, to the site in original containers bearing manufacturer's chemical analysis, name, trade name, or trademark, and indication of conformance to state and federal laws. Instead of

containers, fertilizer, gypsum may be furnished in bulk with a certificate indicating the above information.

1.5.2 Storage

1.5.2.1 Fertilizer, , Mulch Storage

Material shall be stored in designated areas. fertilizer shall be stored in cool, dry locations away from contaminants.

1.5.2.2 Antidessicants Storage

Do not store with fertilizers or other landscape maintenance materials.

1.5.3 Handling

Do not drop or dump materials from vehicles.

1.6 SUSTAINABLE DESIGN REQUIREMENTS

1.6.1 Local/Regional Materials

See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Landscaping materials may be locally available.

PART 2 PRODUCTS

2.1 POST-PLANT FERTILIZER

2.1.1 Granular Fertilizer

Organic, granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients:

29 percent available nitrogen
3 percent available phosphorus
14 percent available potassium
percent sulfur

2.2 WATER

Source of water shall be approved by the Contracting Officer, and be of suitable quality for irrigation.

2.2.1 Hose

Hoses used for watering shall be a minimum of 65 percent post-consumer rubber or plastic.

2.3 MULCHES TOPDRESSING

Free from noxious weeds, mold, or other deleterious materials.

2.3.1 Organic Mulch Materials

Wood cellulose fiber wood chips ground or shredded bark pine straw mulch pine needles recycled from site when available. Biobased content shall be a

minimum of 100 percent. Wood cellulose fiber shall be processed to contain no growth or germination-inhibiting factors, dyed with non-toxic, biodegradable dye to an appropriate color to facilitate visual metering of materials application. Paper-based hydraulic mulch shall contain a minimum of 100 percent post-consumer recycled content. Wood-based hydraulic mulch shall contain a minimum of 100 percent recycled material.

2.3.2 Recycled Organic Mulch

Recycled mulch may include compost, tree trimmings, or pine needles with a gradation that passes through a 2-1/2 by 2-1/2 inch screen. It shall be cleaned of all sticks a minimum 1 inch in diameter and plastic materials a minimum 3 inch length. The material shall be treated to retard the growth of mold and fungi.

2.4 PESTICIDES

Use black sheet polyethylene conforming to ASTM D 2103, minimum thickness 5/32 inch. Submit an Integrated Pest Management Plan, including proposed alternatives to herbicides and pesticides. Use biological pest controls as approved in the Plan.

PART 3 EXECUTION

3.1 EXTENT OF WORK

Provide landscape construction maintenance to include mowing, edging, overseeding, fertilizing, watering, weeding, for all newly installed landscape areas, unless indicated otherwise, and at all areas inside or outside the limits of the construction that are disturbed by the Contractor's operations.

3.1.1 Policing

The Contractor shall police all landscaped areas. Policing includes removal of leaves, branches and limbs regardless of length or diameter, dead vegetation, paper, trash, cigarette butts, garbage, rocks or other debris. Policing shall extend to both sides of fencing or walls. Collected debris shall be promptly removed and disposed of at an approved disposal site.

3.1.2 Drainage System Maintenance

The Contractor shall remove all obstructions from surface and subsurface drain lines to allow water to flow unrestricted in swales, gutters, catch basins, storm drain curb inlets, and yard drains. Remove grates and clear debris in catch basins. Open drainage channels are to be maintained free of all debris and vegetation at all times. Edges of these channels shall be clear of any encroachment by vegetation.

3.2 IRRIGATION ESTABLISHMENT PERIOD

The irrigation establishment period will commence on the date that inspection by the Contracting Officer shows that the new irrigation equipment furnished under this contract have been satisfactorily installed and is functional and shall continue for a period of 365 days.

3.2.1 Maintenance During the Irrigation Establishment Period

Begin maintenance immediately after irrigation equipment has been installed and is functional. Inspect irrigation equipment at least once a week during the installation and establishment period and perform needed maintenance promptly. Automatic controllers not equipped with rain shut-off sensors shall be turned off during periods of rain that exceed twelve hours of continuous rainfall in one day or during rain storms of one day or more. Once the rain has subsided timers shall be reactivated. Irrigation controllers shall be inspected and reprogrammed after power outages. Contractor shall be responsible for winterization and startup. Sprinkler heads shall direct water away from buildings and hard surfaced areas.

3.2.2 Water Restrictions

The Contractor shall abide by state, local or other water conservation regulations in force during the establishment period. Automatic controller shall be adjusted to comply with the water conservation regulations schedule.

3.2.3 Fire Hydrants

To use a fire hydrant for irrigation, the Contractor shall obtain prior clearance from the Contracting Officer and provide the tools and connections approved for use on fire hydrants. If a fire hydrant is used, Contractor shall provide a reduced pressure backflow preventer for each connection between hose and fire hydrant. Backflow preventer used shall be tested once per month by a certified backflow preventer tester.

3.2.4 Final Acceptance

Upon completion of the irrigation establishment period and final acceptance of groundcover and exterior plants, irrigation equipment shall be removed.

3.2.5 Controller Charts

Provide one chart for each controller supplied. Indicate in chart area controlled by the automatic controller. The chart is a reduction of the actual plan that will fit the maximum dimensions inside the controller housing. Use a black line print for the chart and a different pastel or transparent color to indicate each station zone of coverage. After chart is completed and approved for final acceptance, seal chart between two 20 mil pieces of clear plastic.

3.3 GROUNDCOVER ESTABLISHMENT PERIOD

Groundcover establishment period will commence on the date that inspection by the Contracting Officer shows that the new turf furnished under this contract has been satisfactorily installed to a 100 percent stand of coverage. The establishment period shall continue for a period of 365 days.

3.3.1 Frequency of Maintenance

Begin maintenance immediately after turf has been installed. Inspect areas once a week during the installation and establishment period and perform needed maintenance promptly.

3.3.2 Promotion of Growth

Groundcover shall be maintained in a manner that promotes proper health, growth, natural color. Turf shall have a neat uniform manicured appearance, free of bare areas, ruts, holes, weeds, pests, dead vegetation, debris, and unwanted vegetation that present an unsightly appearance. Mow, remove excess clippings, eradicate weeds, water, fertilize, overseed, topdress and perform other operations necessary to promote growth, as approved by Contracting Officer and consistent with approved Integrated Pest Management Plan. Remove noxious weeds common to the area from planting areas by mechanical means.

3.3.3 Mowing

3.3.3.1 Turf

Turf shall be mowed at a uniform finished height. Mow turfed areas to a minimum average height of 3 inches when average height of grass becomes 6 inches for spring/summer maintenance and to a minimum average height of 4 inches when the average height of grass reaches 6 inches for fall winter maintenance. The height of turf is measured from the soil. Mowing of turf shall be performed in a manner that prevents scalping, rutting, bruising, uneven and rough cutting. Prior to mowing, all rubbish, debris, trash, leaves, rocks, paper, and limbs or branches on a turf area shall be picked up and disposed. Adjacent paved areas shall be swept/vacuumed clean.

3.3.3.2 Native Grasses

Mow above height of native grass seedlings (approximately 3.5 to 4 inches). Mow during spring or early summer. Do not mow after early summer during the second growing season.

3.3.3.3 Wildflowers

Mow three times per season above height of the wildflowers (approximately 12 to 15 inches).

3.3.4 Turf Edging and Trimming

Perimeter of planter bed edges, sidewalks, driveways, curbs, and other paved surfaces shall be edged. Uniformly edge these areas to prevent encroachment of vegetation onto paved surfaces and to provide a clear cut division line between planter beds, turf, and ground cover. Edging is to be accomplished in a manner that prevents scalping, rutting, bruising, uneven and rough cutting. Edging shall be performed on the same day that turf is mowed. Use of string line trimmers is permitted in "soft" areas such as an edge between turfgrass and a planter bed. Care shall be exercised to avoid damage to any plant materials, structures, and other landscape features.

Trimming around trees, fences, poles, walls, irrigation valve boxes and other similar objects is to be accomplished to match the height and appearance of surrounding mowed turf growth. Trimming shall be performed on the same day the turf's mowed. Care shall be exercised to avoid "Girdling" trees located in turf areas. The use of protective tree collars on trees in turf areas may be utilized as a temporary means to avoid injury to tree trunks. At the end of the plant establishment period Contractor will be responsible for removing all protective tree collars.

3.3.5 Post-Fertilizer Application

Apply turf fertilizer in a manner that promotes health, growth, vigor, color and appearance of cultivated turf areas. The method of application, fertilizer type and frequencies shall be determined by the laboratory soil analysis results the requirements of the particular turf species. Organic fertilizer shall be used. In the event that organic fertilizer is not producing the desired effect, the Contractor shall contract the Contracting Officer for approval prior to the use of a synthetic type of fertilizer. Fertilizer shall be applied by approved methods in accordance with the manufacturer's recommendations.

3.3.6 Turf Watering

The Contractor shall perform irrigation in a manner that promotes the health, growth, color and appearance of cultivated vegetation and that complies with all Federal, State, and local water agencies and authorities directives. The Contractor shall be responsible to prevent over watering, water run-off, erosion, and ponding due to excessive quantities or rate of application. The Contractor shall abide by state, local or other water conservation regulations or restrictions in force during the establishment period. Irrigation controllers shall be adjusted to comply with the water conservation regulations schedule.

3.3.7 Turf Clearance Area

Trees located in turf areas shall be maintained with a growth free clearance of 18 inches from the tree trunk base. The use of mechanical weed whips to accomplish the turf growth free bed area is prohibited.

3.3.8 Replanting

Replant in accordance with Section 32 92 19 SEEDINGSection 32 92 23 SODDING and within specified planting dates areas which do not have a satisfactory stand of turf.

3.3.9 Final Inspection and Acceptance

Final inspection will be make upon written request from the Contractor at least 10 days prior to the last day of the turf establishment period. Final turf acceptance will be based upon a satisfactory stand of turf.

3.4 EXTERIOR PLANT ESTABLISHMENT PERIOD

The exterior plant establishment period will commence on the date that inspection by the Contracting Officer shows that the new plants furnished under this contract have been satisfactorily installed and shall continue for a period of 365 days.

3.4.1 Frequency of Maintenance

Begin maintenance immediately after plants have been installed. Inspect exterior plants at least once a week during the installation and establishment period and perform needed maintenance promptly.

3.4.2 Promotion of Plant Growth and Vigor

Water, prune, fertilize, mulch, adjust stakes, guys and turnbuckles, eradicate weeds and perform other operations necessary to promote plant

growth, and vigor.

3.4.3 Planter Bed Maintenance

Planter beds shall be weeded, fertilized, irrigated, kept pest free, turf free, pruned, and mulch levels maintained. Planter beds will not be allowed to encroach into turf areas. A definite break shall be maintained between turf areas and planter beds.

3.4.3.1 Shrub Selective Maintenance

In addition to the above requirements, shrubs shall be selectively pruned, and shaped for health and safety when the following conditions exist: Remove growth in front of windows, over entrance ways or walks, and any growth which will obstruct vision at street intersections or of security personnel; Remove dead, damaged or diseased branches or limbs; where shrub growth obstructs pedestrian walkways; where shrub growth is found growing against or over structures; where shrub growth permits concealment of unauthorized persons. All pruning debris shall be disposed of in a proper manner.

3.4.3.2 Tree Maintenance

Tree maintenance shall include adjustment of stakes, ties, guy supports , watering, fertilizing, pest control, mulching, pruning for health and safety and fall leaf cleanup. Stakes, ties, guy supports shall be inspected and adjusted to avoid girdling and promote natural development. All trees within the project boundaries, regardless of caliper, shall be selectively pruned for safety and health reasons. These include but are not limited to removal of dead and broken branches and correction of structural defects. Prune trees according to their natural growth characteristics leaving trees well shaped and balanced. Pruning of all trees including palm trees shall be accomplished by or in the presence of a certified member of the International Society of Arboriculture and in accordance with [TCIA Z133.1](#). All pruning debris generated shall be disposed of in a proper manner.

3.4.4 Removal of Dying or Dead Plants

Remove dead and dying plants and provide new plants immediately upon commencement of the specified planting season, and replace mulch and eroded earth mound water basins. No additional plant establishment period will be required for replacement plants beyond the original warranty period. A tree shall be considered dying or dead when the main leader has died back, or a minimum of 20 percent of the crown has died. A shrub or ground cover shall be considered dying or dead when a minimum of 20 percent of the plant has died. This condition shall be determined by scraping on a branch an area $1/16$ inch square, maximum, to determine the cause for dying plant material and shall provide recommendations for replacement. The Contractor shall determine the cause for dying plant material and provide recommendations for replacement.

3.4.5 Tracking of Unhealthy Plants

Note plants not in healthy growing condition, as determined by the Contracting Officer, and as soon as seasonal conditions permit, remove and replace with plants of the same species and sizes as originally specified. Install replacement plantings in accordance with Section [32 93 00 EXTERIOR PLANTS](#).

3.4.6 Final Inspection

Final inspection will be made upon written request from the Contractor at least 10 days prior to the last day of the establishment period. Final inspection will be based upon satisfactory health and growth of plants and on the following:

3.4.6.1 Total Plants on Site

Plants have been accepted and required number of replacements have been installed.

3.4.6.2 Mulching and Weeding

Planter beds and earth mound water basins are properly mulched and free of weeds.

3.4.6.3 Remedial Work

Remedial measures directed by the Contracting Officer to ensure plant material survival and promote healthy growth have been completed.

3.5 FIELD QUALITY CONTROL

3.5.1 Maintenance Inspection Report

Provide maintenance inspection report to assure that landscape maintenance is being performed in accordance with the specifications and in the best interest of plant growth and survivability. Site observations shall be documented at the start of the establishment period, then quarterly following the start, and at the end of establishment period. Results of site observation visits shall be submitted to the Contracting Officer within 7 calendar days of each site observation visit.

3.5.2 Tree Staking and Guying Removal

The Contractor shall provide a certified letter that all stakes and guys are removed from all project trees at the end of the establishment period.

-- End of Section --

SECTION 32 11 10

DRAINAGE LAYER

08/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 131	(2006) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 29/C 29M	(2009) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C 88	(2005) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM D 2487	(2010) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 4791	(2010) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D 75/D 75M	(2009) Standard Practice for Sampling Aggregates

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST IR 91-4756	(1991) Laboratory Accreditation Activities in the United States
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1.2 SYSTEM DESCRIPTION

Build a drainage layer under the pavements, as indicated on drawings, consisting of .

1.2.1 Equipment

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times.

1.2.2 Placement Equipment

Use an asphalt paving machine to place drainage layer material. Alternate

methods may be used if it can be demonstrated in the test section that these methods obtain the specified results.

1.2.3 Compaction Equipment

Use a dual or single smooth 10 2000 lb- tons (min.) vibratory drum roller, which provides a maximum compactive effort without crushing the drainage layer aggregate, to compact drainage layer material.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Waybills and Delivery Tickets

Certified waybills and delivery tickets for all aggregates materials actually used.

SD-06 Test Reports

Sampling and Testing

Copies of field test results within 24 hours of completion of tests.

Approval of Materials; G

Material sources and material test results prior to field use.

Evaluation

Test section construction report.

1.4 QUALITY ASSURANCE

1.4.1 Sampling and Testing

Sampling and testing are the responsibility of the Contractor to be performed by an approved commercial testing laboratory, or by the Contractor subject to approval. If the Contractor elects to establish testing facilities of its own, approval of such facilities will be based on compliance with NIST IR 91-4756, and no work requiring testing will be permitted until the Contractor's facilities have been inspected and approved. The first inspection of the facilities will be at the expense of the Government and any subsequent inspections required because of failure of the first inspection shall be at the expense of the Contractor. Such costs will be deducted from the total amount due the Contractor. Test drainage layer materials to establish compliance with the specified requirements.

1.4.2 Sampling

Take aggregate samples in accordance with ASTM D 75/D 75M.

1.4.3 Test Methods

1.4.3.1 Soundness Test

Perform soundness tests in accordance with [ASTM C 88](#).

1.4.3.2 Los Angeles Abrasion Test

Perform Los Angeles abrasion tests in accordance with [ASTM C 131](#).

1.4.3.3 Flat or Elongated Particles Tests

Perform flat and/or elongated particles tests in accordance with [ASTM D 4791](#).

1.4.3.4 Fractured Faces Tests

When aggregates are supplied from crushed gravel, use approved test methods to ensure the aggregate meets the requirements for fractured faces in paragraph AGGREGATES.

1.4.4 Initial Tests

Perform one of each of the following tests on the proposed material, prior to commencing construction, to demonstrate that the proposed material meets all specified requirements when furnished. If materials from more than one source are going to be utilized, complete the following tests for each source.

- a. Sieve Analysis including [0.02mm](#) size material.
- b. Flat and/or elongated particles
- c. Fractured Faces
- d. Los Angeles abrasion.
- e. Soundness.

1.4.5 Testing Frequency

1.4.6 [Approval of Materials](#)

1.4.6.1 Aggregate

Select the aggregate source at least 60 days prior to field use in the test section. Tentative approval of the source will be based on certified test results to verify that materials proposed for use meet the contract requirements. Final approval of both the source and the material will be based on test section performance and tests for gradation, soundness, Los Angeles abrasion, flat and/or elongated particles tests and fractured faces tests. For aggregate drainage layer materials, perform these tests on samples taken from the completed and compacted drainage layer course within the test section.

1.5 ENVIRONMENTAL REQUIREMENTS

Place drainage layer material when the atmospheric temperature is above [35 degrees F](#). Correct areas of completed drainage layer or underlying courses

that are damaged by freezing, rainfall, or other weather conditions or by contamination from sediments, dust, dirt, or foreign material to meet specified requirements.

PART 2 PRODUCTS

2.1 AGGREGATES

Provide aggregates consisting of clean, sound, hard, durable, angular particles of crushed stone, crushed slag, or crushed gravel which meet the specification requirements. Slag shall be an air-cooled, blast-furnace product having a dry weight of not less than 65 pcf determined by ASTM C 29/C 29M. Provide aggregates free of silt and clay as defined by ASTM D 2487, vegetable matter, and other objectionable materials or coatings.

2.1.1 Aggregate Quality

The aggregate shall have a soundness loss not greater than 18 percent weighted averaged at 5 cycles when tested in magnesium sulfate in accordance with ASTM C 88 and a percentage of loss on abrasion not to exceed 40 after 500 revolutions as determined by ASTM C 131. Determine the percentage of flat and/or elongated particles by ASTM D 4791 with the following modifications: 1) The aggregates shall be separated into 2 size fractions, particles greater than 1/2 inch sieve and particles passing the 1/2 inch sieve and retained on the No. 4 sieve. 2) The percentage of flat and/or elongated particles in either fraction shall not exceed 20. 3) A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. 4) When the aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements. When the aggregate is supplied from crushed gravel it shall be manufactured from gravel particles, 90 percent of which by weight are retained on the maximum-size sieve listed in TABLE I. In the portion retained on each sieve specified, the crushed gravel shall contain at least 90 percent by weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the face. When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as 2 fractured faces.

2.1.2 Gradation Requirements

Drainage layer aggregates shall be well graded within the limits specified in TABLE I.

TABLE I. GRADATION OF DRAINAGE LAYER MATERIAL

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation
1-1/2 inch
1 inch
3/4 inch
1/2 inch
3/8 inch
No. 4
No. 8

TABLE I. GRADATION OF DRAINAGE LAYER MATERIAL

Percentage by Weight Passing Square-Mesh Sieve

No. 16

NOTE 1: The values are based on aggregates of uniform specific gravity, and the percentages passing the various sieves may require appropriate correction by the Contracting Officer when aggregates of varying specific gravities are used.

PART 3 EXECUTION

3.1 STOCKPILING AGGREGATES

Stockpile aggregates at locations designated by the Contracting Officer. Clear and level stockpile areas prior to stockpiling aggregates to prevent segregation and contamination. Aggregates obtained from different sources shall be stockpiled separately.

3.2 TEST SECTION

3.2.1 Data

Construct a test section to evaluate the ability to carry traffic, including placement of overlaying material and the constructability of the drainage layer including required mixing, placement, and compaction procedures. Test section data will be used by the Contracting Officer to validate the required number of compaction passes given in paragraph Compaction Requirements for full scale production.

3.2.2 Schedule/Evaluation

Construct the test section a minimum of 30 days prior to the start of full scale production to provide sufficient time for an evaluation of the proposed materials, equipment and procedures including Government QA testing.

3.2.3 Location and Size

Place the test section inside the production paving limits. The underlying courses and subgrade preparation, required for the pavement section, shall be completed, inspected and approved in the test section prior to constructing the drainage layer. The test section shall be a minimum of 100 feet long and two full paving lanes wide side by side.

3.2.4 Initial Testing

Provide certified test results, approved by the Contracting Officer prior to the start of the test section, to verify that the materials proposed for use in the test section meet the contract requirements.

3.2.5 Mixing, Placement, and Compaction

Accomplish mixing, placement, and compaction using equipment meeting the requirements of paragraph EQUIPMENT. Compaction equipment speed shall be no greater than 1.5 mph. Start compaction from the outside edges of the paving lane and proceed to the centerline of the lift being placed. The roller shall stay a minimum of one half the roller width from the outside edge of the drainage layer being placed until the desired density is obtained. The outside edge shall then be rolled.

3.2.6 Procedure

3.2.7 Evaluation

Within 10 days of completion of the test section, submit to the Contracting Officer a Test Section Construction Report complete with all required test data and correlations. The Contracting Officer will evaluate the data and validate the required number of passes of the roller, the need for a final static pass of the roller.

3.3 PREPARATION OF UNDERLYING COURSE

Prior to constructing the drainage layer, clean the underlying course of all foreign materials. During construction, the underlying course shall contain no frozen material. The underlying course shall conform to Section 32 11 16.16 SUBBASE COURSES. Correct ruts or soft yielding spots in the underlying courses having inadequate compaction and deviations of the surface from the requirements set forth herein by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line, and grade, and recompacting to specified density. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained in a satisfactory condition until the drainage layer is placed.

3.4 TRANSPORTING MATERIAL

3.4.1 Aggregate Drainage Layer Material

Transport aggregate drainage layer material to the site in a manner which prevents segregation and contamination of materials.

3.5 PLACING

3.5.1 General Requisites

Place drainage layer material on the underlying course in lifts of uniform thickness using equipment meeting the requirements of paragraph EQUIPMENT. When a compacted layer 6 inches or less in thickness is required, place the material in a single lift. When a compacted layer in excess of 6 inches is required, place the material in lifts of equal thickness. No lift shall exceed 6 inches or be less than 3 inches when compacted. The lifts when compacted after placement shall be true to the grades or levels required with the least possible surface disturbance. Where the drainage layer is placed in more than one lift, clean the previously constructed lift of loose and foreign material. Such adjustments in placing procedures or equipment shall be made to obtain true grades and minimize segregation and degradation of the drainage layer material.

3.5.2 Hand Spreading

Spread by hand drainage layer material in areas where machine spreading is impractical. The material shall be spread uniformly in a loose layer to prevent segregation. The material shall conform to the required grade and thickness after compaction.

3.6 COMPACTION REQUIREMENTS

3.6.1 Number of Passes

Accomplish compaction using rollers meeting the requirements of paragraph EQUIPMENT and operating at a rolling speed of no greater than 1.5 miles per hour. Compact each lift of drainage material, including shoulders when specified under the shoulders, with the number of passes of the roller as follows: The Contracting Officer will validate the number of roller passes after the test section is evaluated and before production starts.

3.6.2 Dry Density

Excessive rolling resulting in crushing of aggregate particles shall be avoided. In all places not accessible to the rollers, compact the drainage layer material with mechanical hand operated tampers.

3.7 FINISHING

Finish the top surface of the drainage layer after final compaction, as determined from the test section. Make adjustments in rolling and finishing procedures to obtain grades and minimize segregation and degradation of the drainage layer material.

3.8 EDGES OF DRAINAGE LAYER

Place shoulder material along the edges of the drainage layer course in a quantity that will compact to the thickness of the layer being constructed. At least 3 feet width of the shoulder shall be rolled and compacted simultaneously with the rolling and compacting of each lift of the drainage layer.

3.9 SMOOTHNESS TEST

The surface of the top lift shall not deviate more than 3/8 inch when tested with either a 10 or 12 foot straightedge applied parallel with and at right angles to the centerline of the area to be paved. Correct deviations exceeding 3/8 inch in accordance with paragraph DEFICIENCIES.

3.10 THICKNESS CONTROL

The completed thickness of the drainage layer shall be within 1/2 inch of the thickness indicated. Measure thickness at intervals providing at least one measurement for each 500 square yards of drainage layer. Make measurements in test holes at least 3 inches in diameter unless the Contractor can demonstrate, for COR approval, that a steel rod pushed through the drainage layer clearly stops at the material interface. Where the measured thickness is more than 1/2 inch deficient, such areas shall be corrected in accordance with paragraph DEFICIENCIES. Where the measured thickness is 1/2 inch more than indicated, it will be considered as conforming to the requirements plus 1/2 inch, provided the surface of the drainage layer is within 1/2 inch of established grade. The average job

thickness shall be the average of all job measurements as specified above but within $1/4$ inch of the thickness shown on the drawings.

3.11 DEFICIENCIES

3.11.1 Grade and Thickness

Correct deficiencies in grade and thickness so that both grade and thickness tolerances are met. Thin layers of material shall not be added to the top surface of the drainage layer to meet grade or increase thickness. If the elevation of the top of the drainage layer is more than $1/2$ inch above the plan grade it shall be trimmed to grade and finished in accordance with paragraph FINISHING. If the elevation of the top surface of the drainage layer is $1/2$ inch or more below the required grade, the surface of the drainage layer shall be scarified to a depth of at least 3 inches, new material shall be added, and the layer shall be blended and recompacted to bring it to grade. Where the measured thickness of the drainage layer is more than $1/2$ inch deficient, such areas shall be corrected by excavating to the required depth and replaced with new material to obtain a compacted lift thickness of at least 3 inches. The depth of required excavation shall be controlled to keep the final surface elevation within grade requirements and to preserve layer thicknesses of materials below the drainage layer.

3.11.2 Smoothness

Correct deficiencies in smoothness as if they are deficiencies in grade or thickness. All tolerances for grade and thickness shall be maintained while correcting smoothness deficiencies.

-- End of Section --

SECTION 32 11 23

AGGREGATE AND/OR GRADED-CRUSHED AGGREGATE BASE COURSE
08/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

- AASHTO T 180 (2010) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
- AASHTO T 224 (2010) Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test

ASTM INTERNATIONAL (ASTM)

- ASTM C 117 (2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
- ASTM C 127 (2007) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
- ASTM C 128 (2007a) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
- ASTM C 131 (2006) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- ASTM C 136 (2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
- ASTM C 29/C 29M (2009) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
- ASTM C 88 (2005) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- ASTM D 1556 (2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D 1557	(2009) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³) (2700 kN-m/m ³)
ASTM D 2167	(2008) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(2010) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 422	(1963; R 2007) Particle-Size Analysis of Soils
ASTM D 4318	(2010) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 5821	(2001; R 2006) Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM D 6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D 75/D 75M	(2009) Standard Practice for Sampling Aggregates
ASTM E 11	(2010a) Wire Cloth and Sieves for Testing Purposes

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2002; R 2009) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)
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1.2 DEFINITIONS

For the purposes of this specification, the following definitions apply.

1.2.1 Aggregate Base Course

Aggregate base course (ABC) is well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction.

1.2.2 Graded-Crushed Aggregate Base Course

Graded-crushed aggregate (GCA) base course is well graded, crushed, durable aggregate uniformly moistened and mechanically stabilized by compaction. GCA is similar to ABC, but it has more stringent requirements and it produces a base course with higher strength and stability.

1.2.3 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is

expressed as a percentage of the maximum laboratory dry density obtained by the test procedure presented in [ASTM D 1557](#) abbreviated as a percent of laboratory maximum dry density. Since [ASTM D 1557](#) applies only to soils that have 30 percent or less by weight of their particles retained on the [3/4 inch](#) sieve, the degree of compaction for material having more than 30 percent by weight of their particles retained on the [3/4 inch](#) sieve are expressed as a percentage of the laboratory maximum dry density in accordance with [AASHTO T 180](#) Method D and corrected with [AASHTO T 224](#).

1.3 SYSTEM DESCRIPTION

All [plant, equipment, and tools](#) used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. Submit a list of proposed equipment, including descriptive data. Provide adequate equipment having the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section [01 33 00](#) SUBMITTAL PROCEDURES:

[SD-03 Product Data](#)

[Plant, Equipment, and Tools](#)
[Waybills and Delivery Tickets](#)

[Local/Regional Materials; \(LEED\)](#)

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.]

[Recycled Content; \(LEED\)](#)

Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

[SD-06 Test Reports](#)

[Sampling and Testing; G](#)
[Field Density Tests; G](#)

1.5 QUALITY ASSURANCE

[Sampling and testing](#) are the responsibility of the Contractor and performed by a testing laboratory approved in accordance with Section [01 45 00.00 10](#) QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. Test the materials to establish compliance with the specified requirements; perform testing at

the specified frequency. The Contracting Officer may specify the time and location of the tests. Furnish copies of test results to the Contracting Officer within 24 hours of completion of the tests.

1.5.1 Sampling

Take samples for laboratory testing in conformance with [ASTM D 75/D 75M](#). When deemed necessary, the sampling will be observed by the Contracting Officer.

1.5.2 Tests

Perform the following tests in conformance with the applicable standards listed.

1.5.2.1 Sieve Analysis

Make sieve analysis in conformance with [ASTM C 117](#) and [ASTM C 136](#). Sieves shall conform to [ASTM E 11](#). Particle-size analysis of the soils shall also be completed in conformance with [ASTM D 422](#).

1.5.2.2 Liquid Limit and Plasticity Index

Determine liquid limit and plasticity index in accordance with [ASTM D 4318](#).

1.5.2.3 Moisture-Density Determinations

Determine the laboratory maximum dry density and optimum moisture content in accordance with [AASHTO T 180](#), Method D and corrected with [AASHTO T 224](#).

1.5.2.4 Field Density Tests

Measure field density in accordance with [ASTM D 1556](#), [ASTM D 2167](#) or [ASTM D 6938](#). For the method presented in [ASTM D 6938](#) check the calibration curves and adjust them, if necessary, using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed in accordance with [ASTM D 6938](#) result in a wet unit weight of soil, and [ASTM D 6938](#) shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in [ASTM D 6938](#). The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration of [ASTM D 6938](#), on each different type of material being tested at the beginning of a job and at intervals as directed.

- a. Submit certified copies of test results for approval not less than 30 days before material is required for the work.
- b. Submit calibration curves and related test results prior to using the device or equipment being calibrated.
- c. Submit copies of field test results within 24 hours after the tests are performed.

1.5.2.5 Wear Test

Perform wear tests on GCA course material in conformance with [ASTM C 131](#).

1.5.2.6 Soundness

Perform soundness tests on GCA in accordance with [ASTM C 88](#).

1.5.2.7 Weight of Slag

Determine weight per cubic [foot](#) of slag in accordance with [ASTM C 29/C 29M](#) on the GCA course material.

1.5.3 Testing Frequency

1.5.3.1 Initial Tests

Perform one of each of the following tests, on the proposed material prior to commencing construction, to demonstrate that the proposed material meets all specified requirements when furnished. If materials from more than one source are going to be utilized, this testing shall be completed for each source.

- a. Sieve Analysis including the [No. 635](#) sieve.
- b. Liquid limit and plasticity index.
- c. Moisture-density relationship.
- d. Wear.
- e. Soundness.
- f. .
- g. .

1.5.3.2 In Place Tests

Perform each of the following tests on samples taken from the placed and compacted GCA. Samples shall be taken and tested at the rates indicated. Perform sampling and testing of recycled concrete aggregate at twice the specified frequency until the material uniformity is established.

- a. Perform density tests on every lift of material placed and at a frequency of one set of tests for every [250 square yards](#) , or portion thereof, of completed area.
- b. Perform sieve analysis including the [No. 635](#) sieve on every lift of material placed and at a frequency of one sieve analysis for every [500 square yards](#) , or portion thereof, of material placed.
- c. Perform liquid limit and plasticity index tests at the same frequency as the sieve analysis.
- d. Measure the total thickness of the base course at intervals, in such a manner as to ensure one measurement for each [500 square yards](#) of base course. Measurements shall be made in [3 inch](#) diameter test holes penetrating the base course.

1.5.4 Approval of Material

Select the source of the material 30 days prior to the time the material

will be required in the work. Tentative approval of material will be based on initial test results. Final approval of the materials will be based on sieve analysis, liquid limit, and plasticity index tests performed on samples taken from the completed and fully compacted course(s).

1.6 ENVIRONMENTAL REQUIREMENTS

Perform construction when the atmospheric temperature is above 35 degrees F. When the temperature falls below 35 degrees F, protect all completed areas by approved methods against detrimental effects of freezing. Correct completed areas damaged by freezing, rainfall, or other weather conditions to meet specified requirements.

PART 2 PRODUCTS

2.1 AGGREGATES

Provide GCA consisting of clean, sound, durable particles of crushed stone, crushed slag, crushed gravel, angular sand, or other approved material. GCA shall be free of silt and clay as defined by ASTM D 2487, organic matter, and other objectionable materials or coatings. The portion retained on the No. 4 sieve is known as coarse aggregate; that portion passing the No. 4 sieve is known as fine aggregate.

2.1.1 Coarse Aggregate

Provide coarse aggregates with angular particles of uniform density. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements and shall be stockpiled separately.

- a. Crushed Gravel: Crushed gravel shall be manufactured by crushing gravels, and shall meet all the requirements specified below.
- b. Crushed Stone: Provide crushed stone consisting of freshly mined quarry rock, meeting all the requirements specified below.
- c. Crushed Recycled Concrete: Provide crushed recycled concrete consisting of previously hardened portland cement concrete or other concrete containing pozzolanic binder material. The recycled material shall be free of all reinforcing steel, bituminous concrete surfacing, and any other foreign material and shall be crushed and processed to meet the required gradations for coarse aggregate. Reject recycled concrete aggregate exceeding this value. Crushed recycled concrete shall meet all other applicable requirements specified below.
- d. Crushed Slag: Crushed slag shall be an air-cooled blast-furnace product having an air dry unit weight of not less than 70 pcf as determined by ASTM C 29/C 29M, and shall meet all the requirements specified below.

2.1.1.1 Aggregate Base Course

ABC coarse aggregate shall not show more than 50 percent loss when subjected to the Los Angeles abrasion test in accordance with ASTM C 131. The amount of flat and elongated particles shall not exceed 30 percent. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. In the portion retained on each sieve specified, the crushed aggregates

shall contain at least 50 percent by weight of crushed pieces having two or more freshly fractured faces determined in accordance with [ASTM D 5821](#). When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as two fractured faces. Crushed gravel shall be manufactured from gravel particles 50 percent of which, by weight, are retained on the maximum size sieve listed in TABLE 1.

2.1.1.2 Graded-Crushed Aggregate Base Course

GCA coarse aggregate shall not show more than 40 percent loss when subjected to the Los Angeles abrasion test in accordance with [ASTM C 131](#). GCA coarse aggregate shall not exhibit a loss greater than 18 percent weighted average, at five cycles, when tested for soundness in magnesium sulfate, or 12 percent weighted average, at five cycles, when tested in sodium sulfate in accordance with [ASTM C 88](#). The amount of flat and elongated particles shall not exceed 20 percent for the fraction retained on the $1/2$ inch sieve nor 20 percent for the fraction passing the $1/2$ inch sieve. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. In the portion retained on each sieve specified, the crushed aggregate shall contain at least 90 percent by weight of crushed pieces having two or more freshly fractured faces determined in accordance with [ASTM D 5821](#). When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as two fractured faces. Crushed gravel shall be manufactured from gravel particles 90 percent of which by weight are retained on the maximum size sieve listed in TABLE 1.

2.1.2 Fine Aggregate

Fine aggregates shall be angular particles of uniform density. When the fine aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements.

2.1.2.1 Aggregate Base Course

ABC fine aggregate shall consist of screenings, angular sand, crushed recycled concrete fines, or other finely divided mineral matter processed or naturally combined with the coarse aggregate.

2.1.2.2 Graded-Crushed Aggregate Base Course

Provide GCA fine aggregate consisting of angular particles produced by crushing stone, slag, or gravel that meets the requirements for wear and soundness specified for GCA coarse aggregate. Fine aggregate shall be manufactured from gravel particles 95 percent of which by weight are retained on the $1/2$ inch sieve.

2.1.3 Gradation Requirements

Apply the specified gradation requirements to the completed base course. The aggregates shall be continuously well graded within the limits specified in TABLE 1. Sieves shall conform to [ASTM E 11](#).

TABLE 1. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	No. 1	No. 2	No. 3
2 inch	100	----	----
1-1/2 inch	70-100	100	----
1 inch	45-80	60-100	100
1/2 inch	30-60	30-65	40-70
No. 4	20-50	20-50	20-50
No. 10	15-40	15-40	15-40
No. 40	5-25	5-25	5-25
No. 200	0-8	0-8	0-8

NOTE 1: Particles having diameters less than No. 635 shall not be in excess of 3 percent by weight of the total sample tested.

NOTE 2: The values are based on aggregates of uniform specific gravity. If materials from different sources are used for the coarse and fine aggregates, they shall be tested in accordance with ASTM C 127 and ASTM C 128 to determine their specific gravities. If the specific gravities vary by more than 10 percent, the percentages passing the various sieves shall be corrected as directed by the Contracting Officer.

2.2 LIQUID LIMIT AND PLASTICITY INDEX

Apply liquid limit and plasticity index requirements to the completed course and to any component that is blended to meet the required gradation. The portion of any component or of the completed course passing the No. 40 sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

When the GCA is constructed in more than one layer, clean the previously constructed layer of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Provide adequate drainage during the entire period of construction to prevent water from collecting or standing on the working area. Provide line and grade stakes as necessary for control. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

3.2 OPERATION OF AGGREGATE SOURCES

Clearing, stripping, and excavating are the responsibility of the Contractor. Operate the aggregate sources to produce the quantity and quality of materials meeting the specified requirements in the specified time limit. Upon completion of the work, the aggregate sources on Government property shall be conditioned to drain readily and shall be left in a satisfactory condition. Aggregate sources on private lands shall be conditioned in agreement with local laws or authorities.

3.3 STOCKPILING MATERIAL

Clear and level storage sites prior to stockpiling of material. Stockpile all materials, including approved material available from excavation and grading, in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

3.4 PREPARATION OF UNDERLYING COURSE

Prior to constructing the base course(s), the underlying course or subgrade shall be cleaned of all foreign substances. At the time of construction of the base course(s), the underlying course shall contain no frozen material. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. The underlying course shall conform to Section 31 00 00 EARTHWORK. Ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses containing sands or gravels, as defined in ASTM D 2487, the surface shall be stabilized prior to placement of the base course(s). Stabilization shall be accomplished by mixing GCA into the underlying course and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements of the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained in a satisfactory condition until the base course is placed.

3.5 INSTALLATION

3.5.1 Mixing the Materials

Mix the coarse and fine aggregates in a stationary plant, or in a traveling plant or bucket loader on an approved paved working area. Make adjustments in mixing procedures or in equipment, as directed, to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory base course meeting all requirements of this specification.

3.5.2 Placing

Place the mixed material on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. When a compacted layer 6 inches or less in thickness is required, place the material in a single layer. When a compacted layer in excess of 6 inches is required, place the material in layers of equal thickness. No layer shall be thicker than 6 inches or thinner than 3 inches when compacted. The layers shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the base course is placed in more than one layer, the previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable base course.

3.5.3 Grade Control

The finished and completed base course shall conform to the lines, grades, and cross sections shown. Underlying material(s) shall be excavated and prepared at sufficient depth for the required base course thickness so that the finished base course and the subsequent surface course will meet the designated grades.

3.5.4 Edges of Base Course

The base course(s) shall be placed so that the completed section will be a minimum of 2 feet wider, on all sides, than the next layer that will be placed above it. Additionally, place approved fill material along the outer edges of the base course in sufficient quantities to compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple layer course, allowing in each operation at least a 2 foot width of this material to be rolled and compacted simultaneously with rolling and compacting of each layer of base course. If this base course material is to be placed adjacent to another pavement section, then the layers for both of these sections shall be placed and compacted along this edge at the same time.

3.5.5 Compaction

Compact each layer of the base course, as specified, with approved compaction equipment. Maintain water content during the compaction procedure to within plus or minus 2 percent of the optimum water content determined from laboratory tests as specified in this Section. Begin rolling at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. Speed of the roller shall be such that displacement of the aggregate does not occur. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Continue compaction until each layer has a degree of compaction that is at least 100 percent of laboratory maximum density through the full depth of the layer. Make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory base course. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

3.5.6 Thickness

Construct the compacted thickness of the base course as indicated. No individual layer shall be thicker than 6 inches nor be thinner than 3 inches in compacted thickness. The total compacted thickness of the base course(s) shall be within 1/2 inch of the thickness indicated. Where the measured thickness is more than 1/2 inch deficient, correct such areas by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 1/2 inch thicker than indicated, the course shall be considered as conforming to the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 1/4 inch of the thickness indicated. The total thickness of the base course shall be measured at intervals in such a manner as to ensure one measurement for each 500 square yards of base course. Measurements

shall be made in 3 inch diameter test holes penetrating the base course.

3.5.7 Proof Rolling

Proof rolling of the areas indicated shall be in addition to the compaction specified and shall consist of the application of 5 coverages with a heavy pneumatic-tired roller having four or more tires, each loaded to a minimum of 30,000 pounds and inflated to a minimum of 125 psi. In areas designated, apply proof rolling to the top of the underlying material on which the base course is laid and to each layer of base course top of the completed GCA course. Maintain water content of the underlying material at optimum or at the percentage directed from start of compaction to completion of proof rolling of that layer. Water content of each layer of the base course shall be maintained at the optimum percentage directed from start of compaction to completion of proof rolling. Any base course materials or any underlying materials that produce unsatisfactory results by proof rolling shall be removed and replaced with satisfactory materials, recompacted and proof rolled to meet these specifications.

3.5.8 Finishing

The surface of the top layer of base course shall be finished after final compaction and proof rolling by cutting any overbuild to grade and rolling with a steel-wheeled roller. Thin layers of material shall not be added to the top layer of base course to meet grade. If the elevation of the top layer of base course is 1/2 inch or more below grade, then the top layer should be scarified to a depth of at least 3 inches and new material shall be blended in, compacted and proof rolled to bring to grade. Adjustments to rolling and finishing procedures shall be made as directed to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, the unsatisfactory portion shall be scarified, reworked and recompacted or it shall be replaced as directed.

3.5.9 Smoothness

The surface of the top layer shall show no deviations in excess of 3/8 inch when tested with a 12 foot straightedge. Take measurements in successive positions parallel to the centerline of the area to be paved. Measurements shall also be taken perpendicular to the centerline at 50 foot intervals. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

3.6 TRAFFIC

Do not allow traffic on the completed base course.

3.7 MAINTENANCE

Maintain the base course in a satisfactory condition until the full pavement section is completed and accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any base course that is not paved over prior to the onset of winter, shall be retested to verify that it still complies with the requirements of this specification. Any area of base course that is damaged shall be reworked or replaced as necessary to comply with this specification.

3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

Any unsuitable materials that must be removed shall be disposed of outside the limits of Government-controlled land . No additional payments will be made for materials that must be replaced.

-- End of Section --

SECTION 32 12 10

BITUMINOUS TACK AND PRIME COATS
08/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 81 (1992; R 2008) Standard Specification for
Cutback Asphalt (Rapid-Curing Type)

AASHTO T 40 (2002; R 2006) Sampling Bituminous
Materials

ASTM INTERNATIONAL (ASTM)

ASTM D 140/D 140M (2009) Standard Practice for Sampling
Bituminous Materials

ASTM D 2027 (2010) Cutback Asphalt (Medium-Curing Type)

ASTM D 2028 (2010) Cutback Asphalt (Rapid-Curing Type)

ASTM D 2995 (1999; R 2009) Determining Application
Rate of Bituminous Distributors

ASTM D2026/D2026M (1997; R 2010e1) Cutback Asphalt
(Slow-Curing Type)

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED (2002; R 2005) Leadership in Energy and
Environmental Design(tm) Green Building
Rating System for New Construction
(LEED-NC)

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

Plant, equipment, machines and tools used in the work are subject to approval and shall be maintained in a satisfactory working condition at all times. Calibrated equipment such as asphalt distributors, scales, batching equipment, spreaders and similar equipment, should have been recalibrated by a calibration laboratory within 12 months prior to commencing work .

1.2.2 Bituminous Distributor

Provide a distributor with pneumatic tires of such size and number that the

load produced on the base surface does not exceed 650 psi of tire width to prevent rutting, shoving or otherwise damaging the base surface or other layers in the pavement structure. Design and equip the distributor to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard, with a pressure range of 25 to 75 psi and with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. Include with the distributor equipment a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. Equip the distributor to circulate and agitate the bituminous material during the heating process.

1.2.3 Heating Equipment for Storage Tanks

The equipment for heating the bituminous material shall be steam, electric, or hot oil heaters. Provide steam heaters consisting of steam coils and equipment for producing steam, so designed that the steam cannot get into the material. Fix an armored thermometer to the tank with a temperature range from 40 to 400 degrees F so that the temperature of the bituminous material may be determined at all times.

1.2.4 Power Brooms and Power Blowers

Use power brooms and power blowers suitable for cleaning the surfaces to which the bituminous coat is to be applied.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Waybills and Delivery Tickets

Waybills and delivery tickets, during progress of the work.

Local/Regional Materials

Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project in accordance with LEED.

SD-06 Test Reports

Sampling and Testing

Copies of all test results for emulsified asphalt, and bituminous materials, within 24 hours of completion of tests. Certified copies of the manufacturer's test reports indicating

temperature viscosity relationship for cutback asphalt, compliance with applicable specified requirements, not less than 30 days before the material is required in the work.

1.4 QUALITY ASSURANCE

Use [Local/Regional Materials](#) or products extracted, harvested, or recovered, as well as manufactured, within a [500 mile](#) radius from the project site, if available from a minimum of three sources. See Section [01 33 29](#) LEED(tm) DOCUMENTATION for cumulative total local material requirements. Tack and prime coat materials may be locally available.

1.5 DELIVERY, STORAGE, AND HANDLING

Inspect the materials delivered to the site for contamination and damage. Unload and store the materials with a minimum of handling.

1.6 ENVIRONMENTAL REQUIREMENTS

Apply bituminous coat only when the surface to receive the bituminous coat is dry. Apply bituminous coat only when the atmospheric temperature in the shade is [50 degrees F](#) or above and when the temperature has not been below [35 degrees F](#) for the 12 hours prior to application, unless otherwise directed.

PART 2 PRODUCTS

2.1 PRIME COAT

Provide asphalt conforming to [AASHTO M 81](#), Grade [_____] and specified in the following two subparagraphs.

2.1.1 Cutback Asphalt

Provide cutback asphalt conforming to [ASTM D 2027](#), Grade MC-70 [ASTM D 2028](#), Grade RC-70.

2.2 TACK COAT

Provide asphalt conforming to [ASTM D 2028](#).

2.2.1 Cutback Asphalt

Provide cutback asphalt conforming to [ASTM D2026/D2026M](#), Grade SC-70.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACE

Immediately before applying the bituminous coat, remove all loose material, dirt, clay, or other objectionable material from the surface to be treated by means of a power broom or blower supplemented with hand brooms. The surface shall be dry and clean at the time of treatment.

3.2 APPLICATION RATE

The exact quantities within the range specified, which may be varied to suit field conditions, will be determined by the Contracting Officer.

3.2.1 Tack Coat

Apply bituminous material for the tack coat in quantities of not less than 0.05 gallon nor more than 0.15 gallon per square yard of pavement surface.

3.2.2 Prime Coat

Apply bituminous material for the prime coat in quantities of not less than 0.18 gallon nor more than 0.35 gallon per square yard of pavement surface.

3.3 APPLICATION TEMPERATURE

3.3.1 Viscosity Relationship

Asphalt application temperature shall provide an application viscosity between 10 and 60 seconds, Saybolt Furol, or between 20 and 120 centistokes, kinematic. Furnish the temperature viscosity relation to the Contracting Officer.

3.3.2 Temperature Ranges

The viscosity requirements determine the application temperature to be used. The following is a normal range of application temperatures:

Liquid Asphalts

MC-70

120-225 degrees F

Paving Grade Asphalts

Penetration Grades

85-100

plus 280 degrees F

Viscosity Grades

AC 2.5

plus 270 degrees F

Emulsions

RS-1

70-140 degrees F

These temperature ranges exceed the flash point of the material and care should be taken in their heating.

3.4 APPLICATION

3.4.1 General

Following preparation and subsequent inspection of the surface, apply the bituminous prime or tack coat with the Bituminous Distributor at the

specified rate with uniform distribution over the surface to be treated. Properly treat all areas and spots missed by the distributor with the hand spray. Until the succeeding layer of pavement is placed, maintain the surface by protecting the surface against damage and by repairing deficient areas at no additional cost to the Government. If required, spread clean dry sand to effectively blot up any excess bituminous material. No smoking, fires, or flames other than those from the heaters that are a part of the equipment are permitted within 25 feet of heating, distributing, and transferring operations of bituminous material other than bituminous emulsions. Prevent all traffic, except for paving equipment used in constructing the surfacing, from using the underlying material, whether primed or not, until the surfacing is completed. The bituminous coat shall conform to all requirements as described herein.

3.4.2 Prime Coat

The prime coat is required if it will be at least 7 days before the surfacing (Asphalt cement hot mix concrete) layer is constructed on the underlying (base course, etc.) compacted material. The type of liquid asphalt and application rate will be as specified herein. Protect the underlying from any damage (water, traffic, etc.) until the surfacing is placed. If the Contractor places the surfacing within seven days, the choice of protection measures or actions to be taken is at the Contractor's option. Repair (recompact or replace) damage to the underlying material caused by lack of, or inadequate, protection by approved methods at no additional cost to the Government. If the Contractor opts to use the prime coat, apply as soon as possible after consolidation of the underlying material.] Apply the bituminous material uniformly over the surface to be treated at a pressure range of 25 to 75 psi; the rate shall be as specified above in paragraph APPLICATION RATE. To obtain uniform application of the prime coat on the surface treated at the junction of previous and subsequent applications, spread building paper on the surface for a sufficient distance back from the ends of each application to start and stop the prime coat on the paper and to ensure that all sprayers will operate at full force on the surface to be treated. Immediately after application remove and destroy the building paper.

3.4.3 Tack Coat

Apply tack coat at the locations shown on the drawings. Apply the tack coat when the surface to be treated is dry. Immediately following the preparation of the surface for treatment, apply the bituminous material by means of the bituminous distributor, within the limits of temperature specified herein and at a rate as specified above in paragraph APPLICATION RATE. Apply the bituminous material so that uniform distribution is obtained over the entire surface to be treated. Treat lightly coated areas and spots missed by the distributor with the bituminous material. Following the application of bituminous material, allow the surface to cure without being disturbed for period of time necessary to permit setting of the tack coat. Apply the bituminous tack coat only as far in advance of the placing of the overlying layer as required for that day's operation. Maintain and protect the treated surface from damage until the succeeding course of pavement is placed.

3.5 CURING PERIOD

Following application of the bituminous material and prior to application of the succeeding layer of pavement, allow the bituminous coat to cure and to obtain evaporation of any volatiles or moisture. Maintain the coated

surface until the succeeding layer of pavement is placed, by protecting the surface against damage and by repairing and recoating deficient areas. [Allow the prime coat to cure without being disturbed for a period of at least 48 hours or longer, as may be necessary to attain penetration into the treated course. Furnish and spread enough sand to effectively blot up and cure excess bituminous material.]

3.6 FIELD QUALITY CONTROL

Samples of the bituminous material shall be tested for compliance with the applicable specified requirements. A sample shall be obtained and tested by the Contractor for every 150 gallons] of bituminous material used.

3.7 SAMPLING AND TESTING

Perform sampling and testing by an approved commercial testing laboratory or by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved.

3.7.1 Sampling

The samples of bituminous material, unless otherwise specified, shall be in accordance with ASTM D 140/D 140M or AASHTO T 40. Sources from which bituminous materials are to be obtained shall be selected and notification furnished the Contracting Officer within 15 days after the award of the contract.

3.7.2 Calibration Test

Furnish all equipment, materials, and labor necessary to calibrate the bituminous distributor. Calibration shall be made with the approved job material and prior to applying the bituminous coat material to the prepared surface. Calibrate the bituminous distributor in accordance with ASTM D 2995.

3.7.3 Trial Applications

Before providing the complete bituminous coat, apply three lengths of at least 100 feet for the full width of the distributor bar to evaluate the amount of bituminous material that can be satisfactorily applied.

3.7.3.1 Tack Coat Trial Application Rate

Unless otherwise authorized, apply the trial application rate of bituminous tack coat materials in the amount of 0.05 gallons per square yard. Other trial applications shall be made using various amounts of material as may be deemed necessary.

3.7.3.2 Prime Coat Trial Application Rate

Unless otherwise authorized, apply the trial application rate of bituminous materials in the amount of 0.25 gallon per square yard. Other trial applications shall be made using various amounts of material as may be deemed necessary.

3.7.4 Sampling and Testing During Construction

Perform quality control sampling and testing as required in paragraph FIELD QUALITY CONTROL.

3.8 TRAFFIC CONTROLS

Keep traffic off surfaces freshly treated with bituminous material.
Provide sufficient warning signs and barricades so that traffic will not
travel over freshly treated surfaces.

-- End of Section --

SECTION 32 12 15

HOT-MIX ASPHALT (HMA) FOR AIRFIELDS
08/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

- AASHTO M 156 (1997: R 2009) Standard Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
- AASHTO M 320 (2010) Standard Specification for Performance-Graded Asphalt Binder
- AASHTO T 308 (2010) Standard Method of Test for Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
- AASHTO T 329 (2008) Standard Test Method for Moisture Content of Hot Mix Asphalt (HMA) by Oven Method

ASPHALT INSTITUTE (AI)

- AI MS-02 (1997 6th Ed) Mix Design Methods

ASTM INTERNATIONAL (ASTM)

- ASTM C 117 (2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
- ASTM C 1252 (2010) Standard Test Methods for Uncompacted Void Content of Fine Aggregate (as Influenced by Particle Shape, Surface Texture, and Grading)
- ASTM C 127 (2007) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
- ASTM C 128 (2007a) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
- ASTM C 131 (2006) Standard Test Method for Resistance

	to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 29/C 29M	(2009) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C 566	(1997; R 2004) Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
ASTM C 88	(2005) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C142/C142M	(2010) Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM D 140/D 140M	(2009) Standard Practice for Sampling Bituminous Materials
ASTM D 1461	(1985; R 2006) Moisture or Volatile Distillates in Bituminous Paving Mixtures
ASTM D 2419	(2009) Sand Equivalent Value of Soils and Fine Aggregate
ASTM D 242/D 242M	(2009) Mineral Filler for Bituminous Paving Mixtures
ASTM D 2489/D 2489M	(2008) Estimating Degree of Particle Coating of Bituminous-Aggregate Mixtures
ASTM D 2726	(2010) Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
ASTM D 3665	(2007e1) Random Sampling of Construction Materials
ASTM D 3666	(2009a) Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
ASTM D 4791	(2010) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D 4867/D 4867M	(2009) Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D 5444	(2008) Mechanical Size Analysis of Extracted Aggregate
ASTM D 6307	(2010) Asphalt Content of Hot Mix Asphalt

by Ignition Method

ASTM D 6925 (2009) Standard Test Method for Preparation and Determination of the Relative Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyrotory Compactor

ASTM D 6926 (2010) Standard Practice for Preparation of Bituminous Specimens Using Marshall Apparatus

ASTM D 6927 (2006) Standard Test Method for Marshall Stability and Flow of Bituminous Mixtures

ASTM D 979 (2001; R 2006e1) Sampling Bituminous Paving Mixtures

ASTM D2172/D2172M (2011) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures

ASTM D4125/D4125M (2010) Asphalt Content of Bituminous Mixtures by the Nuclear Method

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS)

CTM 526 (2002) Operation of California Profilograph and Evaluation of Profiles

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 171 (1995) Standard Test Method for Determining Percentage of Crushed Particles in Aggregate

1.2 SYSTEM DESCRIPTION

Perform the work consisting of pavement courses composed of mineral aggregate and asphalt material heated and mixed in a central mixing plant and placed on a prepared course. HMA designed and constructed in accordance with this section shall conform to the lines, grades, thicknesses, and typical cross sections shown on the drawings. Construct each course to the depth, section, or elevation required by the drawings and rolled, finished, and approved before the placement of the next course. Submit proposed [Placement Plan](#), indicating lane widths, longitudinal joints, and transverse joints for each course or lift.

1.2.1 Asphalt Mixing Plant

Plants used for the preparation of hot-mix asphalt shall conform to the requirements of [AASHTO M 156](#) with the following changes:

a. Truck Scales. Weigh the asphalt mixture on approved scales furnished by the Contractor, or on certified public scales at the Contractor's expense. Scales shall be inspected and sealed at least annually by an approved calibration laboratory.

b. Testing Facilities. Provide laboratory facilities at the plant for the use of the [Government's](#) acceptance testing and the Contractor's

quality control testing.

c. Inspection of Plant. The Contracting Officer shall have access at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant; verifying weights, proportions, and material properties; checking the temperatures maintained in the preparation of the mixtures and for taking samples. Provide assistance as requested, for the Government to procure any desired samples.

d. Storage Bins. The asphalt mixture may be stored in non-insulated storage bins for a period of time not exceeding 3 hours. The asphalt mixture may be stored in insulated storage bins for a period of time not exceeding 8 hours. The mix drawn from bins shall meet the same requirements as mix loaded directly into trucks.

1.2.2 Hauling Equipment

Trucks used for hauling hot-mix asphalt shall have tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other approved material. Petroleum based products shall not be used as a release agent. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers (tarps) shall be securely fastened.

1.2.3 Material Transfer Vehicle (MTV)

Material transfer Vehicles shall be required due to the improvement in smoothness and decrease in both physical and thermal segregation. To transfer the material from the hauling equipment to the paver, use a self-propelled, material transfer vehicle that can deliver material to the paver without making contact with the paver. The MTV shall be able to move back and forth between the hauling equipment and the paver providing material transfer to the paver, while allowing the paver to operate at a constant speed. The Material Transfer Vehicle will have remixing and storage capability to prevent physical and thermal segregation.

1.2.4 Asphalt Pavers

Mechanical spreading and finishing equipment shall consist of a self-powered paver, capable of spreading and finishing the mixture to the specified line, grade, and cross section. The screed of the paver shall be capable of laying a uniform mixture to meet the specified thickness, smoothness, and grade without physical or temperature segregation, the full width of the material being placed. The screed will be equipped with a compaction device and it will be used during all placement.

1.2.4.1 Receiving Hopper

The paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed without segregation. The screed shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

1.2.4.2 Automatic Grade Controls

If an automatic grade control device is used, the paver shall be equipped with a control system capable of automatically maintaining the specified screed elevation. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors or sensor-directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent. A transverse slope controller shall not be used to control grade. The controls shall be capable of working in conjunction with any of the following attachments:

- a. Ski-type device of not less than 30 feet in length.
- b. Taut stringline set to grade.
- c. Short ski or shoe for joint matching.
- d. Laser control.

1.2.5 Rollers

Rollers shall be in good condition and shall be operated at slow speeds to avoid displacement of the asphalt mixture. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. Equipment which causes excessive crushing of the aggregate shall not be used.

1.3 SUBMITTALS

All submittals related to airfield pavement mix design will be reviewed by the USACE Transportation Systems Center. Submittals will only be reviewed upon receipt of all required documentation and certifications. The Contractor shall allow (4) four weeks for review of all airfield pavement related submittals.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Placement Plan; G

SD-03 Product Data

Mix Design G

Contractor Quality Control G

SD-04 Samples

Asphalt Cement Binder
Aggregates

SD-06 Test Reports

Aggregates; G
QC Monitoring

SD-07 Certificates

Asphalt Cement Binder; G
Testing Laboratory

1.4 QUALITY ASSURANCE

The **Government** quality assurance (QA) program for this project is separate and distinct from the Contractor's quality control (QC) program specified in Part 3. Testing for acceptability of work will be performed by the **Government** or by an independent laboratory hired by the **Contracting Officer**, except for grade and smoothness testing which shall be performed by the Contractor. Acceptance of the plant produced mix and in-place requirements will be on a lot to lot basis. A standard lot for all requirements will be equal to 2000 short tons. Where appropriate, adjustment in payment for individual lots of hot-mix asphalt will be made based on in-place density, laboratory air voids, grade and smoothness in accordance with the following paragraphs. Grade and surface smoothness determinations will be made on the lot as a whole. Exceptions or adjustments to this will be made in situations where the mix within one lot is placed as part of both the intermediate and surface courses, thus grade and smoothness measurements for the entire lot cannot be made. In order to evaluate laboratory air voids and in-place (field) density, each lot will be divided into four equal sublots.

1.4.1 Sublot Sampling

One random mixture sample for determining laboratory air voids, theoretical maximum density, and for any additional testing the **Contracting Officer** desires, will be taken from a loaded truck delivering mixture to each sublot, or other appropriate location for each sublot. All samples will be selected randomly, using commonly recognized methods of assuring randomness conforming to **ASTM D 3665** and employing tables of random numbers or computer programs. Laboratory air voids will be determined from three laboratory compacted specimens of each sublot sample in accordance with **ASTM D 6926**. The specimens will be compacted within 2 hours of the time the mixture was loaded into trucks at the asphalt plant. Samples will not be reheated prior to compaction and insulated containers will be used as necessary to maintain the temperature.

1.4.2 Additional Sampling and Testing

The **Contracting Officer** reserves the right to direct additional samples and tests for any area which appears to deviate from the specification requirements. The cost of any additional testing will be paid for by the **Government**. Testing in these areas will be treated as a separate lot. Payment will be made for the quantity of HMA represented by these tests in accordance with the provisions of this section.

1.4.3 In-place Density

For determining in-place density, one random core (4 inches or 6 inches in diameter) will be taken by the **Government** from the mat (interior of the lane) of each sublot, and one random core will be taken from the joint

(immediately over joint) of each subplot, in accordance with [ASTM D 979](#). Each random core will be full thickness of the layer being placed. When the random core is less than [1 inch](#) thick, it will not be included in the analysis. In this case, another random core will be taken. After air drying to meet the requirements for laboratory-prepared, thoroughly dry specimens, cores obtained from the mat and from the joints will be used for in-place density determination in accordance with [ASTM D 2726](#).

1.4.4 Surface Smoothness

Use both of the following methods to test and evaluate surface smoothness of the finished surface of the pavement final grade. All testing shall be performed in the presence of the [Contracting Officer](#). Detailed notes of the results of the testing shall be kept and a copy furnished to the [Government](#) immediately after each day's testing. The profilograph method shall be used for all longitudinal and transverse testing, except where the runs would be less than [200 feet](#) in length and the ends where the straightedge shall be used. Where drawings show required deviations from a plane surface (crowns, drainage inlets, etc.), the surface shall be finished to meet the approval of the [Contracting Officer](#).

1.4.4.1 Smoothness Requirements

- a. Straightedge Testing: The finished surfaces of the pavements shall have no abrupt change of [1/8 inch](#) or more, and all pavements shall be within the tolerances specified in Table 3 when checked with an approved [12 foot](#) straightedge.

Table 3. Straightedge Surface Smoothness--Pavements

Pavement Category	Direction of Testing	Tolerance, inches
Runways and taxiways	Longitudinal	1/8
	Transverse	1/4
Calibration hardstands and compass swinging bases	Longitudinal	1/8
	Transverse	1/8
All other airfields and helicopter paved areas	Longitudinal	1/4
	Transverse	1/4

- b. Profilograph Testing: The finished surfaces of the pavements shall have no abrupt change of [1/8 inch](#) or more, and all pavement shall have a Profile Index not greater than specified in Table 4 when tested with an approved California-type profilograph. If the extent of the pavement in either direction is less than [200 feet](#), that direction shall be tested by the straightedge method and shall meet requirements specified above.

Table 4. Profilograph Surface Smoothness--Pavements

Pavement Category	Direction of Testing	Maximum Specified Profile Index (inch/mile)
Runways	Longitudinal Transverse	7 (Use Straightedge)

Table 4. Profilograph Surface Smoothness--Pavements

Pavement Category	Direction of Testing	Maximum Specified Profile Index (inch/mile)
Taxiways	Longitudinal Transverse	9 (Use Straightedge)
Calibration Hardstands & Compass Swinging Bases		(Use Straightedge)
All Other Airfield & Helicopter Paved Areas	Longitudinal Transverse	9 9

1.4.4.2 Testing Method

After the final rolling, but not later than 24 hours after placement, the surface of the pavement in each entire lot shall be tested in such a manner as to reveal all surface irregularities exceeding the tolerances specified above. Separate testing of individual sublots is not required. If any pavement areas are diamond ground, these areas shall be retested immediately after grinding. The area corrected by grinding shall not exceed 10 percent of the total area of the lot. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines. The transverse lines shall be 15 feet or less apart, as directed. The longitudinal lines shall be at the centerline of each paving lane for lines less than 20 feet and at the third points for lanes 20 feet or greater. Other areas having obvious deviations shall also be tested. Longitudinal testing lines shall be continuous across all joints.

a. Straightedge Testing. The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points.

b. Profilograph Testing. Profilograph testing shall be performed using approved equipment and procedures described in [CTM 526](#). The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must-grind" bumps and the Profile Index for the pavement. The "blanking band" shall be 0.2 inches wide and the "bump template" shall span 1 inch with an offset of 0.4 inch. The profilograph shall be operated by an approved, factory-trained operator on the alignments specified above. A copy of the reduced tapes shall be furnished the [Government](#) at the end of each day's testing.

c. Bumps ("Must Grind" Areas). Any bumps ("must grind" areas) shown on the profilograph trace which exceed 0.4 inch in height shall be reduced by diamond grinding until they do not exceed 0.3 inch when retested. Such grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding. The following will not be permitted: (1) skin patching for correcting low areas, (2) planing or milling for correcting high areas. At the Contractor's option, pavement areas, including ground areas, may be rechecked with the profilograph in order to record a lower Profile Index.

1.5 ENVIRONMENTAL REQUIREMENTS

The hot-mix asphalt shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 5. The temperature requirements may be waived by the [Contracting Officer](#), if requested; however, all other requirements, including compaction, shall be met.

Table 5. Surface Temperature Limitations of Underlying Course

Mat Thickness, inches	Degrees F
3 or greater	40
Less than 3	45

PART 2 PRODUCTS

2.1 AGGREGATES

Aggregates shall consist of crushed stone, crushed gravel, crushed slag, screenings, natural sand and mineral filler, as required. The portion of material retained on the No. 4 sieve is coarse aggregate. The portion of material passing the No. 4 sieve and retained on the No. 200 sieve is fine aggregate. The portion passing the No. 200 sieve is defined as mineral filler. Submit sufficient materials to produce 200 lb of blended mixture for mix design verification. All aggregate test results and samples shall be submitted to the [Contracting Officer](#) at least 14 days prior to start of construction. Aggregate testing shall have been performed within 90 days of performing the mix design.

2.1.1 Coarse Aggregate

Coarse aggregate shall consist of sound, tough, durable particles, free from films of material that would prevent thorough coating and bonding with the asphalt material and free from organic matter and other deleterious substances. The coarse aggregate particles shall meet the following requirements:

- a. The percentage of loss shall not be greater than 40 percent after 500 revolutions when tested in accordance with [ASTM C 131](#).
- b. The sodium sulfate soundness loss shall not exceed 12 percent, or the magnesium sulfate soundness loss shall not exceed 18 percent after five cycles when tested in accordance with [ASTM C 88](#).
- c. At least 75 percent by weight of coarse aggregate shall have at least two or more fractured faces when tested in accordance with [COE CRD-C 171](#). Fractured faces shall be produced by crushing.
- d. The particle shape shall be essentially cubical and the aggregate shall not contain more than 20 percent, by weight, of flat and elongated particles (3:1 ratio of maximum to minimum) when tested in accordance with [ASTM D 4791](#).
- e. Slag shall be air-cooled, blast furnace slag, and shall have a compacted weight of not less than 75 lb/cu ft when tested in accordance with [ASTM C 29/C 29M](#).

f. Clay lumps and friable particles shall not exceed 0.3 percent, by weight, when tested in accordance with [ASTM C142/C142M](#).

2.1.2 Fine Aggregate

Fine aggregate shall consist of clean, sound, tough, durable particles. The aggregate particles shall be free from coatings of clay, silt, or any objectionable material and shall contain no clay balls. The fine aggregate particles shall meet the following requirements:

- a. The quantity of natural sand (noncrushed material) added to the aggregate blend shall not exceed 15 percent by weight of total aggregate.
- b. The individual fine aggregate sources shall have a sand equivalent value greater than 45 when tested in accordance with [ASTM D 2419](#).
- c. The fine aggregate portion of the blended aggregate shall have an uncompacted void content greater than 45.0 percent when tested in accordance with [ASTM C 1252](#) Method A.
- d. Clay lumps and friable particles shall not exceed 0.3 percent, by weight, when tested in accordance with [ASTM C142/C142M](#).

2.1.3 Mineral Filler

Mineral filler shall be nonplastic material meeting the requirements of [ASTM D 242/D 242M](#).

2.1.4 Aggregate Gradation

The combined aggregate gradation shall conform to gradations specified in Table 6, when tested in accordance with [ASTM C 136](#) and [ASTM C 117](#), and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa, but grade uniformly from coarse to fine. The JMF shall be within the specification limits; however, the gradation can exceed the limits when the allowable deviation from the JMF shown in Tables 9 and 10 are applied.

Table 6. Aggregate Gradations

Sieve Size, inch	Gradation 1	Gradation 2	Gradation 3
	Percent Passing by Mass	Percent Passing by Mass	Percent Passing by Mass
1	100	---	---
3/4	76-96	100	---
1/2	68-88	76-96	100
3/8	60-82	69-89	76-96
No. 4	45-67	53-73	58-78
No. 8	32-54	38-60	40-60
No. 16	22-44	26-48	28-48
No. 30	15-35	18-38	18-38
No. 50	9-25	11-27	11-27
No. 100	6-18	6-18	6-18
No. 200	3-6	3-6	3-6

2.2 ASPHALT CEMENT BINDER

Asphalt cement binder shall conform to AASHTO M 320 Performance Grade (PG) 64-22. . Test data indicating grade certification shall be provided by the supplier at the time of delivery of each load to the mix plant. Copies of these certifications shall be submitted to the Contracting Officer. The supplier is defined as the last source of any modification to the binder. The Contracting Officer may sample and test the binder at the mix plant at any time before or during mix production. Samples for this verification testing shall be obtained in accordance with ASTM D 140/D 140M and in the presence of the Contracting Officer . These samples shall be furnished to the Contracting Officer for the verification testing, which shall be at no cost to the Contractor. Submit 5 gallon sample of the asphalt cement specified for mix design verification and approval not less than 14 days before start of the test section.

2.3 MIX DESIGN

Develop the mix design. The Job Mix formula (JMF) shall have been developed and aggregates tested no earlier than 6 months before contract award. The asphalt mix shall be composed of a mixture of well-graded aggregate, mineral filler if required, and asphalt material. The aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of Table 6. No hot-mix asphalt for payment shall be produced until a JMF has been approved. The hot-mix asphalt shall be designed using hand-held hammer procedures contained in AI MS-02 and the criteria shown in Table 7. The hot-mix asphalt shall be designed using the Superpave gyratory compactor set at 75 gyrations. Samples shall be prepared at various asphalt contents and compacted in accordance with ASTM D 6925. Laboratory compaction temperatures for Polymer Modified Asphalts shall be as recommended by the asphalt cement manufacturer. If the Tensile Strength Ratio (TSR) of the composite mixture, as determined by ASTM D 4867/D 4867M is less than 75, the aggregates shall be rejected or the asphalt mixture treated with an anti-stripping agent. The amount of anti-stripping agent added shall be sufficient to produce a TSR of not less than 75. If an antistrip agent is required, it shall be provided at no additional cost to the Government. Sufficient materials to produce 200 pound of blended mixture shall be provided to the Contracting Officer for verification of mix design at least 14 days prior to construction of test section.

2.3.1 JMF Requirements

Submit the proposed JMF in writing, for approval, at least 14 days prior to the start of the test section, including as a minimum:

- a. Percent passing each sieve size.
- b. Percent of asphalt cement.
- c. Percent of each aggregate and mineral filler to be used.
- d. Asphalt viscosity grade, penetration grade, or performance grade.
- e. Number of blows of hammer per side of molded specimen. Number of Superpave gyratory compactor gyrations.
- f. Laboratory mixing temperature.

- g. Lab compaction temperature.
- h. Temperature-viscosity relationship of the asphalt cement.
- i. Plot of the combined gradation on the 0.45 power gradation chart, stating the nominal maximum size.
- j. Graphical plots and summary tabulation of stability, flow, air voids, voids in the mineral aggregate, and unit weight versus asphalt content as shown in AI MS-02. Summary tabulation shall include individual specimen data for each specimen tested.
- k. Specific gravity and absorption of each aggregate.
- l. Percent natural sand.
- m. Percent particles with two or more fractured faces (in coarse aggregate).
- n. Fine aggregate angularity.
- o. Percent flat or elongated particles (in coarse aggregate).
- p. Tensile Strength Ratio and wet/dry specimen test results.
- q. Antistrip agent (if required).
- r. List of all modifiers.
- s. Percentage and properties (asphalt content, binder properties, and aggregate properties) of RAP in accordance with paragraph RECYCLED HOT-MIX ASPHALT, if RAP is used.

Table 7. Marshall Design Criteria

Test Property	75 Blow Mix	
Stability, pounds minimum	2150 ⁽¹⁾	
Flow, 0.01 inch	8-16 ⁽²⁾	
Air voids, percent	4 ⁽⁴⁾	
Percent Voids in mineral aggregate (minimum)	See Table 8	S
Dust Proportion ⁽³⁾	0.8-1.2	
TSR, minimum percent	75	

(1) This is a minimum requirement. The average during construction shall be significantly higher than this number to ensure compliance with the specifications.

(2) The flow requirement is not applicable for Polymer Modified Asphalts

(3) Dust Proportion is calculated as the aggregate content, expressed as a percent of mass, passing the No. 200 sieve, divided by the effective asphalt content, in percent of total mass of the mixture.

(4) Select the JMF asphalt content corresponding to an air void content of 4 percent. Verify the other properties of Table 7 meet the specification requirements at this asphalt content.

Table 7. Superpave Gyrotory Compaction Criteria

Test Property	Value
Air voids, percent	4 ⁽¹⁾
Percent Voids in mineral aggregate (minimum)	See Table 8
Dust Proportion ⁽²⁾	0.8-1.2
TSR, minimum percent	75

(1) Select the JMF asphalt content corresponding to an air void content of 4 percent. Verify the other properties of Table 7 meet the specification requirements at this asphalt content.

(2) Dust Proportion is calculated as the aggregate content, expressed as a percent of mass, passing the No. 200 sieve, divided by the effective asphalt content, in percent of total mass of the mixture.

Table 8. Minimum Percent Voids in Mineral Aggregate (VMA)⁽⁴⁾

Aggregate (See Table 6)	Minimum VMA, percent
Gradation 1	13.0
Gradation 2	14.0
Gradation 3	15.0

(1) Calculate VMA in accordance with [AI MS-02](#), based on [ASTM D 2726](#) bulk specific gravity for the aggregate.

2.3.2 Adjustments to JMF

The JMF for each mixture shall be in effect until a new formula is approved in writing by the [Contracting Officer](#). Should a change in sources of any materials be made, a new mix design shall be performed and a new JMF approved before the new material is used. The Contractor will be allowed to make minor adjustments within the specification limits to the JMF to optimize mix volumetric properties. Adjustments to the original JMF shall be limited to plus or minus 4 percent on the No. 4 and coarser sieves; plus or minus 3 percent on the No. 8 to No. 50 sieves; and plus or minus 1 percent on the No. 100 sieve. Adjustments to the JMF shall be limited to plus or minus 1.0 percent on the No. 200 sieve. Asphalt content adjustments shall be limited to plus or minus 0.40 from the original JMF.

If adjustments are needed that exceed these limits, a new mix design shall be developed.

2.4 RECYCLED HOT MIX ASPHALT

Recycled HMA shall consist of reclaimed asphalt pavement (RAP), coarse aggregate, fine aggregate, mineral filler, and asphalt cement. The RAP shall be of a consistent gradation and asphalt content and properties. RAP stockpiles shall be free from contamination, including coal-tar sealers. When RAP is fed into the plant, the maximum RAP chunk size shall not exceed **2 inches**. The individual aggregates in a RAP chunk shall not exceed the maximum size aggregate of the gradation specified in Table 6. The recycled HMA mix shall be designed using procedures contained in **AI MS-02**. The job mix shall meet the requirements of paragraph MIX DESIGN. RAP shall only be used for shoulder surface course mixes and for any intermediate courses. The amount of RAP shall be limited to 30 percent.

2.4.1 RAP Aggregates and Asphalt Cement

The blend of aggregates used in the recycled mix shall meet the requirements of paragraph AGGREGATES. The percentage of asphalt in the RAP shall be established for the mixture design according to **ASTM D2172/D2172M** using the appropriate dust correction procedure.

2.4.2 RAP Mix

The blend of new asphalt cement and the RAP asphalt binder shall meet the penetration requirements in paragraph ASPHALT CEMENT BINDER. The virgin asphalt cement shall not be more than two standard asphalt material grades different than that specified in paragraph ASPHALT CEMENT BINDER.

PART 3 EXECUTION

3.1 CONTRACTOR QUALITY CONTROL

3.1.1 General Quality Control Requirements

Submit the approved Quality Control Plan. Hot-mix asphalt for payment shall not be produced until the quality control plan has been approved. The plan shall address all elements which affect the quality of the pavement including, but not limited to:

- a. Mix Design and unique JMF identification code
- b. Aggregate Grading
- c. Quality of Materials
- d. Stockpile Management and procedures to prevent contamination
- e. Proportioning
- f. Mixing and Transportation
- g. Correlation of mechanical hammer to hand hammer. Determine the number of blows of the mechanical hammer required to provide the same density of the JMF as provided by the hand hammer. Use the average of three specimens per trial blow application.

- h. Mixture Volumetrics
- i. Moisture Content of Mixtures
- j. Placing and Finishing
- k. Joints
- l. Compaction, including HMA-PCC joints
- m. Surface Smoothness
- n. Truck bed release agent

3.1.2 Testing Laboratory

Provide a fully equipped asphalt laboratory located at the plant or job site. It shall be equipped with heating and air conditioning units to maintain a temperature of 75 plus or minus 5 degrees F. Laboratory facilities shall be kept clean and all equipment shall be maintained in proper working condition. The Contracting Officer shall be permitted unrestricted access to inspect the Contractor's laboratory facility, to witness quality control activities, and to perform any check testing desired. The Contracting Officer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to adversely affect test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are corrected.

3.1.3 Quality Control Testing

Perform all quality control tests applicable to these specifications and as set forth in the Quality Control Program. The testing program shall include, but shall not be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, moisture in the asphalt mixture, laboratory air voids, stability, flow, in-place density, grade and smoothness. A Quality Control Testing Plan shall be developed as part of the Quality Control Program.

3.1.3.1 Asphalt Content

A minimum of two tests to determine asphalt content will be performed per lot (a lot is defined in paragraph QUALITY ASSURANCE) by one of the following methods: extraction method in accordance with ASTM D2172/D2172M, Method A or B, the ignition method in accordance with the AASHTO T 308, ASTM D 6307, or the nuclear method in accordance with ASTM D4125/D4125M, provided each method is calibrated for the specific mix being used. For the extraction method, the weight of ash, as described in ASTM D2172/D2172M, shall be determined as part of the first extraction test performed at the beginning of plant production; and as part of every tenth extraction test performed thereafter, for the duration of plant production. The last weight of ash value obtained shall be used in the calculation of the asphalt content for the mixture.

3.1.3.2 Aggregate Properties

Aggregate gradations shall be determined a minimum of twice per lot from mechanical analysis of recovered aggregate in accordance with ASTM D 5444

or [ASTM D 6307](#). For batch plants, aggregates shall be tested in accordance with [ASTM C 136](#) using actual batch weights to determine the combined aggregate gradation of the mixture. The specific gravity of each aggregate size grouping shall be determined for each 20,000 tons in accordance with [ASTM C 127](#) or [ASTM C 128](#). Fractured faces for gravel sources shall be determined for each 18,000 20,000 tons in accordance with [COE CRD-C 171](#). The uncompacted void content of manufactured sand shall be determined for each 20,000 tons in accordance with [ASTM C 1252](#) Method A.

3.1.3.3 Temperatures

Temperatures shall be checked at least four times per lot, at necessary locations, to determine the temperature at the dryer, the asphalt cement in the storage tank, the asphalt mixture at the plant, and the asphalt mixture at the job site.

3.1.3.4 Aggregate Moisture

The moisture content of aggregate used for production shall be determined a minimum of once per lot in accordance with [ASTM C 566](#).

3.1.3.5 Moisture Content of Mixture

The moisture content of the mixture shall be determined at least once per lot in accordance with [AASHTO T 329](#).

3.1.3.6 Laboratory Air Voids, VMA, Marshall Stability and Flow

Mixture samples shall be taken at least four times per lot and compacted into specimens, 75 blows per side with the Marshall hand-held hammer as described in [ASTM D 6926](#).] 75 gyrations of the Superpave gyratory compactor as described in [ASTM D 6925](#).] After compaction, the laboratory air voids and VMA of each specimen shall be determined, as well as the Marshall stability and flow, as described in [ASTM D 6927](#).. The VMA shall be within the limits of Table 8.

3.1.3.7 In-Place Density

Conduct any necessary testing to ensure the specified density is achieved. A nuclear gauge or other non-destructive testing device may be used to monitor pavement density.

3.1.3.8 Grade and Smoothness

Conduct the necessary checks to ensure the grade and smoothness requirements are met in accordance with paragraph QUALITY ASSURANCE.

3.1.3.9 Additional Testing

Any additional testing, which the Contractor deems necessary to control the process, may be performed at the Contractor's option.

3.1.3.10 QC Monitoring

Submit all QC test results to the Contracting Officer on a daily basis as the tests are performed. The Contracting Officer reserves the right to monitor any of the Contractor's quality control testing and to perform duplicate testing as a check to the Contractor's quality control testing.

3.1.4 Sampling

When directed by the Contracting Officer, sample and test any material which appears inconsistent with similar material being produced, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

3.1.5 Control Charts

For process control, establish and maintain linear control charts on both individual samples and the running average of last four samples for the parameters listed in Table 9, as a minimum. These control charts shall be posted as directed by the Contracting Officer and shall be kept current at all times. The control charts shall identify the project number, the test parameter being plotted, the individual sample numbers, the Action and Suspension Limits listed in Table 9 applicable to the test parameter being plotted, and the Contractor's test results. Target values (JMF) shall also be shown on the control charts as indicators of central tendency for the cumulative percent passing, asphalt content, and laboratory air voids parameters. When the test results exceed either applicable Action Limit, take immediate steps to bring the process back in control. When the test results exceed either applicable Suspension Limit, halt production until the problem is solved. When the Suspension Limit is exceeded for individual values or running average values, the Contracting Officer Engineer has the option to require the Contractor to remove and replace the material represented by the samples or to leave in place and base acceptance on mixture volumetric properties and in place density. Use the control charts as part of the process control system for identifying trends so that potential problems can be corrected before they occur. Decisions concerning mix modifications shall be made based on analysis of the results provided in the control charts. The Quality Control Plan shall indicate the appropriate action which shall be taken to bring the process into control when certain parameters exceed their Action Limits.

Table 9. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts

Parameter to be Plotted	Individual Samples		Running Average of Last Four Samples	
	Action Limit	Suspension Limit	Action Limit	Suspension Limit
No. 4 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	6	8	4	5
No. 30 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	4	6	3	4
No. 200 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	1.4	2.0	1.1	1.5
Stability, pounds (minimum) 75 blow JMF	1760	1640	2150	2030

Table 9. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts

Parameter to be Plotted	Individual Samples		Running Average of Last Four Samples	
	Action Limit	Suspension Limit	Action Limit	Suspension Limit
50 blow JMF	950	830	1350	1230
Flow, 0.01 inches				
75 blow JMF	8 min. 16 max.	7 min. 17 max.	9 min. 15 max.	8 min. 16 max.
50 blow JMF	8 min. 18 max.	7 min. 19 max.	9 min. 17 max.	8 min. 18 max.
Asphalt content, % deviation from JMF target; plus or minus value	0.4	0.5	0.2	0.3
Laboratory Air Voids, % deviation from JMF target value	No specific action and suspension limits set since this parameter is used to determine percent payment			
In-place Mat Density, % of TMD	No specific action and suspension limits set since this parameter is used to determine percent payment			
In-place Joint Density, % of TMD	No specific action and suspension limits set since this parameter is used to determine percent payment			

3.2 PREPARATION OF ASPHALT BINDER MATERIAL

The asphalt cement material shall be heated avoiding local overheating and providing a continuous supply of the asphalt material to the mixer at a uniform temperature. The temperature of unmodified asphalts shall be no more than 325 degrees F when added to the aggregates. Performance Graded (PG) asphalts shall be within the temperature range of 265 to 320 degrees F when added to the aggregates.

3.3 PREPARATION OF MINERAL AGGREGATE

The aggregate for the mixture shall be heated and dried prior to mixing. No damage shall occur to the aggregates due to the maximum temperature and rate of heating used. The temperature of the aggregate and mineral filler shall not exceed 350 degrees F when the asphalt cement is added. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

3.4 PREPARATION OF HOT-MIX ASPHALT MIXTURE

The aggregates and the asphalt cement shall be weighed or metered and introduced into the mixer in the amount specified by the JMF. The combined materials shall be mixed until the aggregate obtains a thorough and uniform coating of asphalt binder (testing in accordance with ASTM D 2489/D 2489M

may be required by the Contracting Officer) and is thoroughly distributed throughout the mixture. The moisture content of all hot-mix asphalt upon discharge from the plant shall not exceed 0.5 percent by total weight of mixture as measured by [ASTM D 1461](#).

3.5 PREPARATION OF THE UNDERLYING SURFACE

Immediately before placing the hot mix asphalt, the underlying course shall be cleaned of dust and debris. A prime coat and/or tack coat shall be applied in accordance with the contract specifications.

3.6 TEST SECTION

Prior to full production, place a test section for each JMF used. Construct a test section consisting of a maximum of 250 tons and two paver passes wide placed in two lanes, with a longitudinal cold joint. The test section shall be of the same depth as the course which it represents. The underlying grade or pavement structure upon which the test section is to be constructed shall be the same as the remainder of the course represented by the test section. The equipment used in construction of the test section shall be the same equipment to be used on the remainder of the course represented by the test section. The test section shall be placed as part of the project pavement as approved by the [Contracting Officer](#).

3.6.1 Sampling and Testing for Test Section

One random sample shall be taken at the plant, triplicate specimens compacted, and tested for stability, flow, laboratory air voids, and Tensile Strength Ratio (TSR). A portion of the same sample shall be tested for theoretical maximum density (TMD), aggregate gradation and asphalt content. Four randomly selected cores shall be taken from the finished pavement mat, and four from the longitudinal joint, and tested for density. Random sampling shall be in accordance with procedures contained in [ASTM D 3665](#). The test results shall be within the tolerances or exceed the minimum values shown in Table 10 for work to continue. If all test results meet the specified requirements, the test section shall remain as part of the project pavement. If test results exceed the tolerances shown, the test section shall be removed and replaced at no cost to the [Government](#) and another test section shall be constructed.

Table 10. Test Section Requirements for Material and Mixture Properties

Property	Specification Limit
Aggregate Gradation-Percent Passing (Individual Test Result)	
No. 4 and larger	JMF plus or minus 8
No. 8, No. 16, No. 30, and No. 50	JMF plus or minus 6
No. 100 and No. 200	JMF plus or minus 2.0
Asphalt Content, Percent (Individual Test Result)	JMF plus or minus 0.5
Laboratory Air Voids, Percent (Average of 3 specimens)	JMF plus or minus 1.0
VMA, Percent (Average of 3 specimens)	See Table 8

Table 10. Test Section Requirements for Material and Mixture Properties

Property	Specification Limit
Stability, pounds (Average of 3 specimens)	2150 minimum
Flow, 0.01 inches (Average of 3 specimens)	8 - 18
Tensile Strength Ratio (TSR)	75% minimum
Mat Density, Percent of TMD (Average of 4 Random Cores)	92.0 - 96.0
Joint Density, Percent of TMD (Average of 4 Random Cores)	90.5 minimum

3.6.2 Additional Test Sections

If the initial test section should prove to be unacceptable, the necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made. A second test section shall then be placed. Additional test sections, as required, shall be constructed and evaluated for conformance to the specifications. Full production shall not begin until an acceptable section has been constructed and accepted.

3.7 TESTING LABORATORY

The laboratories used to develop the JMF, perform Contractor Quality Control testing, and for Government acceptance testing shall meet the requirements of ASTM D 3666. All required test methods shall be performed by an accredited laboratory. The Government will inspect the laboratory equipment and test procedures prior to the start of hot-mix operations for conformance with ASTM D 3666. The laboratory shall maintain this validation for the duration of the project. Submit a certification of compliance signed by the manager of the laboratory stating that it meets these requirements to the Contracting Officer prior to the start of construction. The certification shall contain as a minimum:

- a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.
- b. A listing of equipment to be used in developing the job mix.
- c. A copy of the laboratory's quality control system.
- d. Evidence of participation in the AASHTO Materials Reference Laboratory (AMRL) program.

3.8 TRANSPORTING AND PLACING

3.8.1 Transporting

The hot-mix asphalt shall be transported from the mixing plant to the site in clean, tight vehicles. Deliveries shall be scheduled so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Adequate artificial lighting shall be provided for night placements. Hauling over freshly placed material will not be permitted until the material has been compacted as specified, and allowed to cool to

140 degrees F.

3.8.2 Placing

The mix shall be placed in lifts of adequate thickness and compacted at a temperature suitable for obtaining density, surface smoothness, and other specified requirements. Upon arrival, the mixture shall be placed to the full width by an asphalt paver; it shall be struck off in a uniform layer of such depth that, when the work is completed, it shall have the required thickness and conform to the grade and contour indicated. Waste mixture shall not be broadcast onto the mat or recycled into the paver hopper. Collect waste mixture and dispose off site. The speed of the paver shall be regulated to eliminate pulling and tearing of the asphalt mat. Placement of the mixture shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. The mixture shall be placed in consecutive adjacent strips having a minimum width of 10 feet. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 1 foot; however, the joint in the surface course shall be at the centerline of the pavement. Transverse joints in one course shall be offset by at least 10 feet from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 10 feet. On isolated areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread and luted by hand tools.

3.9 COMPACTION OF MIXTURE

3.9.1 General

a. After placing, the mixture shall be thoroughly and uniformly compacted by rolling. The surface shall be compacted as soon as possible without causing displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used are at the discretion of the Contractor, with the exception that application of more than three passes with a vibratory roller in the vibrating mode is prohibited. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Correct at once any displacement occurring as a result of reversing the direction of the roller, or from any other cause.

b. Furnish sufficient rollers to handle the output of the plant. Continue rolling until the surface is of uniform texture, true to grade and cross section, and the required field density is obtained. To prevent adhesion of the mixture to the roller, keep the wheels properly moistened, but excessive water will not be permitted. In areas not accessible to the roller, thoroughly compact the mixture with hand tampers. Remove the full depth of any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or is in any way defective, replace with fresh hot mixture and immediately compact to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching will not be allowed.

3.9.2 Segregation

The Contracting Officer can sample and test any material that looks deficient. When the in-place material appears to be segregated, the Contracting Officer has the option to sample the material and have it

tested and compared to the aggregate gradation, asphalt content, and in-place density requirements in Table 10. If the material fails to meet these specification requirements, the extent of the segregated material will be removed and replaced the full depth of the layer of asphalt mixture at no additional cost to the Government. When segregation occurs in the mat, take appropriate action to correct the process so that additional segregation does not occur.

3.10 JOINTS

The formation of joints shall be made ensuring a continuous bond between the courses and to obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

3.10.1 Transverse Joints

The roller shall not pass over the unprotected end of the freshly laid mixture, except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing the adjacent lane. The cutback material shall be removed from the project. In both methods, all contact surfaces shall be given a light tack coat of asphalt material before placing any fresh mixture against the joint.

3.10.2 Longitudinal Joints

Longitudinal joints which are irregular, damaged, uncompacted, cold (less than 175 degrees F at the time of placing the adjacent lane), or otherwise defective, shall be cut back a maximum of 3 inches from the top edge of the lift with a cutting wheel to expose a clean, sound, near vertical surface for the full depth of the course. All cutback material shall be removed from the project. Cutting equipment that uses water as a cooling or cutting agent shall not be permitted. All contact surfaces shall be given a light tack coat of asphalt material prior to placing any fresh mixture against the joint.

3.10.3 HMA-Portland Cement Concrete Joints

Avoid spalling portland cement concrete (PCC) pavement when compacting HMA at a HMA-PCC joint. Pneumatic-tire rollers should be used and the HMA shall be rolled parallel to the joint. All procedures, including repair of damaged PCC, shall be in accordance with the approved Quality Control Plan.

-- End of Section --

SECTION 32 12 16

HOT-MIX ASPHALT (HMA) FOR ROADS
08/09

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 320 (2010) Standard Specification for
Performance-Graded Asphalt Binder

ASPHALT INSTITUTE (AI)

AI MS-02 (1997 6th Ed) Mix Design Methods

AI MS-22 (2001; 2nd Ed) Construction of Hot-Mix
Asphalt Pavements

AI SP-2 (2001; 3rd Ed) Superpave Mix Design

ASTM INTERNATIONAL (ASTM)

ASTM C 127 (2007) Standard Test Method for Density,
Relative Density (Specific Gravity), and
Absorption of Coarse Aggregate

ASTM C 128 (2007a) Standard Test Method for Density,
Relative Density (Specific Gravity), and
Absorption of Fine Aggregate

ASTM C 136 (2006) Standard Test Method for Sieve
Analysis of Fine and Coarse Aggregates

ASTM C 566 (1997; R 2004) Standard Test Method for
Total Evaporable Moisture Content of
Aggregate by Drying

ASTM D 140/D 140M (2009) Standard Practice for Sampling
Bituminous Materials

ASTM D 1461 (1985; R 2006) Moisture or Volatile
Distillates in Bituminous Paving Mixtures

ASTM D 2172 (2005) Quantitative Extraction of Bitumen
from Bituminous Paving Mixtures

ASTM D 2489/D 2489M (2008) Estimating Degree of Particle
Coating of Bituminous-Aggregate Mixtures

ASTM D 2950	(2009) Density of Bituminous Concrete in Place by Nuclear Methods
ASTM D 3665	(2007) Random Sampling of Construction Materials
ASTM D 3666	(2009a) Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
ASTM D 4125	(2005) Asphalt Content of Bituminous Mixtures by the Nuclear Method
ASTM D 4867/D 4867M	(2009) Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D 5444	(2008) Mechanical Size Analysis of Extracted Aggregate
ASTM D 6307	(2005; R 2010) Asphalt Content of Hot Mix Asphalt by Ignition Method
ASTM D 6925	(2009) Standard Test Method for Preparation and Determination of the Relative Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyrotory Compactor
ASTM D 6926	(2010) Standard Practice for Preparation of Bituminous Specimens Using Marshall Apparatus
ASTM D 6927	(2006) Standard Test Method for Marshall Stability and Flow of Bituminous Mixtures
ASTM D 995	(1995b; R 2002) Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS)

CALTRANS Test 526	(2002) Operation of California Profilograph and Evaluation of Profiles
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1.2 SYSTEM DESCRIPTION

Perform the work consisting of pavement courses composed of mineral aggregate and asphalt material heated and mixed in a central mixing plant and placed on a prepared course. HMA designed and constructed in accordance with this section shall conform to the lines, grades, thicknesses, and typical cross sections shown on the drawings. Construct each course to the depth, section, or elevation required by the drawings and roll, finish, and approve it before the placement of the next course.

1.2.1 Asphalt Mixing Plant

Plants used for the preparation of hot-mix asphalt shall conform to the requirements of ASTM D 995 with the following changes:

- a. Truck Scales. Weigh the asphalt mixture on approved, certified scales at the Contractor's expense. Inspect and seal scales at least annually by an approved calibration laboratory.
- b. Testing Facilities. Provide laboratory facilities at the plant for the use of the Government's acceptance testing and the Contractor's quality control testing.
- c. Inspection of Plant. Provide the Contracting Officer with access at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant; verifying weights, proportions, and material properties; checking the temperatures maintained in the preparation of the mixtures and for taking samples. Provide assistance as requested, for the Government to procure any desired samples.
- d. Storage Bins. Use of storage bins for temporary storage of hot-mix asphalt will be permitted as follows:
 - (1) The asphalt mixture may be stored in non-insulated storage bins for a period of time not exceeding 3 hours.
 - (2) The asphalt mixture may be stored in insulated storage bins for a period of time not exceeding 8 hours. The mix drawn from bins shall meet the same requirements as mix loaded directly into trucks.

1.2.2 Hauling Equipment

Provide trucks for hauling hot-mix asphalt having tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other approved material. Petroleum based products shall not be used as a release agent. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers (tarps) shall be securely fastened.

1.2.3 Asphalt Pavers

Provide asphalt pavers which are self-propelled, with an activated screed, heated as necessary, and capable of spreading and finishing courses of hot-mix asphalt which will meet the specified thickness, smoothness, and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface.

1.2.3.1 Receiving Hopper

Provide paver with a receiving hopper of sufficient capacity to permit a uniform spreading operation and equipped with a distribution system to place the mixture uniformly in front of the screed without segregation. The screed shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

1.2.3.2 Automatic Grade Controls

If an automatic grade control device is used, equip the paver with a control system capable of automatically maintaining the specified screed

elevation. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors or sensor-directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent. A transverse slope controller shall not be used to control grade. Provide controls capable of working in conjunction with any of the following attachments:

- a. Ski-type device of not less than 30 feet in length.
- b. Taut stringline set to grade.
- c. Short ski or shoe for joint matching.
- d. Laser control.

1.2.4 Rollers

Rollers shall be in good condition and shall be operated at slow speeds to avoid displacement of the asphalt mixture. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. Do not use equipment which causes excessive crushing of the aggregate.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Mix Design; G

Proposed JMF.

Contractor Quality Control; G

Quality control plan.

Material Acceptance; G

Acceptance test results.

Percent Payment; G

Pay calculations.

SD-04 Samples

Asphalt Cement Binder

A 5 gallon sample for mix design verification.

Aggregates

Sufficient materials to produce 200 lb of blended mixture for mix design verification.

SD-06 Test Reports

Aggregates; G
QC Monitoring

Aggregate and QC test results.

SD-07 Certificates

Asphalt Cement Binder; G

Copies of certified test data.

Amount, type and description of any modifiers blended into the asphalt cement binder

Testing Laboratory

Certification of compliance.

Plant Scale Calibration Certification

1.4 ENVIRONMENTAL REQUIREMENTS

Do not place the hot-mix asphalt upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 3. The temperature requirements may be waived by the Contracting Officer, if requested; however, all other requirements, including compaction, shall be met.

Table 3. Surface Temperature Limitations of Underlying Course

<u>Mat Thickness, inches</u>	<u>Degrees F</u>
3 or greater	40
Less than 3	45

PART 2 PRODUCTS

2.1 AGGREGATES

Provide aggregates consisting of crushed stone, crushed gravel, crushed slag, screenings, natural sand and mineral filler, as required. The aggregate shall comply with the requirements of the Kentucky Standards Specification for Road and Bridge Construction 2004 Edition Sections 400 and 806.

2.2 ASPHALT CEMENT BINDER

Asphalt cement binder shall conform to AASHTO M 320 Performance Grade (PG) 64-22]. Test data indicating grade certification shall be provided by the supplier at the time of delivery of each load to the mix plant. Submit copies of these certifications to the Contracting Officer. The supplier is defined as the last source of any modification to the binder. The

Contracting Officer may sample and test the binder at the mix plant at any time before or during mix production. Obtain samples for this verification testing in accordance with ASTM D 140/D 140M and in the presence of the Contracting Officer. Furnish these samples to the Contracting Officer for the verification testing, which shall be at no cost to the Contractor. Submit samples of the asphalt cement specified for approval not less than 14 days before start of the test section.

2.3 MIX DESIGN

- a. Develop the mix design. The asphalt mix shall be composed of a mixture of well-graded aggregate, mineral filler if required, and asphalt material. The aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF). Do not produce hot-mix asphalt for payment until a JMF has been approved. The hot-mix asphalt shall be designed in accordance with Marshall (MS-02), Superpave (SP-2), or Hveem (MS-02) procedures and the criteria shown in Table 5. Use the hand-held hammer to compact the specimens for Marshall mix design. If the Tensile Strength Ratio (TSR) of the composite mixture, as determined by ASTM D 4867/D 4867M is less than 75, the aggregates shall be rejected or the asphalt mixture treated with an approved anti-stripping agent. The amount of anti-stripping agent added shall be sufficient to produce a TSR of not less than 75. Provide an antistrip agent, if required, at no additional cost. Sufficient materials to produce 200 pound of blended mixture shall be provided to the Contracting Officer for verification of mix design at least 14 days prior to construction of test section.
- b. At the option of the Contractor, a currently used DOT Superpave hot mix may be used in lieu of developing a Marshall hot mix design as described herein. Design the Superpave volumetric mix in accordance with AI SP-2 and ASTM D 6925. The nominal maximum aggregate size (NMAS) shall be 1 1/2 inch. Other DOT hot mix design methods (Hveem, etc.) may be suitable, as determined by the Contracting Officer. The number of compaction gyrations, Ndes, shall be based on a design traffic of [1000] equivalent single axle loads (EASLs).
- c. Design Superpave mixes with the number of gyrations specified in Table 5, unless the DOT option is chosen.

2.3.1 JMF Requirements

Submit in writing the job mix formula for approval at least 14 days prior to the start of the test section including as a minimum:

- a. Percent passing each sieve size.
- b. Percent of asphalt cement.
- c. Percent of each aggregate and mineral filler to be used.
- d. Asphalt viscosity grade, penetration grade, or performance grade.
- e. Number of blows of hand-held hammer per side of molded specimen. (NA for Superpave)
- f. Number of gyrations of Superpave gyratory compactor, (NA for Marshall mix design)

- g. Laboratory mixing temperature.
- h. Lab compaction temperature.
- i. Temperature-viscosity relationship of the asphalt cement.
- j. Plot of the combined gradation on the 0.45 power gradation chart, stating the nominal maximum size.
- k. Graphical plots of stability (NA for Superpave), flow (NA for Superpave), air voids, voids in the mineral aggregate, and unit weight versus asphalt content as shown in [AI MS-02](#).
- l. Specific gravity and absorption of each aggregate.
- m. Percent natural sand.
- n. Percent particles with 2 or more fractured faces (in coarse aggregate).
- o. Fine aggregate angularity.
- p. Percent flat or elongated particles (in coarse aggregate).
- q. Tensile Strength Ratio(TSR).
- r. Antistrip agent (if required) and amount.
- s. List of all modifiers and amount.
- t. Correlation of hand-held hammer with mechanical hammer (NA for Superpave).
- u. Percentage and properties (asphalt content, binder properties, and aggregate properties) of reclaimed asphalt pavement (RAP) in accordance with paragraph RECYCLED HOT-MIX ASPHALT, if RAP is used.

Table 5. Mix Design Criteria

<u>Test Property</u>	<u>50 Blows or 50 Gyration</u>	<u>75 Blows or 75 Gyration</u>
Stability, pounds, minimum (NA for Superpave)	*1000	*1800
Flow, 0.01 inch (NA for Superpave)	8-18	8-16
Air voids, percent	3-5	3-5
Percent Voids in mineral aggregate VMA, (minimum)		
Gradation 1	13.0	13.0
Gradation 2	14.0	14.0
Gradation 3	15.0	15.0

Table 5. Mix Design Criteria

<u>Test Property</u>	<u>50 Blows or 50 Gyations</u>	<u>75 Blows or 75 Gyations</u>
TSR, minimum percent	75	75

* This is a minimum requirement. The average during construction shall be significantly higher than this number to ensure compliance with the specifications.

** Calculate VMA in accordance with [AI MS-02](#), based on [ASTM C 127](#) and [ASTM C 128](#) bulk specific gravity for the aggregate.

2.3.2 Adjustments to Field JMF

Keep the Laboratory JMF for each mixture in effect until a new formula is approved in writing by the Contracting Officer. Should a change in sources of any materials be made, perform a new laboratory jmf design and a new JMF approved before the new material is used. The Contractor will be allowed to adjust the Laboratory JMF within the limits specified below to optimize mix volumetric properties with the approval of the Contracting Officer. Adjustments to the Laboratory JMF shall be applied to the field (plant) established JMF and limited to those values as shown. Adjustments shall be targeted to produce or nearly produce 4 percent voids total mix (VTM).

TABLE 6. Field (Plant) Established JMF Tolerances
Sieves Adjustments (plus or minus), percent

1/2 inch	3
No. 4	3
No. 8	3
No. 200	1
Binder Content	0.40

If adjustments are needed that exceed these limits, develop a new mix design. Tolerances given above may permit the aggregate grading to be outside the limits shown in Table 4; while not desirable, this is acceptable, except for the No. 200 sieve, which shall remain within the aggregate grading of Table 4.

2.4 RECYCLED HOT MIX ASPHALT

Recycled HMA shall consist of reclaimed asphalt pavement (RAP), coarse aggregate, fine aggregate, mineral filler, and asphalt cement to produce a consistent gradation and asphalt content and properties. When RAP is fed into the plant, the maximum RAP chunk size shall not exceed 2 inches. Design the recycled HMA mix using procedures contained in [AI MS-02](#) and [AI MS-22](#). The job mix shall meet the requirements of paragraph MIX DESIGN. The amount of RAP shall not exceed 30 percent.

2.4.1 RAP Aggregates and Asphalt Cement

The blend of aggregates used in the recycled mix shall meet the requirements of paragraph AGGREGATES. Establish the percentage of asphalt in the RAP for the mixture design according to [ASTM D 2172](#) or [ASTM D 6307](#) using the appropriate dust correction procedure.

2.4.2 RAP Mix

The blend of new asphalt cement and the RAP asphalt binder shall meet [the dynamic shear rheometer at high temperature and bending beam at low temperature] [penetration] [viscosity] requirements in paragraph ASPHALT CEMENT BINDER. The virgin asphalt cement shall not be more than two standard asphalt material grades different than that specified in paragraph ASPHALT CEMENT BINDER.

PART 3 EXECUTION

3.1 PREPARATION OF ASPHALT BINDER MATERIAL

Heat the asphalt cement material avoiding local overheating and providing a continuous supply of the asphalt material to the mixer at a uniform temperature. The temperature of unmodified asphalts shall be no more than 325 degrees F when added to the aggregates. Performance-Graded (PG) asphalts shall be within the temperature range of 265-320degrees F when added to the aggregate.

3.2 PREPARATION OF MINERAL AGGREGATE

Heat and dry the aggregate for the mixture prior to mixing. No damage shall occur to the aggregates due to the maximum temperature and rate of heating used. The temperature of the aggregate and mineral filler shall not exceed 350 degrees F when the asphalt cement is added. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

3.3 PREPARATION OF HOT-MIX ASPHALT MIXTURE

The aggregates and the asphalt cement shall be weighed or metered and introduced into the mixer in the amount specified by the JMF. Mix the combined materials until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but no less than 25 seconds for batch plants. Establish the wet mixing time for all plants based on the procedure for determining the percentage of coated particles described in ASTM D 2489/D 2489M, for each individual plant and for each type of aggregate used. The wet mixing time will be set to at least achieve 95 percent of coated particles. The moisture content of all hot-mix asphalt upon discharge from the plant shall not exceed 0.5 percent by total weight of mixture as measured by ASTM D 1461.

3.4 PREPARATION OF THE UNDERLYING SURFACE

Immediately before placing the hot mix asphalt, clean the underlying course of dust and debris. Apply a prime coat in accordance with the contract specifications.

3.5 TEST SECTION

Prior to full production, place a test section for each JMF used. Construct a test section 250 - 500 feet long and two paver passes wide placed for two lanes, with a longitudinal cold joint. The test section shall be of the same thickness as the course which it represents. The underlying grade or pavement structure upon which the test section is to be constructed shall be the same as the remainder of the course represented by

the test section. The equipment and personnel used in construction of the test section shall be the same equipment to be used on the remainder of the course represented by the test section. Place the test section as part of the project pavement, as approved by the Contracting Officer.

3.5.1 Sampling and Testing for Test Section

Take one random sample at the plant, triplicate specimens compacted, and tested for stability, flow, and laboratory air voids. Test a portion of the same sample for theoretical maximum density (TMD), aggregate gradation and asphalt content. Take four randomly selected cores from the finished pavement mat, and four from the longitudinal joint, and tested for density. Random sampling shall be in accordance with procedures contained in [ASTM D 3665](#). The test results shall be within the tolerances shown in Table 7 for work to continue. If all test results meet the specified requirements, the test section shall remain as part of the project pavement. If test results exceed the tolerances shown, the test section shall be removed and replaced at no cost to the Government and another test section shall be constructed. The test section shall be paid for with the first lot of paving

Table 7. Test Section Requirements for Material and Mixture Properties

<u>Property</u>	<u>Specification Limit</u>
Aggregate Gradation-Percent Passing (Individual Test Result)	
No. 4 and larger	JMF plus or minus 8
No. 8, No. 16, No. 30, and No. 50	JMF plus or minus 6
No. 100 and No. 200	JMF plus or minus 2.0
Asphalt Content, Percent (Individual Test Result)	JMF plus or minus 0.5
Laboratory Air Voids, Percent (Average of 3 specimens)	JMF plus or minus 1.0
VMA, Percent (Average of 3 specimens)	[13] [14] [15] minimum
Stability, pounds (Average of 3 specimens) (NA for superpave)	[1000 minimum for 50 blows] [1800 minimum for 75 blows]
Flow, 0.01 inches (Average of 3 specimens) (NA for superpave)	[8 - 18 for 50 blows] [8 - 16 for 75 blows]
Mat Density, Percent of TMD (Average of 4 Random Cores)	92.0 - 96.0
Joint Density, Percent of TMD (Average of 4 Random Cores)	90.5 - 92.5

3.5.2 Additional Test Sections

If the initial test section should prove to be unacceptable, make the necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures and place a second test section. Additional test

sections, as required, shall be constructed and evaluated for conformance to the specifications. Full production shall not begin until an acceptable section has been constructed and accepted.

3.6 TESTING LABORATORY

Use a laboratory to develop the JMF that meets the requirements of ASTM D 3666. The Government will inspect the laboratory equipment and test procedures prior to the start of hot mix operations for conformance to ASTM D 3666. The laboratory shall maintain the Corps certification for the duration of the project. A statement signed by the manager of the laboratory stating that it meets these requirements or clearly listing all deficiencies shall be submitted to the Contracting Officer prior to the start of construction. The statement shall contain as a minimum:

- a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.
- b. A listing of equipment to be used in developing the job mix.
- c. A copy of the laboratory's quality control system.
- d. Evidence of participation in the AASHTO Materials Reference Laboratory (AMRL) program.

3.7 TRANSPORTING AND PLACING

3.7.1 Transporting

Transport the hot-mix asphalt from the mixing plant to the site in clean, tight vehicles. Schedule deliveries so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Provide adequate artificial lighting for night placements. Hauling over freshly placed material will not be permitted until the material has been compacted as specified, and allowed to cool to 140 degrees F. To deliver mix to the paver, use a material transfer vehicle operated to produce continuous forward motion of the paver.

3.7.2 Placing

Place and compact the mix at a temperature suitable for obtaining density, surface smoothness, and other specified requirements. Upon arrival, place the mixture to the full width by an asphalt paver; it shall be struck off in a uniform layer of such depth that, when the work is completed, it will have the required thickness and conform to the grade and contour indicated. Regulate the speed of the paver to eliminate pulling and tearing of the asphalt mat. Unless otherwise permitted, placement of the mixture shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. Place the mixture in consecutive adjacent strips having a minimum width of 10 feet. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 1 foot; however, the joint in the surface course shall be at the centerline of the pavement. Transverse joints in one course shall be offset by at least 10 feet from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 10 feet. On isolated areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread and luted by hand tools.

3.8 COMPACTION OF MIXTURE

After placing, the mixture shall be thoroughly and uniformly compacted by rolling. Compact the surface as soon as possible without causing displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once. Furnish sufficient rollers to handle the output of the plant. Continue rolling until the surface is of uniform texture, true to grade and cross section, and the required field density is obtained. To prevent adhesion of the mixture to the roller, keep the wheels properly moistened but excessive water will not be permitted. In areas not accessible to the roller, the mixture shall be thoroughly compacted with hand tampers. Any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or is in any way defective shall be removed full depth, replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching will not be allowed.

3.9 JOINTS

The formation of joints shall be performed ensuring a continuous bond between the courses and to obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

3.9.1 Transverse Joints

Do not pass the roller over the unprotected end of the freshly laid mixture, except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing material at the joint. Remove the cutback material from the project. In both methods, all contact surfaces shall be given a light tack coat of asphalt material before placing any fresh mixture against the joint.

3.9.2 Longitudinal Joints

Longitudinal joints which are irregular, damaged, uncompacted, cold (less than 175 degrees F at the time of placing adjacent lanes), or otherwise defective, shall be cut back a maximum of 3 inches from the top of the course with a cutting wheel to expose a clean, sound vertical surface for the full depth of the course. All cutback material shall be removed from the project. All contact surfaces shall be given a light tack coat of asphalt material prior to placing any fresh mixture against the joint. The Contractor will be allowed to use an alternate method if it can be demonstrated that density, smoothness, and texture can be met.

3.10 CONTRACTOR QUALITY CONTROL

3.10.1 General Quality Control Requirements

Develop an approved Quality Control Plan. Do not produce hot-mix asphalt for payment until the quality control plan has been approved addressing all elements which affect the quality of the pavement including, but not

limited to:

- a. Mix Design
- b. Aggregate Grading
- c. Quality of Materials
- d. Stockpile Management
- e. Proportioning
- f. Mixing and Transportation
- g. Mixture Volumetrics
- h. Moisture Content of Mixtures
- i. Placing and Finishing
- j. Joints
- k. Compaction
- l. Surface Smoothness

3.10.2 Testing Laboratory

Provide a fully equipped asphalt laboratory located at the plant or job site and meeting the pertinent requirements in [ASTM D 3666](#). Laboratory facilities shall be kept clean and all equipment maintained in proper working condition. The Contracting Officer shall be permitted unrestricted access to inspect the Contractor's laboratory facility, to witness quality control activities, and to perform any check testing desired. The Contracting Officer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to adversely affect test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are corrected.

3.10.3 Quality Control Testing

Perform all quality control tests applicable to these specifications and as set forth in the Quality Control Program. The testing program shall include, but shall not be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, moisture in the asphalt mixture, laboratory air voids, stability (NA for Superpave), flow (NA for Superpave), in-place density, grade and smoothness. Develop a Quality Control Testing Plan as part of the Quality Control Program.

3.10.3.1 Asphalt Content

A minimum of two tests to determine asphalt content will be performed per lot (a lot is defined in paragraph MATERIAL ACCEPTANCE and PERCENT PAYMENT) by one of the following methods: the extraction method in accordance with [ASTM D 2172](#), Method A or B, the ignition method in accordance with [ASTM D 6307](#), or the nuclear method in accordance with [ASTM D 4125](#). Calibrate the ignition oven or the nuclear gauge for the specific mix being

used. For the extraction method, determine the weight of ash, as described in [ASTM D 2172](#), as part of the first extraction test performed at the beginning of plant production; and as part of every tenth extraction test performed thereafter, for the duration of plant production. The last weight of ash value obtained shall be used in the calculation of the asphalt content for the mixture.

3.10.3.2 Gradation

Determine aggregate gradations a minimum of twice per lot from mechanical analysis of recovered aggregate in accordance with [ASTM D 5444](#). When asphalt content is determined by the ignition oven or nuclear method, aggregate gradation shall be determined from hot bin samples on batch plants, or from the cold feed on drum mix plants. For batch plants, test aggregates in accordance with [ASTM C 136](#) using actual batch weights to determine the combined aggregate gradation of the mixture.

3.10.3.3 Temperatures

Check temperatures at least four times per lot, at necessary locations, to determine the temperature at the dryer, the asphalt cement in the storage tank, the asphalt mixture at the plant, and the asphalt mixture at the job site.

3.10.3.4 Aggregate Moisture

Determine the moisture content of aggregate used for production a minimum of once per lot in accordance with [ASTM C 566](#).

3.10.3.5 Moisture Content of Mixture

Determine the moisture content of the mixture at least once per lot in accordance with [ASTM D 1461](#) or an approved alternate procedure.

3.10.3.6 Laboratory Air Voids, Marshall Stability and Flow

Take mixture samples at least four times per lot compacted into specimens, using 50blows per side with the hand-held Marshall hammer as described in [ASTM D 6926](#). When the Superpave gyratory compactor is used, mixes will be compacted to 50gyrations in accordance with [ASTM D 6925](#). Hot-mix provided under the DOT Superpave option shall be compacted in accordance with the DOT requirements. After compaction, determine the laboratory air voids of each specimen. Stability and flow shall be determined for the Marshall-compacted specimens, in accordance with [ASTM D 6927](#).

3.10.3.7 In-Place Density

Conduct any necessary testing to ensure the specified density is achieved. A nuclear gauge may be used to monitor pavement density in accordance with [ASTM D 2950](#).

3.10.3.8 Grade and Smoothness

Conduct the necessary checks to ensure the grade and smoothness requirements are met in accordance with paragraphs MATERIAL ACCEPTANCE and PERCENT PAYMENT.

3.10.3.9 Additional Testing

Any additional testing, which the Contractor deems necessary to control the process, may be performed at the Contractor's option.

3.10.3.10 QC Monitoring

Submit all QC test results to the Contracting Officer on a daily basis as the tests are performed. The Contracting Officer reserves the right to monitor any of the Contractor's quality control testing and to perform duplicate testing as a check to the Contractor's quality control testing.

3.10.4 Sampling

When directed by the Contracting Officer, sample and test any material which appears inconsistent with similar material being produced, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

3.10.5 Control Charts

For process control, establish and maintain linear control charts on both individual samples and the running average of last four samples for the parameters listed in Table 8, as a minimum. These control charts shall be posted as directed by the Contracting Officer and kept current at all times. The control charts shall identify the project number, the test parameter being plotted, the individual sample numbers, the Action and Suspension Limits listed in Table 8 applicable to the test parameter being plotted, and the Contractor's test results. Target values from the JMF shall also be shown on the control charts as indicators of central tendency for the cumulative percent passing, asphalt content, and laboratory air voids parameters. When the test results exceed either applicable Action Limit, take immediate steps to bring the process back in control. When the test results exceed either applicable Suspension Limit, halt production until the problem is solved. Use the control charts as part of the process control system for identifying trends so that potential problems can be corrected before they occur. Make decisions concerning mix modifications based on analysis of the results provided in the control charts. The Quality Control Plan shall indicate the appropriate action to be taken to bring the process into control when certain parameters exceed their Action Limits.

Table 8. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts

Parameter to be Plotted	<u>Individual Samples</u>		<u>Running Average of Last Four Samples</u>	
	Action Limit	Suspension Limit	Action Limit	Suspension Limit
No. 4 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	6	8	4	5
No. 30 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	4	6	3	4
No. 200 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	1.4	2.0	1.1	1.5
Stability, pounds (minimum) (NA for Superpave)				
75 Blow JMF	1800	1700	1900	1800
50 Blow JMF	1000	900	1100	1000
Flow, 0.01 inches (NA for Superpave)				
75 Blow	8 min. 16 max.	7 min. 17 max.	9 min. 15 max.	8 min. 16 max.
50 Blow	8 min. 18 max.	7 min. 19 max.	9 min. 17 max.	8 min. 18 max.
Asphalt content, % deviation from JMF target; plus or minus value	0.4	0.5	0.2	0.3
Laboratory Air Voids, % deviation from JMF target value	No specific action and suspension limits set since this parameter is used to determine percent payment			
In-place Mat Density, % of TMD	No specific action and suspension limits set since this parameter is used to determine percent payment			
In-place Joint Density, % of TMD	No specific action and suspension limits set since this parameter is used to determine percent payment			

3.11 MATERIAL ACCEPTANCE

Testing for acceptability of work will be performed by an independent laboratory hired by the Contractor. Forward test results and payment calculations daily to the Contracting Officer. Acceptance of the plant produced mix and in-place requirements will be on a lot to lot basis. A standard lot for all requirements will be equal to 8 hours of production. Where appropriate, adjustment in payment for individual lots of hot-mix asphalt will be made based on in-place density, laboratory air voids, grade and smoothness in accordance with the following paragraphs. Grade and surface smoothness determinations will be made on the lot as a whole.

Exceptions or adjustments to this will be made in situations where the mix within one lot is placed as part of both the intermediate and surface courses, thus grade and smoothness measurements for the entire lot cannot be made. In order to evaluate laboratory air voids and in-place (field) density, each lot will be divided into four equal sublots.

3.11.1 Sublot Sampling

One random mixture sample for determining laboratory air voids, theoretical maximum density, and for any additional testing the Contracting Officer desires, will be taken from a loaded truck delivering mixture to each sublot, or other appropriate location for each sublot. All samples will be selected randomly, using commonly recognized methods of assuring randomness conforming to [ASTM D 3665](#) and employing tables of random numbers or computer programs. Laboratory air voids will be determined from three laboratory compacted specimens of each sublot sample in accordance with [ASTM D 6926](#). The specimens will be compacted within 2 hours of the time the mixture was loaded into trucks at the asphalt plant. Samples will not be reheated prior to compaction and insulated containers will be used as necessary to maintain the temperature.

3.11.2 Additional Sampling and Testing

The Contracting Officer reserves the right to direct additional samples and tests for any area which appears to deviate from the specification requirements. The cost of any additional testing will be paid for by the Government. Testing in these areas will be in addition to the lot testing, and the requirements for these areas will be the same as those for a lot.

3.11.3 Grade

The final wearing surface of pavement shall conform to the elevations and cross sections shown and shall vary not more than [0.05 foot](#) from the plan grade established and approved at site of work. Finished surfaces at juncture with other pavements shall coincide with finished surfaces of abutting pavements. Deviation from the plan elevation will not be permitted in areas of pavements where closer conformance with planned elevation is required for the proper functioning of drainage and other appurtenant structures involved. The grade will be determined by running lines of levels at intervals of [25 feet](#), or less, longitudinally and transversely, to determine the elevation of the completed pavement surface. Within 5 working days, after the completion of a particular lot incorporating the final wearing surface, test the final wearing surface of the pavement for conformance with the specified plan grade. Diamond grinding may be used to remove high spots to meet grade requirements. Skin patching for correcting low areas or planing or milling for correcting high areas will not be permitted.

3.11.4 Surface Smoothness

Use one of the following methods to test and evaluate surface smoothness of the pavement. Perform all testing in the presence of the Contracting Officer. Keep detailed notes of the results of the testing and furnish a copy to the Government immediately after each day's testing. Use the profilograph method for all longitudinal testing, except where the runs would be less than [200 feet](#) in length and the ends where the straightedge will be used. Where drawings show required deviations from a plane surface (crowns, drainage inlets, etc.), the surface shall be finished to meet the approval of the Contracting Officer.

3.11.4.1 Smoothness Requirements

- a. Straightedge Testing: The finished surfaces of the pavements shall have no abrupt change of $1/4$ inch or more, and all pavements shall be within the tolerances of $1/4$ inch in both the longitudinal and transverse directions, when tested with an approved 12 feet straightedge.
- b. Profilograph Testing: The finished surfaces of the pavements shall have no abrupt change of $1/8$ inch or more, and each 0.1 mile segment of each pavement lot shall have a Profile Index not greater than 9 inches/mile when tested with an approved California-type profilograph. If the extent of the pavement in either direction is less than 200 feet, that direction shall be tested by the straightedge method and shall meet requirements specified above.

3.11.4.2 Testing Method

After the final rolling, but not later than 24 hours after placement, test the surface of the pavement in each entire lot in such a manner as to reveal all surface irregularities exceeding the tolerances specified above. Separate testing of individual sublots is not required. If any pavement areas are ground, these areas shall be retested immediately after grinding. Test each lot of the pavement in both a longitudinal and a transverse direction on parallel lines. Set the transverse lines 15 feet or less apart, as directed. The longitudinal lines shall be at the centerline of each paving lane for lanes less than 20 feet wide and at the third points for lanes 20 feet or wider. Also test other areas having obvious deviations. Longitudinal testing lines shall be continuous across all joints.

- a. Straightedge Testing. Hold the straightedge in contact with the surface and move it ahead one-half the length of the straightedge for each successive measurement. Determine the amount of surface irregularity by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points.
- b. Profilograph Testing. Perform profilograph testing using approved equipment and procedures described in CALTRANS Test 526. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must-grind" bumps and the Profile Index for each 0.1 mile segment of each pavement lot. Grade breaks on parking lots shall be accommodated by breaking the profile segment into shorter sections and repositioning the blanking band on each segment. The "blanking band" shall be 0.2 inches wide and the "bump template" shall span 1 inch with an offset of 0.3 inch. Compute the Profile Index for each pass of the profilograph in each 0.1 mile segment. The Profile Index for each segment shall be the average of the Profile Indices for each pass in each segment. The profilograph shall be operated by a DOT approved operator. Furnish a copy of the reduced tapes to the Government at the end of each day's testing.

-- End of Section --

SECTION 32 13 11

CONCRETE PAVEMENT FOR AIRFIELDS AND OTHER HEAVY-DUTY PAVEMENTS
08/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

- ACI 211.1 (1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
- ACI 214R (2002; Errata 2010) Evaluation of Strength Test Results of Concrete
- ACI 305R (2010) Specification for Hot Weather Concreting
- ACI 306R (2010) Cold Weather Concreting

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

- AASHTO M 182 (2005; R 2009) Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

ASTM INTERNATIONAL (ASTM)

- ASTM A 184/A 184M (2006) Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
- ASTM A 185/A 185M (2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
- ASTM A 497/A 497M (2007) Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
- ASTM A 615/A 615M (2009b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- ASTM A 775/A 775M (2007b) Standard Specification for Epoxy-Coated Steel Reinforcing Bars
- ASTM A 996/A 996M (2009b) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars

	for Concrete Reinforcement
ASTM C 1017/C 1017M	(2007) Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1064/C 1064M	(2008) Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C 1077	(2010c) Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 117	(2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 123	(2004) Standard Test Method for Lightweight Particles in Aggregate
ASTM C 1240	(2005) Standard Specification for Silica Fume Used in Cementitious Mixtures
ASTM C 1260	(2007) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C 131	(2006) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 138/C 138M	(2010b) Standard Test Method for Density ("Unit Weight"), Yield, and Air Content (Gravimetric) of Concrete
ASTM C 142	(1997; R 2004) Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C 143/C 143M	(2010) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C 150/C 150M	(2009) Standard Specification for Portland Cement
ASTM C 1567	(2008) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C 1602/C 1602M	(2006) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete

ASTM C 1646/C 1646M	(2008a) Making and Curing Test Specimens for Evaluating Frost Resistance of Coarse Aggregate in Air-Entrained Concrete by Rapid Freezing and Thawing
ASTM C 174/C 174M	(2006) Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores
ASTM C 260	(2006) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 29/C 29M	(2009) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C 294	(2005) Standard Descriptive Nomenclature for Constituents of Concrete Aggregates
ASTM C 295	(2008) Petrographic Examination of Aggregates for Concrete
ASTM C 31/C 31M	(2010) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 33/C 33M	(2008) Standard Specification for Concrete Aggregates
ASTM C 494/C 494M	(2010a) Standard Specification for Chemical Admixtures for Concrete
ASTM C 595/C 595M	(2010) Standard Specification for Blended Hydraulic Cements
ASTM C 618	(2008a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C 666/C 666M	(2003; R 2008) Resistance of Concrete to Rapid Freezing and Thawing
ASTM C 88	(2005) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 881/C 881M	(2010) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 94/C 94M	(2010) Standard Specification for Ready-Mixed Concrete
ASTM C 989	(2009a) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C172/C172M	(2010) Standard Practice for Sampling Freshly Mixed Concrete

ASTM C231/C231M	(2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C78/C78M	(2010) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM D 1751	(2004; R 2008) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 2419	(2009) Sand Equivalent Value of Soils and Fine Aggregate
ASTM D 2995	(1999; R 2009) Determining Application Rate of Bituminous Distributors
ASTM D 3665	(2007) Random Sampling of Construction Materials
ASTM D 4791	(2010) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D 75/D 75M	(2009) Standard Practice for Sampling Aggregates

INNOVATIVE PAVEMENT RESEARCH FOUNDATION (IPRF)

IPRF INTERIM TEST PROTOCOL	Test Method to Assess Potential Reactivity of Aggregates in Presence of Airfield Deicing Chemicals (Mortar Bar Test)
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NATIONAL READY MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA QC 3	(2003) Quality Control Manual: Section 3, Plant Certifications Checklist: Certification of Ready Mixed Concrete Production Facilities
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STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS)

CALTRANS Test 526	(2002) Operation of California Profilograph and Evaluation of Profiles
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U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 130	(2001) Standard Recommended Practice for Estimating Scratch Hardness of Coarse Aggregate Particles
COE CRD-C 143	(1962) Specifications for Meters for Automatic Indication of Moisture in Fine Aggregate
COE CRD-C 300	(1990) Specifications for Membrane-Forming

Compounds for Curing Concrete

COE CRD-C 521	(1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete
COE CRD-C 55	(1992) Test Method for Within-Batch Uniformity of Freshly Mixed Concrete
COE CRD-C 662	(2009) Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials, Lithium Nitrate Admixture and Aggregate (Accelerated Mortar-Bar Method)

1.2 SYSTEM DESCRIPTION

This section is intended to stand alone for construction of concrete pavement. However, where the construction covered herein interfaces with other sections, the construction at each interface shall conform to the requirements of both this section and the other section, including tolerances for both.

1.2.1 Surface Smoothness

Use the profilograph method for all longitudinal testing, except for paving lanes less than 200 feet in length. Use the straightedge method for transverse testing, for longitudinal testing where the length of each pavement lane is less than 200 feet, and at the ends of the paving limits for the project. Where drawings show required deviations from a plane surface (crowns, drainage inlets, etc.), finish the surface to meet the approval of the Contracting Officer. Detailed notes shall be kept of the results of the testing and a copy furnished to the Government after each day's testing.

a. Straightedge Testing: The finished surfaces of the pavements shall have no abrupt change of 1/4 inch or more, and all pavements shall be within the limits specified hereinafter when checked with an approved 12 foot straightedge. Runways and taxiways shall have a variation from the specified straight edge not greater than 1/8 inch in the longitudinal direction and not greater than 1/4 inch in the transverse direction. All other airfield areas shall have a variation from a straight edge not greater than 1/4 inch in either the longitudinal or transverse direction. Roads, streets, tank hardstands, vehicular parking areas, and open storage areas shall have a variation from the specified straight edge not greater than 6 mm 1/4 inch in either the longitudinal or transverse direction.

b. Profilograph Testing: The finished surfaces of the pavements shall have no abrupt change of 1/4 inch or more, and each 0.1 mile segment of each pavement lot shall have a Profile Index not greater than specified hereinafter when tested with an approved California-type profilograph. Runways and taxiways shall have a Profile index not greater than 7 inches per mile in the longitudinal direction. Runway and taxiway transverse smoothness shall be measured with the straight edge method and the straight edge requirements shall apply. All other airfield areas shall have a Profile Index not greater than 9 inches per mile in the longitudinal direction. Roads, streets, tank hardstands, vehicular parking areas and open storage areas shall have a Profile index not greater than 9 inches per mile in the longitudinal direction.

c. Bumps ("Must Grind" Areas): Any bumps ("must grind" areas) shown on the profilograph trace which exceed 0.4 inch in height shall be reduced by diamond grinding in accordance with subparagraph "Diamond Grinding of PCC Surfaces" below until they do not exceed 0.3 inch when retested. Such grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding.

d. Testing Method: After the concrete has hardened sufficiently to permit walking thereon, but not later than 48 hours after placement, test the entire surface of the pavement in each lot in such a manner as to reveal all surface irregularities exceeding the tolerances specified above. If any pavement areas are ground, these areas shall be retested immediately after diamond grinding. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines. The transverse lines shall be 15 feet or less apart, as directed. The longitudinal lines shall be at the centerline of each paving lane shown on the drawings, regardless of whether the Contractor is allowed to pave two lanes at a time, and at the 1/8th point in from each side of the lane. Other areas having obvious deviations shall also be tested. Longitudinal testing lines shall be continuous across all joints. Transverse testing lines for pilot lanes shall be carried to construction joint lines and for fill-in lanes shall be carried 24 inches across construction joints, and the readings in this area applied to the fill-in lane. Straightedge testing of the longitudinal edges of slipformed pilot lanes shall also be performed before paving fill-in lanes as specified below.

1). Straightedge Testing: The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. Determine the amount of surface irregularity by placing the freestanding (unleveled) straightedge on the pavement surface and measuring the maximum gap between the straightedge and the pavement surface. Measurements shall be determined along the entire length of the straight edge.

2). Profilograph Testing: Perform profilograph testing using approved equipment and procedures described in CALTRANS Test 526. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must-grind" bumps and the Profile Index for each 0.1 mile segment of the pavement lot. Grade breaks on aprons parking lots shall be accommodated by breaking the profile segment into short sections and repositioning the blanking band on each section. The "blanking band" shall be 0.2 inches wide and the "bump template" shall span 1 inch with an offset of 0.4 inch. The profilograph testing of the last 30 feet of a paving lane in the longitudinal direction from each day's paving operation shall be counted on the following day's continuation lane. The profile index shall be computed for each pass of the profilograph (3 per lane) in each 0.1 mile segment. The profile index for each segment shall be the average of the profile indices for each pass in each segment. Profilographs of unequal lengths shall be scaled and proportioned to an equivalent 0.1 mile as outlined in the CALTRANS Test 526. A copy of the reduced tapes shall be furnished the Government at the end of each day's testing.

1.2.2 Edge Slump and Joint Face Deformation

a. Edge Slump: When slip-form paving is used, not more than 15.0 percent of the total free edge of each pavement panel shall have an edge slump exceeding 1/4 inch and none of the free edge of the pavement lot shall have an edge slump exceeding 3/8 inch. (A pavement panel is defined as a lane width by the length between two adjacent transverse contraction joints. The total free edge of the pavement will be considered to be the cumulative total linear measurement of pavement panel edge originally constructed as non-adjacent to any existing pavement; i.e., 100 feet of pilot lane originally constructed as a separate lane, will have 200 feet of free edge; 100 feet of fill-in lane will have no free edge, etc.,). The area affected by the downward movement of the concrete along the pavement edge shall not exceed 18 inches back from the edge.

b. Joint Face Deformation: In addition to the edge slump limits specified above, the vertical joint face shall have a surface within the maximum limits shown below:

Offset from Straightedge Applied Longitudinally To Pavement Surface	Offset from Straightedge Applied Longitudinally To Vertical Face	Offset From Straightedge Applied Top to Bottom Against the Joint Face	Abrupt Offset in Any Direction	Offset of Joint Face From True Vertical
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Airfield Pavement

3 mm (1/8 in)	6 mm (1/4 in)	9 mm (3/8 in)	3 mm (1/8 in)	8 mm/100 mm (1 in/12 in)
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All other Pavement

6 mm (1/4 in)	All other items same as airfield pavement All other items same as airfield pavement
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c. Slump Determination: Immediately after the concrete has hardened sufficiently to permit walking thereon, the pavement surface of each lot shall be tested by the Contractor. Testing shall be performed with a minimum 12 foot straightedge to reveal irregularities exceeding the edge slump tolerance specified above. The vertical edge slump shall be determined at each freeedge of each slipformed paving lane constructed. The straightedge shall be placed transverse to the direction of paving and the end of the straightedge located at the edge of the paving lane. Measurements shall be made at 5 to 15 foot spacings, as directed, commencing at the header where paving was started. Initially measurements shall be made at 5 foot intervals in each lane. When no deficiencies are present, the Contracting Officer may approve an increase in the interval. When any deficiencies exist, the interval will be returned to 5 feet. In no case shall the interval exceed 15 feet. In addition to the transverse edge slump determination above, the Contractor, at the same time, shall check the longitudinal surface smoothness of the joint on a continuous line 1 inch back from the joint line using the 12 foot straightedge advanced one-half its length for each reading. Other tests of the exposed joint face shall be made to ensure that a uniform, true vertical joint face is attained. The measurements shall be made by the Contractor, shall be properly referenced in accordance with paving lane identification and

stationing, and a report given to the Contracting Officer within 24 hours after measurement is made. The report shall also identify areas requiring replacement.

d. Excessive Edge Slump: When edge slump exceeding the limits specified above is encountered on either side of the paving lane, additional straightedge measurements shall be made, if required, to define the linear limits of the excessive slump. The concrete slabs having excessive edge slump or joint deformation shall be removed and replaced to the next transverse joint in conformance with paragraph: REPAIR, REMOVAL, REPLACEMENT OF NEWLY CONSTRUCTED SLABS. Use of slip-form paving equipment and procedures that fail to consistently provide edges within the specified tolerances on edge slump and joint face deformation shall be discontinued and the pavements shall be constructed by means of standard paving procedures using fixed forms.

1.2.3 Plan Grade

Within 5 days after paving of each lot, the finished surface of the pavement area shall be tested, by running lines of levels at intervals corresponding with every longitudinal and transverse joint to determine the elevation at each joint intersection. The results of this survey shall be recorded and a copy given to the Government at the completion of the survey of each lot. The finished surfaces of airfield runway, taxiway, and apron pavements shall vary not more than 1/2 inch above or below the plan grade line or elevation indicated. The surfaces of other pavements shall vary not more than 3/4 inch. The above deviations from the approved grade line and elevation will not be permitted in areas where closer conformance with the planned grade and elevation is required for the proper functioning of appurtenant structures. The finished surfaces of new abutting pavements shall coincide at their juncture.

1.2.4 Flexural Strength

Each lot of pavement will be evaluated for acceptance in accordance with the following procedures.

- a. **Sampling and Testing:** For acceptance, one composite sample of concrete from each subplot shall be obtained in accordance with **ASTM C172/C172M** from one batch or truckload. Two test cylinders per subplot (8 per lot) shall be tested at 14 days.
- b. **Computations:** Average the eight 14-day strength tests for the lot. The average strength shall be used in accordance with paragraph "Concrete Strength for Final Acceptance" in PART 2.

1.2.5 Thickness

Each lot of pavement will be evaluated for acceptance and payment adjustment in accordance with the following procedure. Two cores, between 4 and 6 inches in diameter, shall be drilled from the pavement, per subplot (8 per lot). The Contractor is responsible for drilling the cores within 3 days after lot placement, filling the core holes with an approved non-shrink concrete, respraying the cored areas with curing compound, and for measuring the cores. Each core shall be inspected for voids, thickness of paste on the surface, and depth of reinforcement (if required). Provide the results with the thickness measurement data. Eight measurements of thickness shall be made around the circumference of each core and one in the center, in accordance with **ASTM C 174/C 174M**, using calibrated calipers

for specimens longer than 10 inches. The pavement thickness from the 8 cores for the lot shall be averaged and shall be evaluated as described in paragraph: PAYMENT ADJUSTMENT FOR THICKNESS above.

1.2.6 Diamond Grinding of PCC Surfaces

In areas not meeting the specified limits for surface smoothness and plan grade, high areas shall be reduced to attain the required smoothness and grade, except as depth is limited below. High areas shall be reduced by grinding the hardened concrete with an approved diamond grinding machine after the concrete is 14 days or more old. Grinding shall be accomplished by sawing with an industrial diamond abrasive which is impregnated in the saw blades. The saw blades shall be assembled in a cutting head mounted on a machine designed specifically for diamond grinding that will produce the required texture and smoothness level without damage to the concrete pavement or joint faces. The saw blades shall be 1/8-inch wide and there shall be a minimum of 55 to 60 blades per 12 inches of cutting head width depending on the hardness of the aggregate. Each machine shall be capable of cutting a path 3 to 4 ft 3 to 4 ft wide. Grinding equipment that causes ravels, aggregate fractures, spalls or disturbance to the joints will not be permitted. The area corrected by grinding the surface of the hardened concrete shall not exceed 10 percent of the total area of any subplot. The depth of diamond grinding shall not exceed 1/4 inch. All pavement areas requiring plan grade or surface smoothness corrections in excess of the limits specified above, shall be removed and replaced in conformance with paragraph REPAIR, REMOVAL, REPLACEMENT OF NEWLY CONSTRUCTED SLABS. In pavement areas given a wire comb or tined texture, areas exceeding 25 square feet that have been corrected by diamond grinding shall be retextured by transverse grooving using an approved grooving machine of standard manufacture. The grooves shall be 1/4 inch deep by 1/4 inch wide on 1-1/2 inch centers and shall be carried into, and tapered to zero depth within the non-corrected surface, or shall match any existing grooves in the adjacent pavement. All areas in which diamond grinding has been performed will be subject to the thickness tolerances specified in paragraph: Thickness, above.

1.3 SUBMITTALS

All submittals related to airfield pavement mix design will be reviewed by the USACE Transportation Systems Center. Submittals will only be reviewed upon receipt of all required documentation and certifications. The Contractor shall allow (4) four weeks for review of all airfield pavement related submittals.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment

a. Details and data on the batching and mixing plant prior to plant assembly including manufacturer's literature showing that the equipment meets all requirements specified herein.

b. A certified copy of the NRMCA QC Manual Section 3 Concrete

Plant Certification Checklist and Calibration documentation on all measuring and weighing devices, submitted prior to uniformity testing.

c. A description of the equipment proposed for transporting concrete mixture from the central mixing plant to the paving equipment.

d. A description of the equipment proposed for the machine and hand placing, consolidating and curing of the concrete mixture. Manufacturer's literature on the paver and finisher, together with the manufacturer's written instructions on adjustments and operating procedures necessary to assure a tight, smooth surface on the concrete pavement. The literature shall show that the equipment meets all details of these specifications. [Detailed information on automatic laser controlled systems shall be submitted if proposed for use.]

Proposed Techniques; G

Placing and protection methods; paving sequence; jointing pattern; data on curing equipment and profilographs; demolition of existing pavements; as specified. Pavement diamond grinding equipment and procedures.

SD-05 Design Data

Proportioning Studies; G, ED

The results of the mixture proportioning studies signed and stamped by the registered professional engineer having technical responsibility for the mix design study, and submitted at least 30 days prior to commencing concrete placing operations. The results shall include a statement giving the maximum nominal coarse aggregate size and the weights and volumes of each ingredient proportioned on a one cubic yard basis. Aggregate quantities shall be based on the mass in a saturated surface dry condition. The recommended mixture proportions shall be accompanied by test results demonstrating that the proportions selected will produce concrete of the qualities indicated.

SD-06 Test Reports

Sampling and Testing; G, ED

Certified copies of laboratory test reports and sources for cement, supplementary cementitious materials (SCM), aggregates, admixtures, curing compound, epoxy, and proprietary patching materials proposed for use on this project. All aggregate tests shall have been performed no earlier than 6 months prior to contract award.

SD-07 Certificates

Contractor Quality Control Staff; G, ED

American Concrete Institute certification for Contractor Quality Control staff. Qualifications and resumes for petrographer, surveyor, concrete batch plant operator, and profilograph operator.

Laboratory Accreditation; G, ED

Accreditation of the commercial laboratory by an independent evaluation authority, indicating conformance to ASTM C 1077, including all applicable test procedures.

Commercial Laboratory; G, ED

USACE validation letter for commercial laboratory.

1.4 QUALITY ASSURANCE

1.4.1 Contractor Quality Control Staff

All Contractor Quality Control personnel assigned to concrete construction shall be American Concrete Institute (ACI) certified in the following grade (or shall have written evidence acceptable to the Contracting Officer's representative of having completed similar qualification programs):

- a. CQC personnel responsible for inspection of concrete paving operations: ACI Concrete Transportation Inspector.
- b. Lead Foreman or Journeyman of the Concrete Placing, Finishing, and Curing Crews: ACI Concrete Flatwork Technician/Finisher.
- c. Field Testing Technicians: ACI Concrete Field Testing Technician, Grade I.
- d. Laboratory Testing Technicians: ACI Concrete Strength Testing Technician and Laboratory Testing Technician, Grade I or II.

1.4.2 Other Staff

Submit for approval, the qualifications and resumes for the following staff:

- a. Petrographer: Bachelor of Science degree in geology or petrography, trained in petrographic examination of concrete aggregate according to ASTM C 294 and ASTM C 295 and trained in identification of the specific deleterious materials and tests identified in this specification. Resume shall detail the education, training and experience related to the project-specific test methods and deleterious materials and shall be submitted at least 20 days before petrographic and deleterious materials examination is to commence.
- b. Licensed Surveyor: All survey work shall be performed under the supervision of a Licensed Surveyor.
- c. Concrete Batch Plant Operator: National Ready Mix Concrete Association (NRMCA) Plant Manager certification at the Plant Manager level.
- d. Profilograph Operator: Certification by equipment manufacturer or a state Department of Transportation.

1.4.3 Laboratory Accreditation

Laboratory and testing facilities shall be provided by and at the expense of the Contractor. The laboratories performing the tests shall be

accredited in accordance with [ASTM C 1077](#), including [ASTM C78/C78M](#) and [ASTM C 1260](#). The accreditation shall be current and shall include the required and optional test methods, as specified throughout this Section. Onsite temperature-controlled concrete curing facilities shall be provided.

- a. Aggregate Testing and Mix Proportioning: Aggregate testing and mixture proportioning studies shall be performed by a commercial laboratory.
- b. Acceptance Testing: Furnish all materials, labor, and facilities required for molding, curing, testing, and protecting test specimens at the site and in the laboratory. Steel molds shall be used for molding the beam specimens. Furnish and maintain boxes or other facilities suitable for storing and curing the specimens at the site while in the mold within the temperature range stipulated by [ASTM C 31/C 31M](#). Flexural loading equipment shall be in accordance with [ASTM C78/C78M](#).
- c. Contractor Quality Control: All sampling and testing shall be performed by an approved, onsite, independent, [commercial laboratory](#), or for cementitious materials and admixtures, the manufacturer's laboratory.
- d. Laboratory Inspection: The Government will inspect the laboratory equipment and test procedures prior to the start of concreting operations for conformance to [ASTM C 1077](#). The laboratory shall maintain this certification for the duration of the project.

1.4.4 Preconstruction Testing of Materials

All sampling and testing shall be performed by, and at the expense of, the Contractor. Use an approved commercial laboratory or, for cementitious materials and chemical admixtures, a laboratory maintained by the manufacturer of the material. No material shall be used until notice of acceptance has been given. The Contractor will not be entitled to any additional payment or extension of time due to failure of any material to meet project requirements, or for any additional sampling or testing required. Additional tests may be performed by the Government at the discretion of the Contracting Officer; such Government testing will not relieve the Contractor of any testing responsibilities.

1.4.4.1 Aggregates

Aggregates shall be sampled in the presence of a Government Representative. Samples shall be obtained in accordance with [ASTM D 75/D 75M](#) and shall be representative of the materials to be used for the project. Test results shall be submitted 7 days before commencing mixture proportioning studies.

1.4.4.2 Chemical Admixtures, Curing Compounds and Epoxies

At least 30 days before the material is used, submit certified copies of test results for the specific lots or batches to be used on the project. Test results shall be not more than 6 months old prior to use in the work. Chemical admixtures that have been in storage at the project site for longer than 6 months or that have been subjected to freezing will be retested at the expense of the Contractor and will be rejected if test results are not satisfactory.

1.4.4.3 Cementitious Materials

Cement, ground granulated blast furnace (GGBF) slag, and pozzolan will be accepted on the basis of manufacturer's certification of compliance, accompanied by mill test reports showing that the material in each shipment meets the requirements of the specification under which it is furnished. Mill test reports shall be no more than 1 month old, prior to use in the work. No cementitious material shall be used until notice of acceptance has been given by the Contracting Officer. Cementitious material may be subjected to check testing by the Government from samples obtained at the mill, at transfer points, or at the project site. If tests prove that a cementitious material that has been delivered is unsatisfactory, it shall be promptly removed from the site of the work. Cementitious material that has not been used within 6 months after testing shall be retested at the Contractor's expense and shall be rejected if test results are not satisfactory.

1.4.5 Testing During Construction

During construction, the Contractor is responsible for sampling and testing aggregates, cementitious materials, and concrete as specified herein. The Government will sample and test concrete and ingredient materials as considered appropriate. Provide facilities and labor as may be necessary for procurement of representative test samples. Testing by the Government will in no way relieve the Contractor of the specified testing requirements.

1.4.6 Test Section

At least 10 days, but not more than 60 days, prior to construction of the concrete pavement, construct a test section near the job site, but not as part of the production pavement area.]. Use the test section to develop and demonstrate to the satisfaction of the Contracting Officer the proposed techniques of mixing, hauling, placing, consolidating, finishing, curing, initial saw cutting, start-up procedures, testing methods, plant operations, and the preparation of the construction joints. Variations in mixture proportions, other than water, shall be made if directed. Vary the water content, as necessary, to arrive at the appropriate content. The mixing plant shall be operated and calibrated prior to start of placing the test section. Use the same equipment, materials, and construction techniques on the test section as will be used in all subsequent work. Base course preparation, concrete production, placing, consolidating, curing, construction of joints, and all testing shall be in accordance with applicable provisions of this specification. Three days after completion of the test section, provide eight cores at least 6 inch diameter by full depth cut from points selected in the test section by the Government. The cores will be evaluated for homogeneity, consolidation and segregation. Construct the test section meeting all specification requirements and being acceptable to the Contracting Officer in all aspects, including surface texture. Failure to construct an acceptable test section will necessitate construction of additional test sections at no additional cost to the Government. Test sections allowed to be constructed as part of the production paving which do not meet specification requirements shall be removed at the Contractor's expense. If the Contractor proposes to use slipform paving and is unable to construct an acceptable test section, the slipform paving equipment shall be removed from the job and the construction completed using stationary side forms and equipment compatible with them. Production paving shall not commence until the results on aggregates and concrete, including evaluation of the cores, and all pavement measurements for edge slump, joint face deformation, actual plan

grade, surface smoothness and thickness have been submitted and approved by the Contracting Officer. Pavement accepted as a production lot will be evaluated and paid in accordance with Paragraph: ACCEPTABILITY OF WORK below.

1.4.6.1 Pilot Lane

The test section shall consist of one paving lane at least 400 feet long and shall be constructed to the same thickness as the thickest portion of pavement shown on the Drawings. The lane width shall be the same as that required for use in the project. The test section shall contain at least one transverse construction joint. If keyed or doweled longitudinal construction joints are required in any of the production pavements, they shall be installed full length along one side of the test strip throughout the test section. If both keys and dowels are required, each shall be installed in half of the test section. Two separate days shall be used for construction of the test section.

1.4.6.2 Fill-In Lane

The first 400 feet of the initial production fill-in lane shall be considered a fill-in lane test section for purposes of testing and evaluation. All requirements for the test section are applicable, as appropriate. Obtain cores from the fill-lane side of the longitudinal construction joint with the pilot lane. The cores will be evaluated for homogeneity, consolidation, and segregation.

1.4.7 Acceptability of Work

The materials and the pavement itself will be accepted on the basis of tests made by the Contractor. The Government may make check tests to validate the results of the Contractor's testing. If the results of the Contractor tests vary by less than 2.0 percent of the Government's test results, the results of the Contractor's tests will be used. If the results of the Government and Contractor tests vary by 2.0 percent, but less than 4.0 percent, the average of the two will be considered the value to be used. If these vary by 4.0 percent or more, each sampling and testing procedure shall be carefully evaluated and both the Government and the Contractor shall take another series of tests on duplicate samples of material. If these vary by 4.0 percent or more, the results of the tests made by the Government shall be used and the Government will continue check testing of this item on a continuous basis until the two sets of tests agree within less than 4.0 percent on a regular basis. Testing performed by the Government will in no way at any time relieve the Contractor from the specified testing requirements.

1.4.8 Acceptance Requirements

1.4.8.1 Pavement Lots

A lot will be that quantity of construction that will be evaluated for acceptance with specification requirements. A lot will be equal to one shift of production not to exceed 1000 cubic yards. In order to evaluate thickness, each lot will be divided into four equal sublots. Grade determinations will be made on the lot as a whole. Surface smoothness determinations will be made on every 0.1 mile segment in each lot. Location of all samples shall be selected on a random basis in accordance with ASTM D 3665. When operational conditions cause a lot to be terminated before the specified four sublots have been completed, the following

procedure shall be used to adjust the lot size and number of tests for the lot. Where three sublots have been completed, they shall constitute a lot. Where one or two sublots have been completed, they shall be incorporated into the next lot (except for the last lot), and the total number of sublots shall be used and acceptance criteria adjusted accordingly.

1.4.8.2 Evaluation

Provide all sampling and testing required for acceptance and payment adjustment at the Contractor's expense. Individuals performing sampling, testing and inspection duties shall meet the required Qualifications. The Contracting Officer reserves the right to direct additional samples and tests for any area which appears to deviate from the specification requirements. Testing in these areas will be in addition to the subplot or lot testing, and the requirements for these areas will be the same as those for a subplot or lot. Provide facilities for and, where directed, personnel to assist in obtaining samples for any Government testing.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Bulk Cementitious Materials

Furnish all cementitious material in bulk. The temperature of the cementitious material, as delivered to storage at the site, shall not exceed 150 degrees F. Sufficient cementitious materials shall be in storage to sustain continuous operation of the concrete mixing plant while the pavement is being placed. Provide separate facilities to prevent any intermixing during unloading, transporting, storing, and handling of each type of cementitious material.

1.5.2 Aggregate Materials

Store aggregate at the site of the batching and mixing plant avoiding breakage, segregation, intermixing or contamination by foreign materials. Each size of aggregate from each source shall be stored separately in free-draining stockpiles. Aggregate stored on ground shall have a minimum 24 inch thick sacrificial layer left undisturbed. Fine aggregate and the smallest size coarse aggregate shall remain in free-draining storage for at least 24 hours immediately prior to use. Sufficient aggregate shall be maintained at the site at all times to permit continuous uninterrupted operation of the mixing plant at the time concrete pavement is being placed. Tracked equipment shall not be allowed on coarse aggregate stockpiles.

1.5.3 Other Materials

Store reinforcing bars and accessories above the ground on supports. All materials shall be stored avoiding contamination and deterioration.

PART 2 PRODUCTS

2.1 CEMENTITIOUS MATERIALS

Cementitious materials shall be portland cement or only portland cement in combination with supplementary cementitious materials (SCM), and shall conform to appropriate specifications listed below. New submittals are required when the cementitious materials sources or types change.

2.1.1 Portland Cement

Provide portland cement conforming to [ASTM C 150/C 150M](#), Type II, low alkali. Low alkali cement is required if the proposed aggregates are found to have greater than 0.04 percent expansion when tested in accordance with paragraph: Alkali-Silica Reactivity below.

2.1.2 Blended Cements

Blended cement shall conform to [ASTM C 595/C 595M](#), Type IP or IS, including the optional requirement for mortar expansion and sulfate soundness. The pozzolan added to the Type IP blend shall be [ASTM C 618](#) Class F or Class N and shall be interground with the cement clinker. The manufacturer shall state in writing that the amount of pozzolan in the finished cement will not vary more than plus or minus 5 mass percent of the finished cement from lot to lot or within a lot. The percentage and type of mineral admixture used in the blend shall not change from that submitted for the aggregate evaluation and mixture proportioning.

2.1.3 Pozzolan

2.1.3.1 Fly Ash

Fly ash shall conform to [ASTM C 618](#), Class F, including the optional requirements for uniformity and effectiveness in controlling Alkali-Silica reaction and shall have a loss on ignition not exceeding [3] [6] percent. Class F fly ash for use in mitigating Alkali-Silica Reactivity shall have a Calcium Oxide (CaO) content of less than 13 percent and a total equivalent alkali content less than 3 percent.

2.1.3.2 Raw or Calcined Natural Pozzolan

Natural pozzolan shall be raw or calcined and conform to [ASTM C 618](#), Class N, including the optional requirements for uniformity and effectiveness in controlling Alkali-Silica reaction and shall have a loss on ignition not exceeding 3 percent. Class N pozzolan for use in mitigating Alkali-Silica Reactivity shall have a Calcium Oxide (CaO) content of less than 13 percent and a total equivalent alkali content less than 3 percent.

2.1.3.3 Ultra Fine Fly Ash and Ultra Fine Pozzolan

Ultra Fine Fly Ash (UFFA) and Ultra Fine Pozzolan (UFP) shall conform to [ASTM C 618](#), Class F or N, and the following additional requirements:

- a. The strength activity index at 28 days of age shall be at least 95 percent of the control specimens.
- b. The average particle size shall not exceed 6 microns.
- c. The sum of SiO₂ + Al₂O₃ + Fe₂O₃ shall be greater than 77 percent.

2.1.4 Ground Granulated Blast-Furnace (GGBF) Slag

Ground Granulated Blast-Furnace Slag shall conform to [ASTM C 989](#), Grade 120.

2.1.5 Silica Fume

Silica fume shall conform to [ASTM C 1240](#), including the optional limits on

reactivity with cement alkalis. Silica fume may be furnished as a dry, densified material or as a slurry. Provide at the Contractor's expense the services of a manufacturer's technical representative, experienced in mixing, proportioning, placement procedures, and curing of concrete containing silica fume. This representative must be present on the project prior to and during at least the first 4 days of concrete production and placement using silica fume.

2.1.6 Supplementary Cementitious Materials (SCM) Content

The Contractor may elect to use one of the SCMs listed below, unless the SCM is required to mitigate ASR. The use of SCMs is encouraged in accordance with Section 01 62 35, Recycled/Recovered Materials.

TABLE 2
SUPPLEMENTARY CEMENTITIOUS MATERIALS CONTENT

<u>Supplementary Cementitious Material</u>	<u>Minimum Content</u>	<u>Maximum Content</u>
Class N Pozzolan and Class F Fly Ash		
SiO ₂ + Al ₂ O ₃ + Fe ₂ O ₃ > 70%	25%	35%
SiO ₂ + Al ₂ O ₃ + Fe ₂ O ₃ > 80%	20%	35%
SiO ₂ + Al ₂ O ₃ + Fe ₂ O ₃ > 90%	15%	35%
UFFFA and UFP	7%	16%
GGBF Slag	40%	50%
Silica Fume	7%	10%

2.2 AGGREGATES

2.2.1 Aggregate Sources

2.2.1.1 Durability

Aggregate shall have a satisfactory service record in freezing and thawing of at least 5 years successful service in three concrete paving projects. The service record shall include a condition survey of the existing concrete and a review of the concrete-making materials, including coarse and fine aggregates, cement, and mineral admixtures. This review should consider the previous aggregate source and test results, cement mill certificate data, mineral admixture chemical and physical composition, and the mix design (cement factor and water-cementitious material ratio). Aggregate not having a satisfactory demonstrable service record shall have a durability factor of 50 or more when subjected to freezing and thawing of specimens prepared in accordance with ASTM C 1646/C 1646M and tested in accordance with ASTM C 666/C 666M, Procedure A.

2.2.1.2 Alkali-Silica Reactivity

Fine and coarse aggregates to be used in all concrete shall be evaluated and tested for alkali-aggregate reactivity. Both coarse aggregate size groups shall be tested.

- a. The fine and coarse aggregates shall be evaluated separately, using ASTM C 1260. Test results of the individual aggregates shall have a measured expansion equal to or less than 0.08 percent after 28 days of immersion in a 1N NaOH solution. Should the test data indicate an expansion of greater than 0.08 percent, the aggregate(s) shall be rejected or additional testing shall be performed as follows: utilize

the Contractor's proposed low alkali portland cement, blended cement, and/or SCM, and/or Lithium Nitrate in combination with each individual aggregate. If only SCMs are being evaluated, the testing shall be in accordance with [ASTM C 1567](#). If Lithium Nitrate is being evaluated, with or without SCMs, the testing shall be in accordance with [COE CRD-C 662](#). Determine the quantity that will meet all the requirements of these specifications and that will lower the expansion equal to or less than 0.08 percent after 28 days of immersion in a 1N NaOH solution. Mixture proportioning shall be based on the highest percentage of SCM required to mitigate ASR-reactivity

b. If any of the above options does not lower the expansion to less than 0.08 percent after 28 days of immersion in a 1N NaOH solution, reject the aggregate(s) and submit new aggregate sources for retesting. Submit the results of testing to the Contracting Officer for evaluation and acceptance.

2.2.1.3 Accelerated Alkali-Silica Reactivity

For concrete anticipated to be exposed to deicer chemicals during its service life, fine and coarse aggregates to be used in the concrete shall be evaluated and tested for alkali-aggregate reactivity in accordance with the [IPRF INTERIM TEST PROTOCOL](#). Liquid anti-icing solutions shall be of the type and concentration used by the facility. Solid deicing chemicals shall be used at a concentration that represents a room-temperature saturated solution. Evaluation of the aggregates and mitigation alternatives shall be in accordance with the previous requirements. Test results shall have a measured expansion equal to or less than 0.08 percent at 28 days of immersion in the soak solution. Should the test data indicate an expansion of greater than 0.08 percent, the aggregate(s) shall be rejected. Mixture proportioning shall be based on the highest percentage of SCM required to mitigate ASR-reactivity, as determined from either the sodium hydroxide or deicer compound test series.

2.2.1.4 Combined Aggregate Gradation

In addition to the grading requirements specified for coarse aggregate and for fine aggregate, the combined aggregate grading shall meet the following requirements:

a. The materials selected and the proportions used shall be such that when the Coarseness Factor (CF) and the Workability Factor (WF) are plotted on a diagram as described in d. below, the point thus determined shall fall within the parallelogram described therein.

b. The Coarseness Factor (CF) shall be determined from the following equation:

$$CF = (\text{cumulative percent retained on the } 3/8 \text{ in. sieve})(100)/(\text{cumulative percent retained on the No. 8 sieve})$$

c. The Workability Factor WF is defined as the percent passing the No. 8 sieve based on the combined gradation. However, WF shall be adjusted, upwards only, by 2.5 percentage points for each 94 pounds of cementitious material per cubic yard greater than 564 pounds per cubic yard.

d. A diagram shall be plotted using a rectangular scale with WF on the Y-axis with units from 20 (bottom) to 45 (top), and with CF on the

X-axis with units from 80 (left side) to 30 (right side). On this diagram a parallelogram shall be plotted with corners at the following coordinates (CF-75, WF-28), (CF-75, WF-40), (CF-45, WF-32.5), and (CF-45, WF-44.5). If the point determined by the intersection of the computed CF and WF does not fall within the above parallelogram, the grading of each size of aggregate used and the proportions selected shall be changed as necessary.)

2.2.2 Coarse Aggregate

2.2.2.1 Material Composition

Coarse aggregate shall consist of crushed or uncrushed gravel, crushed stone, crushed adequately seasoned air-cooled iron blast-furnace slag; steel furnace slag will not be permitted, or a combination thereof. Aggregates, as delivered to the mixers, shall consist of clean, hard, uncoated particles meeting the requirements of [ASTM C 33/C 33M](#) except as specified herein. Coarse aggregate shall be washed. Washing shall be sufficient to remove dust and other coatings. Iron blast-furnace slag conforming to the grading to be used in the concrete shall have a compact density of not less than [70 lb/cu. ft.](#) determined in accordance with [ASTM C 29/C 29M](#). Coarse aggregate shall not show more than 40 percent loss when subjected to the Los Angeles abrasion test in accordance with [ASTM C 131](#). The sodium sulfate soundness loss shall not exceed 12 percent, or the magnesium sulfate soundness loss shall not exceed 18 percent after five cycles when tested in accordance with [ASTM C 88](#).

2.2.2.2 Particle Shape Characteristics

Particles of the coarse aggregate shall be generally spherical or cubical in shape. The quantity of flat and elongated particles in any size group coarser than the [3/8 inch](#) sieve shall not exceed 20 percent by weight as determined by the Flat Particle Test and the Elongated Particle Test of [ASTM D 4791](#). A flat particle is defined as one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3.

2.2.2.3 Size and Grading

The nominal maximum size of the coarse aggregate shall be [1.5inch](#). The individual aggregates shall be graded and furnished in size groups to meet the coarseness and workability factor criteria for the contractor-proposed combined gradation.

2.2.2.4 Deleterious Materials - Airfield Pavements

The amount of deleterious material in each size group of coarse aggregate shall not exceed the limits shown in Table 5 below, determined in accordance with the test methods shown.

TABLE 5
LIMITS OF DELETERIOUS MATERIALS IN COARSE AGGREGATE
FOR AIRFIELD PAVEMENTS
Percentage by Mass

Materials ^(h)	Severe Weather W
Clay lumps and friable particles (ASTM C 142)	0.2
Shale (a) (ASTM C 295)	0.1
Material finer than 0.075 mm (No. 200 sieve) (b) (ASTM C 117)	0.5
Lightweight particles (c) (ASTM C 123)	0.2
Clay ironstone (d) (ASTM C 295)	0.1
Chert and cherty stone (less than 2.40 Mg/cubic meter density SSD (2.40 Sp. Gr.)) (e) (ASTM C 123) and ASTM C 295)	0.1
Claystone, mudstone, and siltstone (f) (ASTM C 295)	0.1
Shaly and argillaceous limestone (g) (ASTM C 295)	0.2
Other soft particles (COE CRD-C 130)	1.0
Total of all deleterious substances exclusive of material finer than 0.075 mm (No. 200 sieve)	1.0

a. Shale is defined as a fine-grained, thinly laminated or fissile sedimentary rock. It is commonly composed of clay or silt or both. It has been indurated by compaction or by cementation, but not so much as to have become slate.

b. Limit for material finer than 0.075 mm (No. 200 sieve) will be increased to 1.5 percent for crushed aggregates if the fine material consists of crusher dust that is essentially free from clay or shale. Use ASTM D 2419, if required, to differentiate between crusher dust and clay/shale.

c. The separation medium shall have a density of 2.0 Mg/cubic meter (Sp. Gr. of 2.0). This limit does not apply to coarse aggregate manufactured from blast-furnace slag unless contamination is evident.

d. Clay ironstone is defined as an impure variety of iron carbonate,

iron oxide, hydrous iron oxide, or combinations thereof, commonly mixed with clay, silt, or sand. It commonly occurs as dull, earthy particles, homogeneous concretionary masses, or hard-shell particles with soft interiors. Other names commonly used for clay ironstone are "chocolate bars" and limonite concretions.

e. Chert is defined as a rock composed of quartz, chalcedony or opal, or any mixture of these forms of silica. It is variable in color. The texture is so fine that the individual mineral grains are too small to be distinguished by the unaided eye. Its hardness is such that it scratches glass but is not scratched by a knife blade. It may contain impurities such as clay, carbonates, iron oxides, and other minerals. Cherty stone is defined as any type of rock (generally limestone) that contains chert as lenses and nodules, or irregular masses partially or completely replacing the original stone.

f. Claystone, mudstone, or siltstone, is defined as a massive fine-grained sedimentary rock that consists predominantly of indurated clay or silt without laminations or fissility. It may be indurated either by compaction or by cementation.

g. Shaly limestone is defined as limestone in which shale occurs as one or more thin beds or laminae. These laminae may be regular or very irregular and may be spaced from a few inches down to minute fractions of an inch. Argillaceous limestone is defined as a limestone in which clay minerals occur disseminated in the stone in the amount of 10 to 50 percent by weight of the rock; when these make up from 50 to 90 percent, the rock is known as calcareous (or dolomitic) shale (or claystone, mudstone, or siltstone).

h. Testing shall be performed in accordance with the referenced test methods, except that the minimum sample size shall be as specified below.

2.2.2.5 Testing Sequence/Deleterious Materials - Airfields Only

The Contractor will not be entitled to any extension of time or additional payment due to any delays caused by the testing, evaluation, or personnel requirements. The size of the coarse aggregate sample shall be at least 200 pounds for the 3/4 inch and larger maximum size and 25 pounds for the No. 4 to 3/4 inch coarse aggregate and 10 pounds for the fine aggregate. Provide facilities for the ready procurement of representative test samples. The testing procedure on each sample of coarse aggregate for compliance with limits on deleterious materials shall be as follows:

Step 1: Wash each full sample of coarse aggregate for material finer than the No. 200 sieve. Discard material finer than the No. 200 sieve.

Step 2: Test remaining full sample for clay lumps and friable particles and remove.

Step 3: Test remaining full sample for lightweight particles (Sp.Gr.2.0) and remove.

Step 4. Test remaining full sample for chert and/or cherty stone with SSD density of less than 2.40 Mg/cubic meter (Sp. Gr. 2.40). Remove lightweight chert and/or cherty stone. Restore other materials less than 2.40 to the sample.

Step 5: Test remaining sample for clay-ironstone, shale, claystone, mudstone, siltstone, shaly and/or argillaceous limestone, and remove.

Step 6: Test approximately one-fifth of remaining full sample for other soft particles.

2.2.3 Fine Aggregate

2.2.3.1 Composition

Fine aggregate shall consist of natural sand, manufactured sand, or a combination of the two, and shall be composed of clean, hard, durable particles meeting the requirements of ASTM C 33/C 33M. Each type of fine aggregate shall be stockpiled and batched separately. Particles of the fine aggregate shall be generally spherical or cubical in shape.

2.2.3.2 Grading

Grading of the fine aggregate, as delivered to the mixer, shall conform to the requirements of ASTM C 33/C 33M and shall have a fineness modulus of not less than 2.50 nor more than 3.00.

2.2.3.3 Deleterious Material

The amount of deleterious material in the fine aggregate shall not exceed the following limits by mass:

Material	Percentage by Mass
Clay lumps and friable particles ASTM C 142	1.0
Material finer than 0.075 mm (No. 200 sieve) ASTM C 117	3.0
Lightweight particles ASTM C 123 using a medium with a density of 2.0 Mg/cubic meter (Sp. Gr. of 2.0))	0.5
Total of all above	3.0

2.3 CHEMICAL ADMIXTURES

2.3.1 General Requirements

Chemical admixtures may only be used when the specific admixture type and manufacturer is the same material used in the mixture proportioning studies. The air-entraining admixture shall conform to ASTM C 260. An accelerator conforming to ASTM C 494/C 494M, Type C, may be used only when specified in paragraph: SPECIFIED CONCRETE STRENGTH AND OTHER PROPERTIES below and shall not be used to reduce the amount of cementitious material used. Calcium chloride and admixtures containing calcium chloride shall not be used. Retarding or water-reducing admixture shall meet the requirements of ASTM C 494/C 494M, Type A, B, or D, except that the 6-month and 1-year compressive strength tests are waived. ASTM C 494/C 494M, Type F and G high range water reducing admixtures and ASTM C 1017/C 1017M flowable admixtures shall not be used.

2.3.2 Lithium Nitrate

The lithium admixture shall be a nominal 30 percent aqueous solution of

Lithium Nitrate, with a density of 10 pounds/gallon, and shall have the approximate chemical form as shown below:

<u>Constituent</u>	<u>Limit (Percent by Mass)</u>
LiNO ₃ (Lithium Nitrate)	30 +/- 0.5
SO ₄ ⁻² (Sulfate Ion)	0.1 (max)
Cl ⁻ (Chloride Ion)	0.2 (max)
Na ⁺ (Sodium Ion)	0.1 (max)
K ⁺ (Potassium Ion)	0.1 (max)

The Lithium Nitrate manufacturer shall provide a trained representative to supervise the lithium nitrate admixture dispensing and mixing operations.

2.3.3 High Range Water Reducing Admixture (HRWRA)

A high-range water-reducing admixture shall meet the requirements of ASTM C 494/C 494M, Type F or G. The HRWRA shall be free from chlorides, alkalis, and shall be of the synthesized, sulfonated complex polymer type. The HRWRA shall be added to the concrete as a single component at the batch plant. The admixture shall be added to the concrete mixture only when its use is approved or directed, and only when it has been used in mixture proportioning studies to arrive at approved mixture proportions. Submit certified copies of the independent laboratory test results required for compliance with ASTM C 494/C 494M.

2.4 MEMBRANE FORMING CURING COMPOUND

Membrane forming curing compound shall be a white pigmented compound conforming to COE CRD-C 300..

2.5 WATER

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that non-potable water, or water from concrete production operations, may be used if it meets the requirements of ASTM C 1602/C 1602M.

2.6 JOINT MATERIALS

2.6.1 Expansion Joint Material

Expansion joint filler shall be a preformed material conforming to ASTM D 1751 Expansion joint filler shall be 3/4 inch thick, unless otherwise indicated, and shall be furnished in a single full depth piece.

2.6.2 Slip Joint Material

Slip joint material shall be 1/4 inch thick expansion joint filler, unless otherwise indicated, conforming to paragraph: Expansion Joint Material.

2.7 REINFORCING

All reinforcement shall be free from loose, flaky rust, loose scale, oil, grease, mud, or other coatings that might reduce the bond with concrete. Removal of thin powdery rust and tight rust is not required. However, reinforcing steel which is rusted to the extent that it does not conform to the required dimensions or mechanical properties shall not be used.

2.7.1 Reinforcing Bars and Bar Mats

Reinforcing bars shall conform to [ASTM A 615/A 615M](#), billet-steel. Bar mats shall conform to [ASTM A 184/A 184M](#). The bar members may be billet rail or axle steel.

2.7.2 Welded Wire Reinforcement

Welded Wire Reinforcement shall be deformed or smooth, conforming to [ASTM A 497/A 497M](#) or [ASTM A 185/A 185M](#), and shall be furnished in flat sheets.

2.8 DOWELS AND TIE BARS

2.8.1 Dowels

Dowels shall be single piece bars fabricated or cut to length at the shop or mill before delivery to the site. Dowels shall be free of loose, flaky rust and loose scale and shall be clean and straight. Dowels may be sheared to length provided that the deformation from true shape caused by shearing does not exceed [0.04 inch](#) on the diameter of the dowel and does not extend more than [0.04 inch](#) from the end of the dowel. Dowels shall be plain (non-deformed) steel bars conforming to [ASTM A 615/A 615M](#), Grade 40 or 60; [ASTM A 996/A 996M](#), Grade 50 or 60. Dowel bars shall be epoxy coated in conformance with [ASTM A 775/A 775M](#). Grout retention rings shall be fully circular metal or plastic devices capable of supporting the dowel until the epoxy hardens. Dowel sleeves or inserts are not permitted.

2.8.2 Dowel Bar Assemblies

Dowel bar assemblies shall consist of a framework of metal bars or wires arranged to provide rigid support for the dowels throughout the paving operation, with a minimum of four continuous bars or wires extending along the joint line. The dowels shall be welded to the assembly or held firmly by mechanical locking arrangements that will prevent them from rising, sliding out, or becoming distorted during paving operations.

2.8.3 Tie Bars

Tie bars shall be deformed steel bars conforming to [ASTM A 615/A 615M](#), or [ASTM A 996/A 996M](#), Grade 60, and of the sizes and dimensions indicated. Deformed rail steel bars and high-strength billet or axle steel bars, Grade 50 or higher, shall not be used for bars that are bent and straightened during construction.

2.9 EPOXY RESIN

All epoxy-resin materials shall be two-component materials conforming to the requirements of [ASTM C 881/C 881M](#), Class as appropriate for each application temperature to be encountered, except that in addition, the materials shall meet the following requirements:

- a. Material for use for embedding dowels and anchor bolts shall be Type IV, Grade 3.
- b. Material for use as patching materials for complete filling of spalls and other voids and for use in preparing epoxy resin mortar shall be Type III, Grade as approved.

c. Material for use for injecting cracks shall be Type IV, Grade 1.

d. Material for bonding freshly mixed portland cement concrete or mortar or freshly mixed epoxy resin concrete or mortar to hardened concrete shall be Type V, Grade as approved.

2.10 EQUIPMENT

All plant, equipment, tools, and machines used in the work shall be maintained in satisfactory working conditions at all times.

2.10.1 Batching and Mixing Plant

a. Location: The batching and mixing plant shall be located off Government premises no more than 15 minutes haul time from the placing site. There shall be operable telephonic or radio communication between the plant and the placing site at all times concreting is taking place.

b. Type and Capacity: The batching and mixing plant shall be a stationary-type central mix plant, including permanent installations or portable/relocatable plants installed on stable foundations. The plant shall be designed and operated to produce concrete within the specified tolerances, and shall have a capacity of at least 250 cubic yards per hour. The batching and mixing plant shall conform to the requirements of NRMCA QC 3 including provisions addressing:

1. Material Storage and Handling
2. Batching Equipment
3. Central Mixer
4. Ticketing System
5. Delivery System

c. Tolerances: The following tolerances shall apply.

Materials	Percentage of Required Mass
Cementitious Materials	plus or minus 1
Aggregate	plus or minus 2
Water	plus or minus 1
Admixture	plus or minus 3

For volumetric batching equipment for water and admixtures, the above numeric tolerances shall apply to the required volume of material being batched. Concentrated admixtures shall be uniformly diluted, if necessary, to provide sufficient volume per batch to ensure that the batchers will consistently operate within the above tolerance.

d. Moisture Control: The plant shall be capable of ready adjustment to compensate for the varying moisture contents of the aggregates and to change the quantities of the materials being batched. An electric moisture meter complying with the provisions of COE CRD-C 143 shall be provided for measuring of moisture in the fine aggregate. The sensing element shall be arranged so that measurement is made near the batcher charging gate of the fine aggregate bin or in the fine aggregate batcher.

2.10.2 Concrete Mixers

a. General: Mixers shall be stationary or truck mixers. Mixers shall be capable of combining the materials into a uniform mixture and of discharging this mixture without segregation. The mixers shall not be charged in excess of the capacity recommended by the manufacturer. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition, and the mixer drums shall be kept free of hardened concrete. Mixer blades or paddles shall be replaced when worn down more than 10 percent of their depth when compared with the manufacturer's dimension for new blades or paddles.

b. Stationary: Stationary mixers shall be drum or pan mixers. Mixers shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed.

c. Mixing Time and Uniformity for Stationary Mixers: For stationary mixers, before uniformity data are available, the mixing time for each batch after all solid materials are in the mixer, provided that all of the mixing water is introduced before one-fourth of the mixing time has elapsed, shall be 1 minute for mixers having a capacity of 1 cubic yard. For mixers of greater capacity, this minimum time shall be increased 20 seconds for each additional 1.33 cubic yard or fraction thereof. After results of uniformity tests are available, the mixing time may be reduced to the minimum time required to meet uniformity requirements; but if uniformity requirements are not being met, the mixing time shall be increased as directed. The mixing time for full batch production shall be a minimum of 75 seconds. Mixer performance tests at new mixing times shall be performed immediately after any change in mixing time. The Regular Test sequence shall be conducted for initial determination of the mixing time or as directed. When regular testing is performed, the concrete shall meet the limits of any five of the six uniformity requirements listed in Table 1 below.

d. The Abbreviated Test sequence shall be conducted for production concrete verification at the frequency specified in Table 6. When abbreviated testing is performed, the concrete shall meet only those requirements listed for abbreviated testing. The concrete proportions used for uniformity tests shall be as used on the project. Regular testing shall consist of performing all six tests on three batches of concrete. The range for regular testing shall be the average of the ranges of the three batches. Abbreviated testing shall consist of performing the three required tests on a single batch of concrete. The range for abbreviated testing shall be the range for one batch. If more than one mixer is used and all are identical in terms of make, type, capacity, condition, speed of rotation, etc., the results of tests on one of the mixers shall apply to the others, subject to the approval of the Contracting Officer. All mixer performance (uniformity) testing shall be performed in accordance with COE CRD-C 55 and with paragraph titled TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL in PART 3.

TABLE 1
UNIFORMITY REQUIREMENTS--STATIONARY MIXERS

Parameter	Regular Tests Allowable Maximum Range for Average of 3 Batches	Abbreviated Tests Allowable Maximum Range for 1 Batch
Unit weight of air-free mortar (Unit weight of air-free mortar	32 kg/cubic m 2.0 lbs/cubic ft	32 kg/cubic m 2.0 lbs/cubic ft)
Air content	1.0 percent	--
Slump (Slump	25 mm 1.0 inch	25 mm 1.0 inch)
Coarse aggregate	6.0 percent	6.0 percent
Compressive strength at 7 days,	10.0 percent	10.0 percent
Water content	1.5 percent	

e. Truck: Truck mixers shall not be used for mixing or transporting slipformed paving concrete. The only truck mixers used for mixing or transporting paving concrete shall be those designed with extra large blading and rear opening specifically for low-slump paving concrete. Truck mixers, the mixing of concrete therein, and concrete uniformity and testing thereof shall conform to the requirements of [ASTM C 94/C 94M](#). The number of revolutions between 70 to 100 for truck-mixed concrete and the number of revolutions for shrink-mixed concrete shall be determined by uniformity tests as specified in [ASTM C 94/C 94M](#) and in requirements for mixer performance stated in paragraph TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL in PART 3. If requirements for the uniformity of concrete are not met with 100 revolutions of mixing after all ingredients including water are in the truck mixer drum, the mixer shall not be used until the condition is corrected. Water shall not be added after the initial introduction of mixing water except, when on arrival at the job site, the slump is less than specified and the water-cement ratio is less than that given as a maximum in the approved mixture. Additional water may be added to bring the slump within the specified range provided the approved water-cement ratio is not exceeded. Water shall be injected into the head of the mixer (end opposite the discharge opening) drum under pressure, and the drum or blades shall be turned a minimum of 30 additional revolutions at mixing speed. Water shall not be added to the batch at any later time. Mixer performance (uniformity) tests for truck mixers shall be made in accordance with [ASTM C 94/C 94M](#).

2.10.3 Transporting Equipment

Slipform concrete shall be transported to the paving site in nonagitating equipment conforming to [ASTM C 94/C 94M](#) or in approved agitators. Fixed form concrete shall be transported in approved truck mixers designed with extra large blading and rear opening specifically for low slump concrete. All transporting equipment shall be designed and operated to deliver and discharge the required concrete mixture completely without segregation.

2.10.4 Transfer and Spreading Equipment

Equipment for transferring concrete from the transporting equipment to the paving lane in front of the paver shall be specially manufactured, self-propelled transfer equipment which will accept the concrete outside the paving lane and will transfer and spread it evenly across the paving lane in front of the paver and strike off the surface evenly to a depth which permits the paver to operate efficiently.

2.10.5 Paver-Finisher

a. General: The paver-finisher shall be a heavy-duty, self-propelled machine designed specifically for paving and finishing high quality pavement. The paver-finisher shall weigh at least 2200 lb/foot of lane width, and shall be powered by an engine having at least 6.0 horsepower/foot of lane width. The paver-finisher shall spread, consolidate, and shape the plastic concrete to the desired cross section in one pass. The mechanisms for forming the pavement shall be easily adjustable in width and thickness and for required crown. In addition to other spreaders required by paragraph above, the paver-finisher shall be equipped with a full width knock-down auger or paddle mechanism, capable of operating in both directions, which will evenly spread the fresh concrete in front of the screed or extrusion plate.

b. Vibrators: Immersion vibrators shall be gang mounted at the front of the paver on a frame equipped with suitable controls so that all vibrators can be operated at any desired depth within the slab or completely withdrawn from the concrete, as required. The vibrators shall be automatically controlled so that they will be immediately stopped as forward motion of the paver ceases. The paver-finisher shall be equipped with an electronic vibrator monitoring device displaying the operating frequency of each individual internal vibrator. The monitoring device shall have a readout display visible to the paver operator. It shall operate continuously while paving, and shall display all vibrator frequencies with manual or automatic sequencing among all individual vibrators. The spacing of the immersion vibrators across the paving lane shall be as necessary to properly consolidate the concrete, but the clear distance between vibrators shall not exceed 30 inches. The outside vibrators shall not be more than 12 inches from the lane edge. Spud vibrators shall operate at a frequency of not less than 8000 impulses/minute and an amplitude of not less than 0.03 inch, as determined by COE CRD-C 521.

c. Screed or Extrusion Plate: The paver-finisher shall be equipped with a transversely oscillating screed or an extrusion plate to shape, compact, and smooth the surface and shall so finish the surface that no significant amount of hand finishing, except use of cutting straightedges, is required. The screed or extrusion plate shall be constructed to provide adjustment for crown in the pavement. The entire machine shall provide adjustment for variation in lane width or thickness and to prevent more than 8 inches of the screed or extrusion plate extending over previously placed concrete on either end when paving fill-in lanes. Machines that cause displacement of properly installed forms or cause ruts or indentations in the prepared underlying materials and machines that cause frequent delays due to mechanical failures shall be replaced as directed.

d. Fixed Forms: The paver-finisher shall be equipped with wheels

designed to ride the forms, keep it aligned with the forms, and spread the load so as to prevent deformation of the forms. Paver-finishers traveling on guide rails located outside the paving lane shall be equipped with wheels when traveling on new or existing concrete to remain.

e. Slipform: The slipform paver-finisher shall be automatically controlled and crawler mounted with padded tracks so as to be completely stable under all operating conditions. The paver-finisher shall finish the surface and edges so that no edge slump beyond allowable tolerance occurs. Suitable moving side forms shall be provided that are adjustable and will produce smooth, even edges, perpendicular to the top surface and meeting specification requirements for alignment and freedom from edge slump.

f. Longitudinal Mechanical Float: A longitudinal mechanical float shall be specially designed and manufactured to smooth and finish the pavement surface without working excess paste to the surface. It shall be rigidly attached to the rear of the paver-finisher or to a separate self-propelled frame spanning the paving lane. The float plate shall be at least 5 feet long by 8 inches wide and shall automatically be oscillated in the longitudinal direction while slowly moving from edge to edge of the paving lane, with the float plate in contact with the surface at all times.

g. Nonrotating Pipe Float: A pipe float if used, shall be a nonrotating pipe 6 to 10 inches in diameter and sufficiently long to span the full paving width when oriented at an angle of approximately 60 degrees with the centerline. The pipe float shall be mounted on a self-propelled frame that spans the paving lane. No means of applying water to the surface shall be incorporated in the pipe float.

h. Other Types of Finishing Equipment: Clary screeds, other rotating tube floats, or bridge deck finishers are not allowed on mainline paving, but may be allowed on irregular or odd-shaped slabs, and near buildings or trench drains, subject to the Contracting Officer's approval. Bridge deck finishers shall have a minimum operating weight of 7500 pounds and shall have a transversely operating carriage containing a knock-down auger and a minimum of two immersion vibrators. Vibrating screeds or pans shall be used only for isolated slabs where hand finishing is permitted as specified, and only where specifically approved.

2.10.6 Curing Equipment

Equipment for applying membrane-forming curing compound shall be mounted on a self-propelled frame that spans the paving lane. The reservoir for curing compound shall be constantly mechanically (not air) agitated during operation and shall contain means for completely draining the reservoir. The spraying system shall consist of a mechanically powered pump which will maintain constant pressure during operation, an operable pressure gauge, and either a series of spray nozzles evenly spaced across the lane to give uniformly overlapping coverage or a single spray nozzle which is mounted on a carriage which automatically traverses the lane width at a speed correlated with the forward movement of the overall frame. All spray nozzles shall be protected with wind screens. Calibrate the spraying system in accordance with ASTM D 2995, Method A, for the rate of application required in paragraph: Membrane Curing. Any hand-operated sprayers allowed by that paragraph shall be compressed air supplied by a

mechanical air compressor. If the curing equipment fails to apply an even coating of compound at the specified rate, it shall immediately be replaced.

2.10.7 Texturing Equipment

a. General: Texturing equipment shall be as specified below. Before use, the texturing equipment shall be demonstrated on a test section, and the equipment shall be modified as necessary to produce the texture directed.

b. Burlap Drag: A burlap drag shall be securely attached to a separate wheel mounted frame spanning the paving lane or to one of the other similar pieces of equipment. Length of the material shall provide 24 to 36 inches dragging flat on the pavement surface. Width shall be at least equal to the width of the slab. The material shall be clean, reasonably new burlap, completely saturated with water before attachment to the frame, always resaturated before start of use, and kept clean and saturated during use. Burlap shall conform to AASHTO M 182, Class 3 or 4.

2.10.8 Sawing Equipment

Equipment for sawing joints and for other similar sawing of concrete shall be standard diamond-type concrete saws mounted on a wheeled chassis which can be easily guided to follow the required alignment. Blades shall be diamond tipped. If demonstrated to operate properly, abrasive blades may be used. Provide spares as required to maintain the required sawing rate. Wheel saws used in the removal of concrete shall be saws with large diameter tungsten carbide tipped blades mounted on a heavy-duty chassis which will produce a saw kerf at least 1-1/2 inch wide. All saws shall be capable of sawing to the full depth required. Early-entry saws may be used, subject to demonstration and approval of the Contracting Officer. No change to the initial sawcut depth shall be permitted.

2.10.9 Straightedge

Furnish and maintain at the job site, in good condition, one 12 foot straightedge for each paving train for testing the hardened portland cement concrete surfaces. These straightedges shall be constructed of aluminum or magnesium alloy and shall have blades of box or box-girder cross section with flat bottom, adequately reinforced to insure rigidity and accuracy. Straightedges shall have handles for operation on the pavement.

2.11 SPECIFIED CONCRETE STRENGTH AND OTHER PROPERTIES

2.11.1 Specified Flexural Strength

Specified flexural strength, R, for concrete is 650 psi at [90] days, , Maximum allowable water-cementitious material ratio is 0.45. The water-cementitious material ratio will be the equivalent water-cement ratio as determined by conversion from the weight ratio of water to cement plus SCM by the mass equivalency method described in ACI 211.1. The concrete shall be air-entrained with a total air content of 6 plus or minus 1.5 percentage points, at the point of placement. Air content shall be determined in accordance with ASTM C231/C231M. The maximum allowable slump of the concrete at the point of placement shall be 2 inches for pavement constructed with fixed forms. For slipformed pavement, at the start of the

project, select a maximum allowable slump which will produce in-place pavement meeting the specified tolerances for control of edge slump. The selected slump shall be applicable to both pilot and fill-in lanes.

2.11.2 Concrete Temperature

The temperature of the concrete as delivered shall conform to the requirements of paragraphs, Paving in Hot Weather and Paving in Cold Weather, in PART 3. Temperature of concrete shall be determined in accordance with [ASTM C 1064/C 1064M](#).

2.11.3 Concrete Strength for Final Acceptance

, and no individual set (2 specimens per subplot) in the lot are 25 psi or more below the equivalent 'Specified Flexural Strength'. If any lot or subplot, respectively, fails to meet the above criteria, the lot or subplot shall be removed and replaced at no additional cost to the Government. This is in addition to and does not replace the average strength required for day-to-day CQC operations as specified in paragraph: Average CQC Flexural Strength Required for Mixtures, below.

2.12 MIXTURE PROPORTIONS

2.12.1 Composition

Concrete shall be composed of cementitious material, water, fine and coarse aggregates, and admixtures. Supplementary Cementitious Materials (SCM) choice and usage shall be in accordance with paragraph: Supplementary Cementitious Materials (SCM) Content. The total cementitious material content shall be at least 470 lb./cu. yd.. Admixtures shall consist of air entraining admixture and may also include, as approved, water-reducing admixture.

2.12.2 Proportioning Studies

Trial design batches, mixture proportioning studies, and testing requirements are the responsibility of the Contractor. Trial mixtures having proportions, slumps, and air content suitable for the work shall be based on methodology described in [ACI 211.1](#), modified as necessary to accommodate flexural strength. Submit test results including:

- a. Coarse and fine aggregate gradations and plots.
- b. Combined aggregate gradation [and coarseness/workability] plots.
- c. Coarse aggregate quality test results, include deleterious materials.
- d. Fine aggregate quality test results.
- e. Mill certificates for cement and supplemental cementitious materials.
- f. Certified test results for air entraining, water reducing, retarding, non-chloride accelerating, and Lithium Nitrate admixtures.
- g. Specified flexural strength, slump, and air content.
- h. Documentation of required average CQC flexural strength, Ra.
- i. Recommended proportions/volumes for proposed mixture and each of three trial water-cementitious materials ratios.
- j. Individual beam breaks.
- k. Flexural strength summaries and plots.
- l. Correlation ratios for acceptance testing and CQC testing.
- m. Historical record of test results, documenting production standard deviation (if available).

2.12.2.1 Water-Cement Ratio

At least three different water-cement ratios, which will produce a range of strength encompassing that required on the project, shall be used. The maximum allowable water-cement ratio required in paragraph: Specified Flexural Strength, above will be the equivalent water-cement ratio. Laboratory trial mixtures shall be proportioned for maximum permitted slump and air content.

2.12.2.2 Trial Mixture Studies

Separate sets of trial mixture studies shall be made for each combination of cementitious materials and each combination of admixtures proposed for use. No combination of either shall be used until proven by such studies, except that, if approved in writing and otherwise permitted by these specifications, an accelerator or a retarder may be used without separate trial mixture study. Separate trial mixture studies shall also be made for concrete for each placing method (slip form, fixed form, or hand placement) proposed. The temperature of concrete in each trial batch shall be reported. Each mixture shall be designed to promote easy and suitable concrete placement, consolidation and finishing, and to prevent segregation and excessive bleeding.

2.12.2.3 Mixture Proportioning for Flexural Strength

The following step by step procedure shall be followed:

2.12.3 Average CQC Flexural Strength Required for Mixtures

In order to ensure meeting the strength requirements specified in paragraph: SPECIFIED CONCRETE STRENGTH AND OTHER PROPERTIES above, during production, the mixture proportions selected during mixture proportioning studies and used during construction shall produce a required average CQC flexural strength exceeding the specified strength, R , by the amount indicated below. This required average CQC flexural strength, R_a , will be used only for CQC operations as specified in paragraph: TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL in PART 3 and as specified in the previous paragraph. During production, the required R_a shall be adjusted, as appropriate and as approved, based on the standard deviation of -day strengths being attained during paving.

- a. From Previous Test Records: Where a concrete production facility has previous test records current to within 18 months, a standard deviation shall be established in accordance with the applicable provisions of ACI 214R. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected, shall represent concrete produced to meet a specified flexural strength or strengths within 150 psi of the 90-day flexural strength specified for the proposed work, and shall consist of at least 30 consecutive tests. Perform verification testing, as directed by the Contracting Officer, to document the current strength. A strength test shall be the average of the strengths of two specimens made from the same sample of concrete and tested at 90days. Required average CQC flexural strength, R_a , used as the basis for selection of concrete proportions shall be the value

from the equation that follows, using the standard deviation as determined above:

$$R_a = R + 1.34S$$

Where: S = standard deviation
 R = specified flexural strength
 R_a = required average flexural strength

Where a concrete production facility does not have test records meeting the requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation shall be established as the product of the calculated standard deviation and a modification factor from the following table:

NUMBER OF TESTS	MODIFICATION FACTOR FOR STANDARD DEVIATION
15	1.16
20	1.08
25	1.03
30 or more	1.00

b. Without Previous Test Records: When a concrete production facility does not have sufficient field strength test records for calculation of the standard deviation, the required average strength, R_a, shall be determined by adding 15 percent to the specified flexural strength, R.

PART 3 EXECUTION

3.1 PREPARATION FOR PAVING

Before commencing paving, perform the following. If used, forms shall be in place, cleaned, coated, and adequately supported. Any reinforcing steel needed shall be at the paving site. All transporting and transfer equipment shall be ready for use, clean, and free of hardened concrete and foreign material. Equipment for spreading, consolidating, screeding, finishing, and texturing concrete shall be at the paving site, clean and in proper working order. All equipment and material for curing and for protecting concrete from weather or mechanical damage shall be at the paving site, in proper working condition, and in sufficient amount for the entire placement.

3.1.1 Weather Prevention

When windy conditions during paving appear probable, equipment and material shall be at the paving site to provide windbreaks, shading, fogging, or other action to prevent plastic shrinkage cracking or other damaging drying of the concrete.

3.1.2 Proposed Techniques

Submit for approval the following items:

- a. A description of the placing and protection methods proposed when concrete is to be placed in or exposed to hot, cold, or rainy weather conditions.
- b. A detailed paving sequence plan and proposed paving pattern

showing all planned construction joints; transverse and longitudinal dowel bar spacing; and identifying pilot lanes and hand placement areas. No deviation from the jointing pattern shown on the drawings shall be made without written approval of the design engineer.

c. Plan and equipment proposed to control alignment of sawn joints within the specified tolerances.

d. Data on the curing equipment, media and methods to be used.

e. Data on profilograph and methods to measure pavement smoothness.

f. Pavement demolition work plan, presenting the proposed methods and equipment to remove existing pavement and protect pavement to remain in place.

3.2 CONDITIONING OF UNDERLYING MATERIAL

3.2.1 General Procedures

Underlying material, upon which concrete is to be placed shall be clean, damp, and free from debris, waste concrete or cement, frost, ice, and standing or running water. Prior to setting forms or placement of concrete, the underlying material shall be well drained and shall have been satisfactorily graded by string-line controlled, automated, trimmer/fine grader and uniformly compacted in accordance with the applicable Section of these specifications. The surface of the underlying material shall be tested as to crown, elevation, and density in advance of setting forms or of concrete placement using slip-form techniques. High areas shall be trimmed to proper elevation. Low areas shall be filled and compacted to a condition similar to that of surrounding grade, or filled with concrete monolithically with the pavement. Low areas filled with concrete shall not be cored for thickness to avoid biasing the average thickness used for evaluation and payment adjustment. Any underlying material disturbed by construction operations shall be reworked and recompact to specified density immediately in front of the paver. If a slipform paver is used, the same underlying material under the paving lane shall be continued beyond the edge of the lane a sufficient distance and shall be thoroughly compacted and true to grade to provide a suitable trackline for the slipform paver and firm support for the edge of the paving lane.

3.2.2 Traffic on Underlying Material

After the underlying material has been prepared for concrete placement, no equipment shall be permitted thereon. Subject to specific approval, crossing of the prepared underlying material at specified intervals for construction purposes may be permitted, provided rutting or indentations do not occur. The surface shall be reworked and reprepared to the satisfaction of the Contracting Officer before concrete is placed. Equipment shall be allowed to operate on the underlying material only if approved by the Contracting Officer and only if no damage is done to the underlying material and its degree of compaction. Any disturbance to the underlying material that does occur shall be corrected, as approved, before the paver-finisher or the deposited concrete reaches the location of the disturbance and the equipment shall be replaced or procedures changed to prevent any future damage.

3.3 WEATHER LIMITATIONS

3.3.1 Placement and Protection During Inclement Weather

Do not commence placing operations when heavy rain or other damaging weather conditions appear imminent. At all times when placing concrete, maintain on-site sufficient waterproof cover and means to rapidly place it over all unhardened concrete or concrete that might be damaged by rain. Suspend placement of concrete whenever rain, high winds, or other damaging weather commences to damage the surface or texture of the placed unhardened concrete, washes cement out of the concrete, or changes the water content of the surface concrete. All unhardened concrete shall be immediately covered and protected from the rain or other damaging weather. Any slab damaged by rain or other weather shall be completely removed full depth, by full slab width, to the nearest original joint, and replaced at the Contractor's expense as specified in paragraph: REPAIR, REMOVAL AND REPLACEMENT OF NEWLY CONSTRUCTED SLABS below.

3.3.2 Paving in Hot Weather

When the ambient temperature during paving is expected to exceed 90 degrees F, the concrete shall be properly placed and finished in accordance with procedures previously submitted, approved, and as specified herein. The concrete temperature at time of delivery to the forms shall not exceed the temperature shown in the table below when measured in accordance with ASTM C 1064/C 1064M. Cooling of the mixing water or aggregates or placing in the cooler part of the day may be required to obtain an adequate placing temperature. Steel forms and reinforcing shall be cooled as needed to maintain steel temperatures below 120 degrees F. Transporting and placing equipment shall be cooled or protected if necessary to maintain proper concrete placing temperature. The finished surfaces of the newly laid pavement shall be kept damp by applying a fog spray (mist) with approved spraying equipment until the pavement is covered by the curing medium.

Maximum Allowable Concrete Placing Temperature

Relative Humidity, Percent, During Time of Concrete Placement	Maximum Allowable Concrete Temperature in Degrees F
Greater than 60	90
40-60	85
Less than 40	80

3.3.3 Prevention of Plastic Shrinkage Cracking

During weather with low humidity, and particularly with high temperature and appreciable wind, develop and institute measures to prevent plastic shrinkage cracks from developing. If plastic shrinkage cracking occurs, halt further placement of concrete until protective measures are in place to prevent further cracking. Periods of high potential for plastic shrinkage cracking can be anticipated by use of Fig. 2.1.5 of ACI 305R. In addition to the protective measures specified in the previous paragraph, the concrete placement shall be further protected by erecting shades and windbreaks and by applying fog sprays of water, the addition of monomolecular films, or wet covering. When such water treatment is stopped, curing procedures shall be immediately commenced. Plastic shrinkage cracks that occur shall be repaired in accordance with paragraph: REPAIR, REMOVAL, REPLACEMENT OF NEWLY CONSTRUCTED SLABS. Plastic shrinkage

cracks shall never be troweled over or filled with slurry.

3.3.4 Paving in Cold Weather

Cold weather paving shall conform to [ACI 306R](#). Special protection measures, as specified herein, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period. Placement of concrete shall not begin unless the ambient temperature is at least [35 degrees F](#) and rising. Thereafter, placement of concrete shall be halted whenever the ambient temperature drops below [40 degrees F](#). When the ambient temperature is less than [50 degrees F](#), the temperature of the concrete when placed shall be not less than [50 degrees F](#) nor more than [75 degrees F](#). Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. If allowed under paragraph: MIXTURE PROPORTIONS in PART 2, an accelerating admixture may be used when the ambient temperature is below [50 degrees F](#). Covering and other means shall be provided for maintaining the concrete at a temperature of at least [50 degrees F](#) for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period. Pavement slabs damaged by freezing shall be removed full depth, by full slab width, to the nearest original joint, and replaced at the Contractor's expense as specified in paragraph: REPAIR, REMOVAL, REPLACEMENT OF NEWLY CONSTRUCTED SLABS.

3.4 CONCRETE PRODUCTION

Batching, mixing, and transporting equipment shall have a capacity sufficient to maintain a continuous, uniform forward movement of the paver of not less than [2.5 feet](#) per minute. Concrete transported in non-agitating equipment shall be deposited in front of the paver within 45 minutes from the time cement has been charged into the mixing drum, except that if the ambient temperature is above [90 degrees F](#), the time shall be reduced to 30 minutes. Concrete transported in truck mixers shall be deposited in front of the paver within 90 minutes from the time cement has been charged into the mixer drum of the plant or truck mixer. If the ambient temperature is above [90 degrees F](#), the time shall be reduced to 60 minutes. Every load of concrete delivered to the paving site shall be accompanied by a batch ticket from the operator of the batching plant. Tickets shall be on approved forms and shall show at least the mass, or volume, of all ingredients in each batch delivered, the water meter and revolution meter reading on truck mixers and the time of day. Tickets shall be delivered to the placing foreman who shall keep them on file and deliver them to the Government weekly, or as directed by the Contracting Officer.

3.4.1 Batching and Mixing Concrete

Scale pivots and bearings shall be kept clean and free of rust. Any equipment which fails to perform as specified shall immediately be removed from use until properly repaired and adjusted, or replaced.

3.4.2 Transporting and Transfer - Spreading Operations

Non-agitating equipment shall be used only on smooth roads and for haul time less than 15 minutes. Concrete shall be deposited as close as possible to its final position in the paving lane. All equipment shall be operated to discharge and transfer concrete without segregation. In no

case shall dumping of concrete in discrete piles be permitted. No transfer or spreading operation which requires the use of front-end loaders, dozers, or similar equipment to distribute the concrete will be permitted.

3.5 PAVING

3.5.1 General Requirements

Pavement shall be constructed with paving and finishing equipment utilizing rigid fixed forms or by use of slipform paving equipment. Paving and finishing equipment and procedures shall be capable of constructing paving lanes of the required width at a rate of at least 100 feet of paving lane per hour on a routine basis. Paving equipment and its operation shall be controlled, and coordinated with all other operations, such that the paver-finisher has a continuous forward movement, at a reasonably uniform speed, from beginning to end of each paving lane, except for inadvertent equipment breakdown. Failure to achieve this shall require the Contractor to halt operations, regroup, and modify operations to achieve this requirement. Workmen with foreign material on their footwear or construction equipment that might deposit foreign material shall not be permitted to walk or operate in the plastic concrete. Where an open-graded granular base is required under the concrete, select paving equipment and procedures which will operate properly on the base course without causing displacement or other damage.

3.5.2 Consolidation

Concrete shall be consolidated with the specified type of lane-spanning, gang-mounted, mechanical, immersion type vibrating equipment mounted in front of the paver, supplemented, in rare instances as specified, by hand-operated vibrators. The vibrators shall be inserted into the concrete to a depth that will provide the best full-depth consolidation but not closer to the underlying material than 2 inches. Excessive vibration shall not be permitted. If the vibrators cause visible tracking in the paving lane, the paving operation shall be stopped and equipment and operations modified to prevent it. Concrete in small, odd-shaped slabs or in isolated locations inaccessible to the gang-mounted vibration equipment shall be vibrated with an approved hand-operated immersion vibrator operated from a bridge spanning the area. Vibrators shall not be used to transport or spread the concrete. Hand-operated vibrators shall not be operated in the concrete at one location for more than 20 seconds. Insertion locations for hand-operated vibrators shall be between 6 to 15 inches on centers. For each paving train, at least one additional vibrator spud, or sufficient parts for rapid replacement and repair of vibrators shall be maintained at the paving site at all times. Any evidence of inadequate consolidation (honeycomb along the edges, large air pockets, or any other evidence) shall require the immediate stopping of the paving operation and approved adjustment of the equipment or procedures.

3.5.3 Operation

When the paver approaches a header at the end of a paving lane, a sufficient amount of concrete shall be maintained ahead of the paver to provide a roll of concrete which will spill over the header. The amount of extra concrete shall be sufficient to prevent any slurry that is formed and carried along ahead of the paver from being deposited adjacent to the header. The spud vibrators in front of the paver shall be brought as close to the header as possible before they are lifted. Additional consolidation shall be provided adjacent to the headers by hand-manipulated vibrators.

When the paver is operated between or adjacent to previously constructed pavement (fill-in lanes), provisions shall be made to prevent damage to the previously constructed pavement. Screeds or extrusion plates shall be electronically controlled from the previously placed pavement so as to prevent them from applying pressure to the existing pavement and to prevent abrasion of the pavement surface. The overlapping area of existing pavement surface shall at all times be kept completely free of any loose or bonded foreign material as the paver-finisher operates across it. When the paver travels on existing pavement, approved provisions shall be made to prevent damage to the existing pavement. Pavers using transversely oscillating screeds shall not be used to form fill-in lanes that have widths less than a full width for which the paver was designed or adjusted.

3.5.4 Required Results

The paver-finisher, and its gang-mounted vibrators, together with its operating procedures shall be adjusted and operated and coordinated with the concrete mixture being used to produce a thoroughly consolidated slab throughout, true to line and grade within specified tolerances. The paver-finishing operation shall produce a surface finish free of irregularities, tears, voids of any kind, and any other discontinuities. The paver-finisher shall make only one pass across the pavement; multiple passes will not be permitted. The equipment and its operation shall produce a finished surface requiring no hand finishing other than the use of cutting straightedges, except in very infrequent instances. If any equipment or operation fails to produce the above results, the paving shall be stopped, the equipment shall be replaced or properly adjusted, the operation shall be appropriately modified, or the mixture proportions modified, in order to produce the required results before recommencing paving. No water, other than fog sprays (mist) as specified in paragraph: Prevention of Plastic Shrinkage Cracking above, shall be applied to the concrete or the concrete surface during paving and finishing.

3.5.5 Fixed Form Paving

Paving equipment for fixed-form paving and the operation thereof shall conform to the requirements of paragraph EQUIPMENT, and all requirements specified herein.

3.5.5.1 Forms for Fixed-Form Paving

a. Straight forms shall be made of steel and shall be furnished in sections not less than 10 feet in length. Flexible or curved forms of proper radius shall be used for curves of 100-foot radius or less. Wood forms for curves and fillets shall be made of well-seasoned, surfaced plank or plywood, straight, and free from warp or bend. Wood forms shall be adequate in strength and rigidly braced. Forms shall have a depth equal to the pavement thickness at the edge. Where the project requires several different slab thicknesses, forms may be built up by bolting or welding a tubular metal section or by bolting wood planks to the bottom of the form to completely cover the underside of the base of the form and provide an increase in depth of not more than 25 percent. The base width of the one-piece or built-up form shall be not less than eight-tenths of the vertical height of the form, except than forms 8 inches or less in vertical height shall have a base width not less than the vertical height of the form. Maximum vertical deviation of top of any side form, including joints, shall not vary from a true plane more than 1/8 inch in 10 feet, and the upstanding leg shall not vary more than 1/4 inch. [Where keyway forms are required,

they shall be rigidly attached to the main form so no displacement can take place. Metal keyway forms shall be tack-welded to steel forms. Keyway forms shall be so aligned that there is no variation over 1/4 inch either vertically or horizontally, when tested with a 12 foot template after forms are set, including tests across form joints.]

b. Form sections shall be tightly locked and shall be free from play or movement in any direction. Forms shall be provided with adequate devices for secure settings so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment.

c. Set forms for full bearing on foundation for entire length and width and in alignment with edge of finished pavement. Support forms during entire operation of placing, compaction, and finishing so that forms will not deviate vertically more than 0.01 foot from required grade and elevations indicated. Conformity to the alignment and grade elevations shown on the drawings shall be checked and necessary corrections shall be made immediately prior to placing the concrete. The forms shall be cleaned and oiled each time before concrete is placed. No concrete shall be placed until setting of forms has been checked and approved by the CQC team.

d. Do not anchor guide rails for fixed form pavers into new concrete or existing concrete to remain.

e. Forms for overlay pavements and for other locations where forms must be set on existing pavements shall be held securely in place with stakes or by other approved methods. Holes in existing pavements for form stakes shall be carefully drilled by methods which will not crack or spall the existing pavement. After use, the holes shall be filled flush with the surrounding surface using approved material, prior to overlying materials being placed. Any method which does not hold the form securely or which damages the existing pavement shall be immediately discontinued. Prior to setting forms for paving operations, demonstrate the proposed form setting procedures at an approved location without proceeding further until the proposed method is approved by the Contracting Officer.

3.5.5.2 Form Removal

Keep forms in place at least 12 hours after the concrete has been placed. When conditions are such that the early strength gain of the concrete is delayed, leave the forms in place for a longer time, as directed. Remove forms by procedures that do not injure the concrete. Bars or heavy metal tools shall not be used directly against the concrete in removing the forms. Any concrete found to be defective after form removal shall be repaired promptly, using procedures specified hereinafter or as directed.

3.5.6 Slipform Paving

3.5.6.1 General

Paving equipment for slipform paving and the operation thereof shall conform to the requirement of paragraph EQUIPMENT, and all requirements specified herein. The slipform paver shall shape the concrete to the specified and indicated cross section, meeting all tolerances, in one pass. The slipform paver shall finish the surface and edges so that only a very minimum isolated amount of hand finishing is required. If the paving

operation does not meet the above requirements and the specified tolerances, immediately stop the operation, and regroup and replace or modify any equipment as necessary, modify paving procedures or modify the concrete mix, in order to resolve the problem. The slipform paver shall be automatically electronically controlled from a taut wire guideline for horizontal alignment and on both sides from a taut wire guideline for vertical alignment, except that electronic control from a ski operating on a previously constructed adjoining lane shall be used where applicable for either or both sides. Automatic, electronic controls for vertical alignment shall always be used on both sides of the lane. Control from a slope-adjustment control or control operating from the underlying material shall never be used. Side forms on slipform pavers shall be properly adjusted so that the finished edge of the paving lane meets all specified tolerances. Dowels in longitudinal construction joints shall be installed as specified below. The installation of these dowels by dowel inserters attached to the paver or by any other means of inserting the dowels into the plastic concrete shall not be permitted. If a keyway is required, a 26 gauge thick metal keyway liner shall be installed as the keyway is extruded. Keyway forms shall not vary more than plus or minus 1/8 inch from the dimensions indicated and shall not deviate more than plus or minus 1/4 inch from the mid-depth of the pavement. There shall be no abrupt offset either horizontally or vertically in the completed keyway. The keyway liner shall be protected and shall remain in place and become part of the joint.

3.5.6.2 Guideline for Slipform Paving

Accurately and securely install guidelines well in advance of concrete placement. Provide supports at necessary intervals to eliminate all sag in the guideline when properly tightened. The guideline shall be high strength wire set with sufficient tension to remove all sag between supports. Supports shall be securely staked to the underlying material or other provisions made to ensure that the supports will not be displaced when the guideline is tightened or when the guideline or supports are accidentally touched by workmen or equipment during construction. The appliances for attaching the guideline to the supports shall be capable of easy adjustment in both the horizontal and vertical directions. When it is necessary to leave gaps in the guideline to permit equipment to use or cross underlying material, provisions shall be made for quickly and accurately replacing the guideline without any delay to the forward progress of the paver. Supports on either side of the gap shall be secured in such a manner as to avoid disturbing the remainder of the guideline when the portion across the gap is positioned and tightened. The guideline across the gap and adjacent to the gap for a distance of 200 feet shall be checked for horizontal and vertical alignment after the guideline across the gap is tightened. Vertical and horizontal positioning of the guideline shall be such that the finished pavement shall conform to the alignment and grade elevations shown on the drawings within the specified tolerances for grade and smoothness. The specified tolerances are intended to cover only the normal deviations in the finished pavement that may occur under good supervision and do not apply to setting of the guideline. The guideline shall be set true to line and grade.

3.5.6.3 Laser Controls

If the Contractor proposes to use any type of automatic laser controls, submit a detailed description of the system and perform a trial field demonstration in the presence of the Contracting Officer at least one week prior to start of paving. Approval of the control system will be based on

the results of the demonstration and on continuing satisfactory operation during paving.

3.5.7 Placing Reinforcing Steel

The type and amount of steel reinforcement shall be as shown on the drawings.

3.5.7.1 Pavement Thickness Greater Than 12 Inches

For pavement thickness of 12 inches or more, the reinforcement steel shall be installed by the strike-off method wherein a layer of concrete is deposited on the underlying material, consolidated, and struck to the indicated elevation of the steel reinforcement. The reinforcement shall be laid upon the prestruck surface, and the remaining concrete shall then be placed and finished in the required manner. When placement of the second lift causes the steel to be displaced horizontally from its original position, provisions shall be made for increasing the thickness of the first lift and depressing the reinforcement into the unhardened concrete to the required elevation. The increase in thickness shall be only as necessary to permit correct horizontal alignment to be maintained. Any portions of the bottom layer of concrete that have been placed more than 30 minutes without being covered with the top layer shall be removed and replaced with newly mixed concrete without additional cost to the Government.

3.5.7.2 Pavement Thickness Less Than 12 Inches

For pavements less than 12 inches thick, the reinforcement shall be positioned on suitable chairs or continuous mesh support devices securely fastened to the subgrade prior to concrete placement. Concrete shall be vibrated after the steel has been placed. Regardless of placement procedure, the reinforcing steel shall be free from coatings which could impair bond between the steel and concrete, and laps in the reinforcement shall be as indicated. Regardless of the equipment or procedures used for installing reinforcement, ensure that the entire depth of concrete is adequately consolidated.

3.5.8 Placing Dowels and Tie Bars

The method used in installing and holding dowels in position shall ensure that the error in alignment of any dowel from its required horizontal and vertical alignment after the pavement has been completed will not be greater than 1/8 in. per ft. Except as otherwise specified below, horizontal spacing of dowels shall be within a tolerance of plus or minus 5/8 inch. The vertical location on the face of the slab shall be within a tolerance of plus or minus 1/2 inch). The vertical alignment of the dowels shall be measured parallel to the designated top surface of the pavement, except for those across the crown or other grade change joints. Dowels across crowns and other joints at grade changes shall be measured to a level surface. Horizontal alignment shall be checked perpendicular to the joint edge. The horizontal alignment shall be checked with a framing square. Dowels and tie bars shall not be placed closer than 0.6 times the dowel bar tie bar length to the planned joint line. If the last regularly spaced dowel tie bar is closer than that dimension, it shall be moved away from the joint to a location 0.6 times the dowel bar tie bar length, but not closer than 6 inches to its nearest neighbor. Dowel (tie bar) interference at a transverse joint-longitudinal joint intersection shall be resolved by deleting the closest transverse dowel (tie bar). Dowels shall be installed

as specified in the following subparagraphs.

3.5.8.1 Contraction Joints

Dowels and tie bars in longitudinal and transverse contraction joints within the paving lane shall be held securely in place, as indicated, by means of rigid metal frames or basket assemblies of an approved type. The basket assemblies shall be held securely in the proper location by means of suitable pins or anchors. Do not cut or crimp the dowel basket tie wires. At the Contractor's option, in lieu of the above, dowels and tie bars in contraction joints shall be installed near the front of the paver by insertion into the plastic concrete using approved equipment and procedures. Approval will be based on the results of a preconstruction demonstration, showing that the dowels and tie bars are installed within specified tolerances.

3.5.8.2 Construction Joints-Fixed Form Paving

Installation of dowels and tie bars shall be by the bonded-in-place method. Installation by removing and replacing in preformed holes will not be permitted. Dowels and tie bars shall be prepared and placed across joints where indicated, correctly aligned, and securely held in the proper horizontal and vertical position during placing and finishing operations, by means of devices fastened to the forms. The spacing of dowels [and tie bars] in construction joints shall be as indicated, except that, where the planned spacing cannot be maintained because of form length or interference with form braces, closer spacing with additional dowels or tie bars shall be used.

3.5.8.3 Dowels Installed in Hardened Concrete

Install dowels in hardened concrete by bonding the dowels into holes drilled into the hardened concrete. The concrete shall have cured for 7 days or reached a minimum before drilling commences. Holes $1/8$ inch greater in diameter than the dowels shall be drilled into the hardened concrete using rotary-core drills. Rotary-percussion drills may be used, provided that excessive spalling does not occur to the concrete joint face. Continuing damage shall require modification of the equipment and operation. Depth of dowel hole shall be within a tolerance of plus/minus $1/2$ inch of the dimension shown on the drawings. Upon completion of the drilling operation, the dowel hole shall be blown out with oil-free, compressed air. Dowels shall be bonded in the drilled holes using epoxy resin. Epoxy resin shall be injected at the back of the hole before installing the dowel and extruded to the collar during insertion of the dowel so as to completely fill the void around the dowel. Application by buttering the dowel will not be permitted. The dowels shall be held in alignment at the collar of the hole, after insertion and before the grout hardens, by means of a suitable metal or plastic grout retention ring fitted around the dowel. Dowels required to be installed in any joints between new and existing concrete shall be grouted in holes drilled in the existing concrete, all as specified above. Where tie bars are required in longitudinal construction joints of slipform pavement, bent tie bars shall be installed at the paver, in front of the transverse screed or extrusion plate. Tie bars shall not be installed in preformed holes. A standard keyway shall be constructed, and the bent tie bars shall be inserted into the plastic concrete through a 26 gauge thick metal keyway liner. The keyway liner shall be protected and shall remain in place and become part of the joint. When bending tie bars, the radius of bend shall not be less than the minimum recommended for the particular grade of steel in the

appropriate material standard. Before placement of the adjoining paving lane, the tie bars shall be straightened, using procedures which will not spall the concrete around the bar.

3.5.8.4 Lubricating Dowel Bars

The portion of each dowel intended to move within the concrete or expansion cap shall be wiped clean and coated with a thin, even film of lubricating oil or light grease before the concrete is placed.

3.6 FINISHING

Finishing operations shall be a continuing part of placing operations starting immediately behind the strike-off of the paver. Initial finishing shall be provided by the transverse screed or extrusion plate. The sequence of operations shall be transverse finishing, longitudinal machine floating if used, straightedge finishing, texturing, and then edging of joints. Finishing shall be by the machine method. The hand method shall be used only on isolated areas of odd slab widths or shapes and in the event of a breakdown of the mechanical finishing equipment. Supplemental hand finishing for machine finished pavement shall be kept to an absolute minimum. Any machine finishing operation which requires appreciable hand finishing, other than a moderate amount of straightedge finishing, shall be immediately stopped and proper adjustments made or the equipment replaced. Any operations which produce more than 1/8 inch of mortar-rich surface (defined as deficient in plus U.S. No. 4 sieve size aggregate) shall be halted immediately and the equipment, mixture, or procedures modified as necessary. Compensation shall be made for surging behind the screeds or extrusion plate and settlement during hardening and care shall be taken to ensure that paving and finishing machines are properly adjusted so that the finished surface of the concrete (not just the cutting edges of the screeds) will be at the required line and grade. Finishing equipment and tools shall be maintained clean and in an approved condition. At no time shall water be added to the surface of the slab with the finishing equipment or tools, or in any other way, except for fog (mist) sprays specified to prevent plastic shrinkage cracking.

3.6.1 Machine Finishing With Fixed Forms

The machine shall be designed to ride the forms and shall be operated to screed and consolidate the concrete. Machines that cause displacement of the forms shall be replaced. The machine shall make only one pass over each area of pavement. If the equipment and procedures do not produce a surface of uniform texture, true to grade, in one pass, the operation shall be immediately stopped and the equipment, mixture, and procedures adjusted as necessary.

3.6.2 Machine Finishing with Slipform Pavers

The slipform paver shall be operated so that only a very minimum of additional finishing work is required to produce pavement surfaces and edges meeting the specified tolerances. Any equipment or procedure that fails to meet these specified requirements shall immediately be replaced or modified as necessary. A self-propelled nonrotating pipe float may be used while the concrete is still plastic, to remove minor irregularities and score marks. Only one pass of the pipe float shall be allowed. If there is concrete slurry or fluid paste on the surface that runs over the edge of the pavement, the paving operation shall be immediately stopped and the equipment, mixture, or operation modified to prevent formation of such

slurry. Any slurry which does run down the vertical edges shall be immediately removed by hand, using stiff brushes or scrapers. No slurry, concrete or concrete mortar shall be used to build up along the edges of the pavement to compensate for excessive edge slump, either while the concrete is plastic or after it hardens.

3.6.3 Surface Correction and Testing

After all other finishing is completed but while the concrete is still plastic, minor irregularities and score marks in the pavement surface shall be eliminated by means of cutting straightedges. Such straightedges shall be 12 feet in length and shall be operated from the sides of the pavement and from bridges. A straightedge operated from the side of the pavement shall be equipped with a handle 3 feet longer than one-half the width of the pavement. The surface shall then be tested for trueness with a straightedge held in successive positions parallel and at right angles to the center line of the pavement, and the whole area covered as necessary to detect variations. The straightedge shall be advanced along the pavement in successive stages of not more than one-half the length of the straightedge. Depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated with an internal vibrator, and refinished. Projections above the required elevation shall also be struck off and refinished. The straightedge testing and finishing shall continue until the entire surface of the concrete is free from observable departure from the straightedge and conforms to the surface requirements specified in paragraph: ACCEPTABILITY OF WORK in PART 1. This straightedging shall not be used as a replacement for the straightedge testing of paragraph: Surface Smoothness in PART 1. Long-handled, flat bull floats shall be used very sparingly and only as necessary to correct minor, scattered surface defects. If frequent use of bull floats is necessary, the paving operation shall be stopped and the equipment, mixture or procedures adjusted to eliminate the surface defects. Finishing with hand floats and trowels shall be held to the absolute minimum necessary. Extreme care shall be taken to prevent overfinishing joints and edges. The surface finish of the pavement shall be produced essentially by the finishing machine and not by subsequent hand finishing operations. All hand finishing operations shall be subject to approval and shall be modified when directed.

3.6.4 Hand Finishing

Use hand finishing operations only as specified below.

3.6.4.1 Equipment and Template

In addition to approved mechanical internal vibrators for consolidating the concrete, provide a strike-off and tamping template and a longitudinal float for hand finishing. The template shall be at least 1 foot longer than the width of pavement being finished, of an approved design, and sufficiently rigid to retain its shape, and shall be constructed of metal or other suitable material shod with metal. The longitudinal float shall be at least 10 feet long, of approved design, and rigid and substantially braced, and shall maintain a plane surface on the bottom. Grate tampers (jitterbugs) shall not be used.

3.6.4.2 Finishing and Floating

As soon as placed and vibrated, the concrete shall be struck off and screeded to the crown and cross section and to such elevation above grade that when consolidated and finished, the surface of the pavement will be at

the required elevation. In addition to previously specified complete coverage with handheld immersion vibrators, the entire surface shall be tamped with the strike-off and tamping template, and the tamping operation continued until the required compaction and reduction of internal and surface voids are accomplished. Immediately following the final tamping of the surface, the pavement shall be floated longitudinally from bridges resting on the side forms and spanning but not touching the concrete. If necessary, additional concrete shall be placed, consolidated and screeded, and the float operated until a satisfactory surface has been produced. The floating operation shall be advanced not more than half the length of the float and then continued over the new and previously floated surfaces.

3.6.5 Texturing

Before the surface sheen has disappeared and before the concrete hardens or curing compound is applied, the surface of the pavement shall be given a texture as described herein. After curing is complete, all textured surfaces shall be thoroughly power broomed to remove all debris.

3.6.5.1 Burlap Drag Surface

Surface texture shall be applied by dragging the surface of the pavement, in the direction of the concrete placement, with an approved burlap drag. The drag shall be operated with the fabric moist, and the fabric shall be cleaned or changed as required to keep clean. The dragging shall be done so as to produce a uniform finished surface having a fine sandy texture without disfiguring marks.

3.6.5.2 Artificial Turf Drag Surface

Artificial turf texture shall be applied by dragging the surface of the pavement in the direction of concrete placement with an approved full-width drag made with artificial turf.

3.6.5.3 Broom Texturing

Brooming should be completed before the concrete has hardened to the point where the surface will be unduly torn or roughened, but after hardening has progressed enough so that the mortar will not flow and reduce the sharpness of the scores. Successive passes of the broom shall be overlapped the minimum necessary to obtain a uniformly textured surface. Brooms shall be washed thoroughly at frequent intervals during use. Worn or damaged brooms shall be removed from the job site. Hand brooming will be permitted only on isolated odd shaped slabs or slabs where hand finishing is permitted. For hand brooming, the brooms shall have handles longer than half the width of slab to be finished. The hand brooms shall be drawn transversely across the surface from the center line to each edge with slight overlapping strokes.

3.6.5.4 Wire-Comb Texturing

Surface texture shall be applied using an approved mechanical wire comb drag operated to comb the surface transverse to the pavement center line. The comb shall be capable of traversing the full width of the pavement in a single pass at a uniform speed and with a uniform pressure. Successive passes of the comb shall be overlapped the minimum necessary to obtain a continuous and uniformly textured surface. Texturing shall be completed before the concrete has hardened to the point where the surface and edges will be unduly torn, but after hardening has progressed to the point where

the serrations will not close up. The serrations shall be 1/16 to 3/16 inch deep, 1/16 to 1/8 inch wide, and spaced 3/8 inch apart. Transverse texturing shall produce grooves in straight lines across each lane within a tolerance of plus or minus 1/2 inch of a true line.

3.6.5.5 Surface Grooving

The areas indicated on the drawings shall be grooved with a spring tine drag producing individual grooves 1/4 inch deep and 1/4 inch wide at a spacing between groove centerlines of 1-1/2 inches. These grooves shall be cut perpendicular to the centerline. Before grooving begins, the concrete shall be allowed to attain sufficient strength to prevent aggregate spalling. Grooves shall not be cut within 6 inches of a runway centerline, transverse joint, or crack; and they shall not be cut through neoprene compression seals. Transverse texturing shall produce grooves in straight lines across each lane within a tolerance of plus or minus 1/2 inch of a true line.

3.6.6 Edging

After texturing has been completed, the edge of the slabs along the forms, along the edges of slipformed lanes, and at the joints shall be carefully finished with an edging tool to form a smooth rounded surface of 1/8 inch radius. Tool marks shall be eliminated, and the edges shall be smooth and true to line. No water shall be added to the surface during edging. Extreme care shall be taken to prevent overworking the concrete.

3.6.7 Outlets in Pavement

Recesses for the tie-down anchors, lighting fixtures, and other outlets in the pavement shall be constructed to conform to the details and dimensions shown. The concrete in these areas shall be carefully finished to provide a surface of the same texture as the surrounding area that will be within the requirements for plan grade and surface smoothness.

3.7 CURING

3.7.1 Protection of Concrete

Concrete shall be continuously protected against loss of moisture and rapid temperature changes for at least 7 days from the completion of finishing operations. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. If any selected method of curing does not afford the proper curing and protection against concrete cracking, the damaged pavement shall be removed and replaced, and another method of curing shall be employed as directed. Curing shall be accomplished by one of the following methods.

3.7.2 Membrane Curing

A uniform coating of white-pigmented, membrane-forming, curing compound shall be applied to the entire exposed surface of the concrete as soon as the free water has disappeared from the surface after [finishing] [moist curing ceases]. Along the formed edge faces, it shall be applied immediately after the forms are removed. Concrete shall not be allowed to dry before the application of the membrane. If any drying has occurred, the surface of the concrete shall be moistened with a fine spray of water, and the curing compound applied as soon as the free water disappears. The

curing compound shall be applied to the finished surfaces by means of an approved automatic spraying machine. The curing compound shall be applied with an overlapping coverage that will give a two-coat application at a coverage of 400 square feet per gallon, plus or minus 5.0 percent for each coat. A one-coat application may be applied provided a uniform application and coverage of 200 square feet per gallon, plus or minus 5.0 percent is obtained. The application of curing compound by hand-operated, mechanical powered pressure sprayers will be permitted only on odd widths or shapes of slabs and on concrete surfaces exposed by the removal of forms. When the application is made by hand-operated sprayers, a second coat shall be applied in a direction approximately at right angles to the direction of the first coat. If pinholes, abrasions, or other discontinuities exist, an additional coat shall be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be immediately resprayed. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from any other possible damage to the continuity of the membrane.

3.7.3 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period, or until curing compound is applied, commencing immediately after finishing. If forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces, using suitable materials. Surfaces shall be cured by ponding, by continuous sprinkling, by continuously saturated burlap or cotton mats, or by continuously saturated plastic coated burlap. Burlap and mats shall be clean and free from any contamination and shall be completely saturated before being placed on the concrete. Lap sheets to provide full coverage. Provide an approved work system to ensure that moist curing is continuous 24 hours per day and that the entire surface is wet.

3.8 JOINTS

3.8.1 General Requirements for Joints

Joints shall conform to the locations and details indicated and shall be perpendicular to the finished grade of the pavement. All joints shall be straight and continuous from edge to edge or end to end of the pavement with no abrupt offset and no gradual deviation greater than 1/2 inch. Where any joint fails to meet these tolerances, the slabs adjacent to the joint shall be removed and replaced at no additional cost to the Government. No change from the jointing pattern shown on the drawings shall be made without written approval of the Contracting Officer. Joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. Joints shall be sealed as specified in Section 32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS.

3.8.2 Longitudinal Construction Joints

Dowels or keys or tie bars shall be installed in the longitudinal construction joints, or the edges shall be thickened as indicated. [Dowels] [Tie bars] shall be installed as specified above. If any length

of completed keyway of 5 feet or more fails to meet the previously specified tolerances, dowels shall be installed in that part of the joint by drilling holes in the hardened concrete and grouting the dowels in place with epoxy resin. After the end of the curing period, longitudinal construction joints shall be sawed to provide a groove at the top for sealant conforming to the details and dimensions indicated.

3.8.3 Transverse Construction Joints

Transverse construction joints shall be installed at the end of each day's placing operations and at any other points within a paving lane when concrete placement is interrupted for 30 minutes or longer. The transverse construction joint shall be installed at a planned transverse joint. Transverse construction joints shall be constructed by utilizing headers or by paving through the joint, then full-depth sawcutting the excess concrete. Pavement shall be constructed with the paver as close to the header as possible, and the paver shall be run out completely past the header. Transverse construction joints installed at a planned transverse joint shall be constructed as shown or, if not shown otherwise, shall be dowelled in accordance with paragraph: Dowels Installed in Hardened Concrete, or paragraph: Fixed Form Paving above.

3.8.4 Expansion Joints

Expansion joints shall be formed where indicated, and about any structures and features that project through or into the pavement, using joint filler of the type, thickness, and width indicated, and shall be installed to form a complete, uniform separation between the structure and the pavement. The filler shall be attached to the original concrete placement with adhesive or other fasteners and shall extend the full slab depth. Adjacent sections of filler shall be fitted tightly together, and the filler shall extend across the full width of the paving lane or other complete distance in order to prevent entrance of concrete into the expansion space. Edges of the concrete at the joint face shall be finished with an edger with a radius of 1/8 inch. The joint filler strips shall be installed 3/4 inch below the pavement surface with a slightly tapered, dressed-and-oiled wood strip or other approved material temporarily secured to the top of the filler to form a recess to be filled with joint sealant.

3.8.5 Slip Joints

Slip joints shall be installed where indicated using the specified materials. Preformed joint filler material shall be attached to the face of the original concrete placement with adhesive or other fasteners. A 3/4 inch deep reservoir for joint sealant shall be constructed at the top of the joint. Edges of the joint face shall be finished with an edger with a radius of 1/8 inch.

3.8.6 Contraction Joints

Construct transverse and longitudinal contraction joints by sawing an initial groove in the concrete with a 1/8 inch blade to the indicated depth. During sawing of joints, and again 24 hours later, the CQC team shall inspect all exposed lane edges for development of cracks below the saw cut, and shall immediately report results to the Contracting Officer. If the Contracting Officer determines that there are more uncracked joints than desired, the Contractor will be directed to saw succeeding joints 25 percent deeper than originally indicated at no additional cost to the Government. The time of initial sawing shall vary depending on existing

and anticipated weather conditions and shall be such as to prevent uncontrolled cracking of the pavement. Sawing of the joints shall commence as soon as the concrete has hardened sufficiently to permit cutting the concrete without chipping, spalling, or tearing. The sawed faces of joints will be inspected for undercutting or washing of the concrete due to the early sawing, and sawing shall be delayed if undercutting is sufficiently deep to cause structural weakness or excessive roughness in the joint. The sawing operation shall be carried on as required during both day and night regardless of weather conditions. The joints shall be sawed at the required spacing consecutively in the sequence of the concrete placement. Adequate lighting shall be provided for night work. Illumination using vehicle headlights will not be permitted. A chalk line or other suitable guide shall be used to mark the alignment of the joint. Before sawing a joint, the concrete shall be examined closely for cracks, and the joint shall not be sawed if a crack has occurred near the planned joint location. Sawing shall be discontinued when a crack develops ahead of the saw cut. Immediately after the joint is sawed, the saw cut and adjacent concrete surface shall be thoroughly flushed with water and vacuumed until all waste from sawing is removed from the joint and adjacent concrete surface. The surface shall be resprayed with curing compound as soon as free water disappears. Necessary precautions shall be taken to insure that the concrete is properly protected from damage and cured at sawed joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed with cord backer rod before the concrete in the region of the joint is resprayed with curing compound, and shall be maintained until removed immediately before sawing the joint sealant reservoir. The exposed saw cuts on the faces of pilot lanes shall be sealed with bituminous mastic or masking tape. After expiration of the curing period, the upper portion of the groove shall be widened by sawing with ganged diamond saw blades to the width and depth indicated for the joint sealer. The reservoir shall be centered over the initial sawcut.

3.8.7 Thickened Edge Joints

Construct thickened edge joints as indicated on the drawings. Underlying material in the transition area shall be graded as shown and shall meet the requirements for smoothness and compaction specified for all other areas of the underlying material.

3.9 REPAIR, REMOVAL AND REPLACEMENT OF NEWLY CONSTRUCTED SLABS

3.9.1 General Criteria

New pavement slabs that are broken, have spalled edges, or contain cracks shall be removed and replaced or repaired, as specified hereinafter at no cost to the Government. Removal of partial slabs is not permitted. Not more than 15.0 percent of each slab's longitudinal joint edge shall be spalled. Prior to fill-in lane placement, pilot lane slabs with spalls exceeding this quantity, regardless of spall size, shall be sawn full depth to remove the spalled face. All other slabs shall be removed, as directed. The Contracting Officer will determine whether cracks extend full depth of the pavement and may require cores to be drilled on the crack to determine depth of cracking. Such cores shall be at least 6 inch diameter, and shall be drilled and backfilled with an approved non-shrink concrete. Perform drilling of cores and refilling holes at no expense to the Government.

3.9.2 Slabs with Cracks

Cracks that do not exceed 25 percent of the design thickness in depth shall be cleaned and then pressure injected full depth with epoxy resin, Type IV, Grade 1. Slabs containing cracks deeper than 25 percent of the design thickness shall be removed.

3.9.3 Removal and Replacement of Full Slabs

Where it is necessary to remove full slabs, removal shall be in accordance with paragraph: Removal of Existing Pavement Slab below. Removal and replacement shall be full depth, by full width of the slab, and the limit of removal shall be normal to the paving lane and extend to each original joint. Dowels of the size and spacing as specified for other joints in similar pavement shall be installed by epoxy grouting them into holes drilled into the existing concrete using procedures as specified in paragraph: Placing Dowels and Tie Bars, above. Original damaged dowels or tie bars shall be cut off flush with the joint face. Protruding portions of dowels shall be painted and lightly oiled. All four edges of the new slab shall thus contain dowels. Placement of concrete shall be as specified for original construction. Prior to placement of new concrete, the underlying material shall be recompact and shaped as specified in the appropriate section of these specifications, and the surfaces of all four joint faces shall be cleaned of all loose material and contaminants and coated with a double application of membrane forming curing compound as bond breaker. Care shall be taken to prevent any curing compound from contacting dowels or tie bars. The resulting joints around the new slab shall be prepared and sealed as specified for original construction.

3.9.4 Repairing Spalls Along Joints

Where directed, spalls along joints of new slabs, along edges of adjacent existing concrete, and along parallel cracks shall be repaired by first making a vertical saw cut at least 1 inch outside the spalled area and to a depth of at least 2 inches. Saw cuts shall be straight lines forming rectangular areas. The concrete between the saw cut and the joint, or crack, shall be chipped out to remove all unsound concrete and into at least 1/2 inch of visually sound concrete. Spalls along joints to be sealed with compression seals shall be sawn, chipped out, and repaired to a depth to restore the full joint-face support. The cavity thus formed shall be thoroughly cleaned with high pressure water jets supplemented with oil-free compressed air to remove all loose material. Immediately before filling the cavity, a prime coat shall be applied to the dry cleaned surface of all sides and bottom of the cavity, except any joint face. The prime coat shall be applied in a thin coating and scrubbed into the surface with a stiff-bristle brush. Prime coat for portland cement repairs shall be a neat cement grout and for epoxy resin repairs shall be epoxy resin, Type III, Grade 1. The prepared cavity shall be filled with: Portland cement concrete or latex modified mortar for larger cavities, those more than 1/3 cu. ft. in size after removal operations; Portland cement mortar for cavities between 0.03 cu. ft. and 1/3 cu. ft.; and epoxy resin mortar or epoxy resin or latex modified mortar for those cavities less than 0.03 cu. ft. in size. Portland cement concretes and mortars shall be very low slump mixtures, 1/2 inch slump or less, proportioned, mixed, placed, consolidated by tamping, and cured, all as directed. Epoxy resin mortars shall be made with Type III, Grade 1, epoxy resin, using proportions and mixing and placing procedures as recommended by the manufacturer and approved by the Contracting Officer. Proprietary patching materials may be used, subject to approval by the Contracting Officer. The epoxy resin

materials shall be placed in the cavity in layers not over 2 inches thick. The time interval between placement of additional layers shall be such that the temperature of the epoxy resin material does not exceed 140 degrees F at any time during hardening. Mechanical vibrators and hand tampers shall be used to consolidate the concrete or mortar. Any repair material on the surrounding surfaces of the existing concrete shall be removed before it hardens. Where the spalled area abuts a joint, an insert or other bond-breaking medium shall be used to prevent bond at the joint face. A reservoir for the joint sealant shall be sawed to the dimensions required for other joints. The reservoir shall be thoroughly cleaned and then sealed with the sealer specified for the joints. In lieu of sawing, spalls not adjacent to joints and popouts, both less than 6 inches in maximum dimension, may be prepared by drilling a core 2 inches in diameter greater than the size of the defect, centered over the defect, and 2 inches deep or 1/2 inch into sound concrete, whichever is greater. The core hole shall be repaired as specified above for other spalls.

3.9.5 Repair of Weak Surfaces

Weak surfaces are defined as mortar-rich, rain-damaged, uncured, or containing exposed voids or deleterious materials. Slabs containing weak surfaces less than 1/4 inch (6 mm) thick shall be diamond ground to remove the weak surface. Diamond grinding shall be in accordance with paragraph: Diamond Grinding of PCC Surfaces in PART 1. All ground areas shall meet the thickness, smoothness and grade criteria of paragraph: Acceptance Requirements in PART 1. Slabs containing weak surfaces greater than 1/4 inch thick shall be removed and replaced.

3.9.6 Repair of Pilot Lane Vertical Faces

Excessive edge slump and joint face deformation shall be repaired in accordance with paragraph: Edge Slump and Joint Face Deformation in PART 1. Inadequate consolidation (honeycombing or air voids) shall be repaired by saw cutting the face full depth along the entire lane length with a diamond blade. Obtain cores, as directed, to determine the depth of removal.

3.10 EXISTING CONCRETE PAVEMENT REMOVAL AND REPAIR

Existing concrete pavement shall be removed at locations indicated on the drawings. Prior to commencing pavement removal operations, inventory the pavement distresses (cracks, spalls, and corner breaks) along the pavement edge to remain. After pavement removal, the remaining edge shall again be surveyed to quantify any damage caused by Contractor's removal operations. Perform both surveys in the presence of the Contracting Officer. Repairs shall be made as indicated and as specified herein. All operations shall be carefully controlled to prevent damage to the concrete pavement and to the underlying material to remain in place. All saw cuts shall be made perpendicular to the slab surface, forming rectangular areas.

3.10.1 Removal of Existing Pavement Slab

When existing concrete pavement is to be removed and adjacent concrete is to be left in place, the joint between the removal area and adjoining pavement to stay in place shall first be cut full depth with a standard diamond-type concrete saw. Next, a full depth saw cut shall be made parallel to the joint at least 24 inches from the joint and at least 6 inches from the end of any dowels. This saw cut shall be made with a wheel saw as specified in paragraph: Sawing Equipment. All pavement to be

removed beyond this last saw cut shall be removed in accordance with the approved demolition work plan. All pavement between this last saw cut and the joint line shall be removed by carefully pulling pieces and blocks away from the joint face with suitable equipment and then picking them up for removal. In lieu of this method, this strip of concrete may be carefully broken up and removed using hand-held jackhammers, 30 lb or less, or other approved light-duty equipment which will not cause stress to propagate across the joint saw cut and cause distress in the pavement which is to remain in place. In lieu of the above specified removal method, the slab may be sawcut full depth to divide it into several pieces and each piece lifted out and removed. Suitable equipment shall be used to provide a truly vertical lift, and safe lifting devices used for attachment to the slab.

3.10.2 Edge Repair

The edge of existing concrete pavement against which new pavement abuts shall be protected from damage at all times. Slabs which are damaged during construction shall be removed and replaced as directed by the Contracting Officer at no cost to the Government. Repair of previously existing damage areas will be considered a subsidiary part of concrete pavement construction. All exposed keyways shall be sawn off full depth.

3.10.2.1 Spall Repair

Not more than 15.0 percent of each slab's edge shall be spalled as a result of the Contractor's actions. Slabs with spalls exceeding this quantity, regardless of spall size, shall be sawn full depth on the exposed face to remove the spalled face. Repair materials and procedures shall be as previously specified in paragraph: Repairing Spalls Along Joints.

3.10.2.2 Underbreak and Underlying Material

All underbreak shall be repaired by removal and replacement of the damaged slabs in accordance with paragraph: Removal and Replacement of Full Slabs above. The underlying material adjacent to the edge of and under the existing pavement which is to remain in place shall be protected from damage or disturbance during removal operations and until placement of new concrete, and shall be shaped as shown on the drawings or as directed. Sufficient underlying material shall be kept in place outside the joint line to completely prevent disturbance of material under the pavement which is to remain in place. Any material under the portion of the concrete pavement to remain in place which is disturbed or loses its compaction shall be carefully removed and replaced with concrete.

3.11 PAVEMENT PROTECTION

Protect the pavement against all damage prior to final acceptance of the work by the Government. Aggregates, rubble, or other similar construction materials shall not be placed on airfield pavements. Traffic shall be excluded from the new pavement by erecting and maintaining barricades and signs until the concrete is at least 14 days old, or for a longer period if so directed. As a construction expedient in paving intermediate lanes between newly paved pilot lanes, operation of the hauling and paving equipment will be permitted on the new pavement after the pavement has been cured for 7 days and the joints have been sealed or otherwise protected, the concrete has attained a minimum field cured flexural strength of 550 psi. and approved means are furnished to prevent damage to the slab edge. All new and existing pavement carrying construction traffic or equipment shall

be continuously kept completely clean, and spillage of concrete or other materials shall be cleaned up immediately upon occurrence. Special care shall be used where Contractor's traffic uses or crosses active airfield pavement. Power broom other existing pavements at least daily when traffic operates. For fill-in lanes, equipment shall be used that will not damage or spall the edges or joints of the previously constructed pavement.

3.12 TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL

3.12.1 Testing and Inspection by Contractor

During construction, the Contractor is responsible for sampling and testing aggregates, cementitious materials (cement, GGBF and pozzolan), and concrete to determine compliance with the specifications. Provide facilities and labor as may be necessary for procurement of representative test samples. Furnish sampling platforms and belt templates to obtain representative samples of aggregates from charging belts at the concrete plant. Samples of concrete shall be obtained at the point of delivery to the paver. Testing by the Government will in no way relieve the Contractor of the specified testing requirements. Perform the inspection and tests described below, and based upon the results of these inspections and tests, take the action required and submit reports as required. This testing shall be performed regardless of any other testing performed by the Government, either for pay adjustment purposes or for any other reason.

3.12.2 Testing and Inspection Requirements

Contractor CQC sampling, testing, inspection and reporting shall be in accordance with the following Table.

TABLE 6
CONTRACTOR TESTING AND INSPECTION REQUIREMENTS

<u>Frequency</u>	<u>Test Method</u>	<u>Control Limit/Corrective Action</u>
		<u>Fine Aggregate Gradation and Fineness Modulus</u>
2 per lot	ASTM C 136 sample at belt	9 of 10 tests vary <0.15 from average Outside limits on any sieve-retest 2nd failure-stop, repair, retest
		<u>Coarse Aggregate Gradation</u>
2 per lot	ASTM C 136 sample at belt	Outside limits on any sieve-retest 2nd failure-report to COR, correct 2 consecutive avgs of 5 tests out- report to COR, stop ops, repair, retest
		<u>Workability Factor and Coarseness Factor Computation</u>
Same as C.A. & F.A.	see paragraph: Aggregates	Use individual C.A. and F.A. gradations Combine using batch ticket percentages Tolerances: +/- 3 points on WF +/- 5 points on CF from approved mix design values Check batching tolerances, recalibrate scales
		<u>Aggregate Deleterious, Quality, and ASR Tests</u>
Every 30 days	see paragraph: AGGREGATES	Stop production, retest, replace aggregate Increase testing interval to 90 days if previous 2 tests pass

<u>Frequency</u>	<u>Test Method</u>	<u>Control Limit/Corrective Action</u>
Monthly	<u>Plant - Scales, Weighing Accuracy</u> NRMCA QC 3	Stop plant ops, repair, recalibrate
Weekly	<u>Plant - Batching and Recording Accuracy</u> Record/Report	Record required/recorded/actual batch mass Stop plant ops, repair, recalibrate
Every lot	<u>Plant - Batch Plant Control</u> Record/Report	Record type/amt of each material per lot
Every 4 months during paving	<u>Plant - Mixer Uniformity - Stationary Mixers</u> COE CRD-C 55	After initial approval, use abbreviated method. Increase mixing time, change batching sequence, reduce batch size to bring into compliance. Retest
Every 4 months during paving	<u>Plant - Mixer Uniformity - Truck Mixers</u> ASTM C 94/C 94M	Random selection of truck. Increase mixing time, change batching sequence, reduce batch size to bring into compliance. Retest.
When test specimens prepared + 2 random	<u>Concrete Mixture - Air Content</u> ASTM C231/C231M	Individual test control chart: Warning +/-1.0 - adjust AEA, retest Action +/-1.5 - halt ops, repair, retest Range between 2 consecutive tests: Warning +2.0 - recalibrate AEA dispenser Action +3.0 - halt ops, repair, retest
Same as Air content	<u>Concrete Mixture - Unit Weight and Yield</u> ASTM C 138/C 138M	Individual test basis: Warning Yield -0/+1% - check batching tol. Action Yield -0/+5% - halt ops, recalibrate
When test specimens prepared + 4 random	<u>Concrete Mixture - Slump</u> ASTM C 143/C 143M	Individual test control chart: Upper Warning - 1/2 inch below max- adjust batch masses within max W/C ratio Upper Action - maximum allowable slump stop operations, adjust, retest Range between each consecutive test: 1-1/2 inches stop operations, repair, retest
When test specimens prepared	<u>Concrete Mixture - Temperature</u> ASTM C 1064/C 1064M	See paragraph: WEATHER LIMITATIONS sample at paving site
8 per lot	<u>Concrete Mixture - Strength</u> ASTM C 31/C 31M	See Paragraph: Concrete Strength Testing sample at paving site for QOC
Prior to Report	<u>Paving - Inspection Before Paving</u>	Inspect underlying materials, construction

<u>Frequency</u>	<u>Test Method</u>	<u>Control Limit/Corrective Action</u>
each paving operation		joint faces, forms, reinforcing, dowels, and embedded items
During each paving operation		<u>Paving - Inspection During Paving</u> Monitor and control paving operation, including placement, consolidation, finishing, texturing, curing, and joint sawing.
Weekly, during paving	COE CRD-C 521	<u>Paving - Vibrators</u> Test frequency (in concrete), and amplitude (in air), measure at tip/head and average. Repair or replace defective vibrators.
2 per lot, min 4 per day	Visual	<u>Moist Curing</u> Repair defects, extend curing by 1 day
Daily	Visual	<u>Membrane Compound Curing</u> Calculate coverage based on quantity/area Respray areas where coverage defective Recalibrate equipment
Once per	Visual	<u>Cold Weather Protection</u> Repair defects, report conditions to COR

3.12.3 Concrete Strength Testing for Contractor CQC

3.12.4 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. Prepare a weekly report for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, make daily reports of pertinent temperatures. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all Contractor quality control records.

-- End of Section --

SECTION 32 13 73

COMPRESSION JOINT SEALS FOR CONCRETE PAVEMENTS

04/08

PART 1 GENERAL

1.1 UNIT PRICES

1.1.1 Measurement

The quantity of each sealing item to be paid for will be determined by measuring the length of in-place material that has been approved.

1.1.2 Payment

Payment will be made at the contract unit bid prices per unit length for the sealing items scheduled, including approved trail joint installation. Include in the unit bid prices the cost of all labor, materials, the use of all equipment, and tools required to complete the work.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 2628 (1991; R 2005) Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements

ASTM D 2835 (1989; R 2007) Lubricant for Installation of Preformed Compression Seals in Concrete Pavements

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 548 (1988) Standard Specification for Jet-Fuel and Heat-Resistant Preformed Polychloroprene Elastomeric Joint Seals for Rigid Pavements

1.3 SYSTEM DESCRIPTION

Provide machines, tools, and equipment, used in the performance of the work required by this section, approved before the work is started and maintained in satisfactory condition at all times.

1.3.1 Joint Cleaning Equipment

1.3.1.1 Concrete Saw

Provide a self-propelled power saw with water-cooled diamond saw blades for cutting joints to the depths and widths specified and for removing filler, existing old joint seal, or other material embedded in the joints or

adhered to the joint faces.

1.3.1.2 Sandblasting Equipment

Include with the sandblasting equipment an air compressor, hose, and a long-wearing venturi-type nozzle of proper size, shape, and opening. The maximum nozzle opening should not exceed $1/4$ inch. Provide a portable air compressor capable of furnishing not less than 150 cubic feet per minute and maintaining a line pressure of not less than 90 psi at the nozzle while in use. The compressor shall be equipped with traps that will maintain the compressed air free of oil and water. The nozzle shall have an adjustable guide that will hold the nozzle aligned with the joint about 1 inch above the pavement surface and will direct the blast to clean the joint walls. Adjust the height, angle of inclination, and the size of the nozzle as necessary to ensure satisfactory results.

1.3.1.3 Waterblasting Equipment

Include with the waterblasting equipment a trailer-mounted water tank, pumps, high-pressure hose, a wand with safety release cutoff controls, nozzle, and auxiliary water resupply equipment. The water tank and auxiliary water resupply equipment shall be of sufficient capacity to permit continuous operations. The pumps, hoses, wand, and nozzle shall be of sufficient capacity to permit the cleaning of both walls of the joint and the pavement surface for a width of at least $1/2$ inch on either side of the joint. A pressure gauge mounted at the pump shall show at all times the pressure in psi at which the equipment is operating.

1.3.2 Sealing Equipment

Equipment used to install the compression seal shall place the compression seal to the prescribed depths within the specified tolerances without cutting, nicking, twisting, or otherwise damaging the seal. The equipment shall be capable of placing the seal with not more than two percent longitudinal stretch or compression of the seal during installation. The machine shall be an automatic self-propelled joint seal application equipment and engine powered. The machine shall include a reservoir for the lubricant/adhesive, a device for conveying the lubricant/adhesive in the proper quantities to the sides of the compression seal or the sidewalls of the joints, a reel capable of holding one full spool of compression seal, and a power-driven apparatus for feeding the joint seal through a compression device and inserting the seal into the joint. The equipment shall also include a guide to maintain the proper course along the joint being sealed. The machine shall at all times be operated by an experienced operator.

1.3.3 Test Requirements

Each lot of compression joint seal and lubricant/adhesive shall be sampled, identified, and tested for conformance with the applicable material specification. A lot of compression seal shall consist of 1 day's production or 20,000 linear feet for each cross section, whichever is less. A lot of lubricant/adhesive shall consist of 1 day's production. . Furnish additional samples of materials, in sufficient quantity to be tested, upon request. Final acceptance will be based on conformance to the specified test requirements and the performance of the in-place materials.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment

List of proposed equipment to be used in the performance of construction work, including descriptive data, 14 days prior to use on the project.

Manufacturer's Instructions

Where installation procedures are required in accordance with the manufacturer's recommendations, printed copies of manufacturers' instructions, 14 days prior to use on the project.

SD-04, Samples

Compression Seals; G

Regardless of testing responsibility, 9 foot long samples of the materials, 60 days prior to use on the project. Printed directions from the manufacturer on recommended installation criteria shall be furnished with the samples plus the manufacturer's certification that the selected seal is recommended for the installation on this project.

SD-06 Test Reports

Test Requirements

Certified copies of test results, 14 days prior to use of material on the project.

1.5 QUALITY ASSURANCE

1.5.1 Safety

DO NOT place compression joint seals within 25 feet of liquid oxygen (LOX) equipment, LOX storage, or LOX piping.

1.5.2 Trial Joint Seal and Lubricant/Adhesive Installation

Prior to the cleaning and sealing of the joints for the entire project, prepare a test section at least 200 feet long at a designated location in the project pavement, using the specified materials and the approved equipment to demonstrate the proposed joint preparation and sealing of all types of joints in the project. Following the completion of the trial length and before any other joint is sealed, the trial joints will be inspected by the Government to determine that the materials and installation meet the requirements specified. If materials or installation do not meet requirements, remove the materials, and the joints shall be recleaned and resealed at no cost to the Government. No other joints shall

be sealed until the test installation has been approved. If the trial section is approved, it may be incorporated into the permanent work. Seal other joints in the manner approved for sealing the trial joint.

1.6 DELIVERY, STORAGE, AND HANDLING

Materials delivered to the jobsite shall be inspected for defects, unloaded, and stored with a minimum of handling to avoid damage. Provide storage facilities that protect materials from weather and maintain materials at temperatures recommended by the manufacturer.

1.7 ENVIRONMENTAL REQUIREMENTS

The ambient temperature and the pavement temperature within the joint wall shall be at least 35 degrees F and rising at the time of installation of the materials. Sealant installation will not be allowed if moisture or foreign material is observed in the joint.

PART 2 PRODUCTS

2.1 COMPRESSION SEALS

Compression joint seal materials shall be a vulcanized elastomeric compound using polychloroprene as the only base polymer. The material and manufactured seal shall conform to ASTM D 2628 and COE CRD-C 548 where jet fuel and/or heat blast resistance is required. The joint seal shall be a labyrinth type seal. The uncompressed depth of the face of the compression seal (that is to be bonded to the joint wall) shall be greater than the uncompressed width of the seal, except that for seals 1 inch or greater in width, the depth need be only 1 inch or greater. The actual width of the uncompressed seal for construction and contraction joints shall be 0.75 or 1 inches and for expansion joints shall be 1.25 inches. The tolerance on the seal shall be plus 1/8 inch or minus 1/16 inch.

2.2 LUBRICANT/ADHESIVE

Lubricant/adhesive used for the compression elastomeric joint seal shall be a one-component compound conforming to ASTM D 2835.

PART 3 EXECUTION

3.1 PREPARATION OF JOINTS

Immediately before installation of the compression joint seal, thoroughly clean the joints to remove laitance, filler, existing sealer, foreign material and protrusions of hardened concrete from the sides and upper edges of the joint space to be sealed. Cleaning shall be by sandblasting or waterblasting and shall extend along pavement surfaces at least 1/2 inch on either side of the joint. After final cleaning and immediately prior to sealing, the joints shall be blown out with compressed air and left completely free of debris and water. Demonstrate that the selected cleaning operation meets the cleanliness requirements. Correct any irregularity in the joint face which would prevent uniform contact between the joint seal and the joint face prior to the installation of the joint seal.

3.1.1 Sawing

Clean and open joints to the specified width and depth by sawing.

Immediately following the sawing operation, thoroughly clean the joint faces and opening using a water jet to remove saw cuttings or debris remaining on the faces or in the joint opening. Install compression seal within 3 calendar days of the time the joint cavity is sawed. Depth of the joint cavity shall be in accordance with [manufacturer's instructions](#). The saw cut for the joint seal cavity shall be centered over the joint line. The nominal width of the sawed joint seal cavity shall be the width of the compression seal plus 1/4 inch.

3.1.2 Sandblast Cleaning

Use a multiple pass sandblasting technique until the surfaces are free of dust, dirt, curing compound, or any residue that might prevent ready insertion or uniform contact of the seal and bonding of the lubricant/adhesive to the concrete.

3.1.3 Waterblast Cleaning

Use a multiple pass waterblast technique until the surfaces are free of dust, dirt, curing compound, or any residue that might prevent ready insertion or uniform contact of the seal and bonding of the lubricant/adhesive to the concrete.

3.1.4 Rate of Progress

Limit sandblasting or waterblasting of joint faces to the length of joint that can be sealed during the same workday.

3.2 INSTALLATION OF THE COMPRESSION SEAL

3.2.1 Time of Installation

Seal joints immediately within 3 calendar days of sawing the joint seal cavity and following concrete cure and the final cleaning of the joint walls. Provide open joints, ready for sealing that cannot be sealed under the specified conditions, with an approved temporary seal to prevent infiltration of foreign material. When rain interrupts the sealing operations, the joints shall be washed, air pressure cleaned, and allowed to dry prior to installing the lubricant/adhesive and compression seal.

3.2.2 Sequence of Installation

Seal first longitudinal joints, followed by transverse joints. Install seals in longitudinal joints so that all transverse joint seals will be intact from edge to edge of the pavement. Intersections shall be made monolithic by use of joint seal adhesive and care in fitting the intersection parts together. Extender pieces of seal shall not be used at intersections. Any seal falling short at the intersection shall be removed and replaced with new seal at no additional cost to the Government. Seals that are required to change direction by more than 20 degrees, may require a poured sealant at the intersection. Poured sealant shall be in accordance with compression seal manufacturer's instructions.

3.3 SEALING OF JOINTS

The sides of the joint seal or the sides of the joint shall be covered with a coating of lubricant/adhesive and the seal installed as specified. Butt joints and seal intersections shall be coated with liberal applications of lubricant/adhesive. Lubricant/adhesive spilled on the pavement shall be

removed immediately to prevent setting on the pavement. The in-place joint seal shall be in an upright position and free from twisting, distortion, and cuts. Adjustments shall be made to the installation equipment and procedure, if the stretch exceeds 1 percent. Any seal exceeding 2 percent stretch shall be removed and replaced. The joint seal shall be placed at a uniform depth within the tolerances specified. In-place joint seal which fails to meet the specified requirements shall be removed and replaced with new joint seal at no cost to the Government. The compression joint seal shall be placed to a depth of $1/4$ inch, plus or minus $1/8$ inch, below the pavement surface except when the joint is beveled or has a radius at the surface, or unless otherwise directed. For beveled joints or joints with a radius at the surface, the compression joint seal shall be installed at a depth of $1/8$ inch, plus or minus $1/8$ inch, below the bottom of the edge of the bevel or radius. No part of the seal shall be allowed to project above the surface of the pavement or above the edge of the bevel or radius. The seal shall be installed in the longest practicable lengths in longitudinal joints and shall be cut at the joint intersections to provide continuous installation of the seal in the transverse joints. The lubricant/adhesive in the longitudinal joints shall be allowed to set for 1 hour prior to cutting at the joint intersections to reduce the possibility of shrinkage. For all transverse joints, the minimum length of the compression joint seal shall be the pavement width from edge to edge.

3.4 CLEAN-UP

Upon completion of the project, remove all unused materials from the site, remove any lubricant/adhesive on the pavement surface, and leave the pavement in clean condition.

3.5 QUALITY CONTROL PROVISIONS

3.5.1 Application Equipment

Inspect the application equipment to assure uniform application of lubricant/adhesive to the sides of the compression joint seal or the walls of the joint. If any equipment causes cutting, twisting, nicking, excessive stretching or compressing of the seal, or improper application of the lubricant/adhesive, suspend the operation until causes of the deficiencies are determined and corrected.

3.5.2 Procedures

3.5.2.1 Quality Control Inspection

Provide quality control provisions during the joint cleaning process to prevent or correct improper equipment and cleaning techniques that damage the concrete in any manner. Cleaned joints shall be approved by the Government prior to installation of the lubricant/adhesive and compression joint seal.

3.5.2.2 Conformance to Stretching and Compression Limitations

Determine conformance to stretching and compression limitations. Mark the top surface of the compression seal at 1 foot intervals in a manner clear and durable to enable length determinations of the seal. After installation, measure the distance between the marks on the seal. If the stretching or compression exceeds 2 percent, remove the seal and replace it with new joint at no additional cost to the Government. The seal shall be removed up to the last correct measurement. The seal shall be inspected a

minimum of once per 400 feet of seal for compliance to the shrinkage or compression requirements. Measurements shall also be made at the same interval to determine conformance with depth and width of installation requirements. Remove and replace compression seal that is not in conformance with specification requirements with new joint seal at no additional cost to the Government.

3.5.2.3 Pavement Temperature

Determine the pavement temperature by placing a thermometer in the initial saw cut for the joint and record the reading. The thermometer shall remain in the joint for an adequate time to provide a control reading.

3.5.3 Final Inspection

Inspect the joint sealing system (compression seal and lubricant/adhesive) for proper rate of cure and bonding to the concrete, cuts, twists, nicks and other deficiencies. Seals exhibiting any defects, at any time prior to final acceptance of the project, shall be removed from the joint, wasted, and replaced in a satisfactory manner.

-- End of Section --

SECTION 32 16 13

CONCRETE SIDEWALKS AND CURBS AND GUTTERS

04/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 182 (2005; R 2009) Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

ASTM INTERNATIONAL (ASTM)

ASTM A185/A185M (2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

ASTM A615/A615M (2009b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM C 143/C 143M (2010) Standard Test Method for Slump of Hydraulic-Cement Concrete

ASTM C 171 (2007) Standard Specification for Sheet Materials for Curing Concrete

ASTM C 173/C 173M (2010b) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

ASTM C 309 (2007) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

ASTM C 31/C 31M (2010) Standard Practice for Making and Curing Concrete Test Specimens in the Field

ASTM C 920 (2011) Standard Specification for Elastomeric Joint Sealants

ASTM C172/C172M (2010) Standard Practice for Sampling Freshly Mixed Concrete

ASTM C231/C231M (2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

ASTM D 1751 (2004; R 2008) Standard Specification for

Preformed Expansion Joint Filler for
Concrete Paving and Structural
Construction (Nonextruding and Resilient
Bituminous Types)

ASTM D 1752

(2004a; R 2008) Standard Specification for
Preformed Sponge Rubber Cork and Recycled
PVC Expansion

ASTM D5893/D5893M

(2010) Cold Applied, Single Component,
Chemically Curing Silicone Joint Sealant
for Portland Cement Concrete Pavements

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

Provide plant, equipment, machines, and tools used in the work subject to approval and maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The Contracting Officer shall have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

1.2.2 Slip Form Equipment

Slip form paver or curb forming machine, will be approved based on trial use on the job and shall be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in 1 pass.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Concrete

Copies of certified delivery tickets for all concrete used in the construction.

SD-06 Test Reports

Field Quality Control

Copies of all test reports within 24 hours of completion of the test.

1.4 ENVIRONMENTAL REQUIREMENTS

1.4.1 Placing During Cold Weather

Do not place concrete when the air temperature reaches 40 degrees F and is falling, or is already below that point. Placement may begin when the air temperature reaches 35 degrees F and is rising, or is already above 40 degrees F. Make provisions to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F, placement and protection shall be approved in writing. Approval will be contingent upon full conformance with the following provisions. The underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. Mixing water and aggregates shall be heated as necessary to result in the temperature of the in-place concrete being between 50 and 85 degrees F. Methods and equipment for heating shall be approved. The aggregates shall be free of ice, snow, and frozen lumps before entering the mixer. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

1.4.2 Placing During Warm Weather

The temperature of the concrete as placed shall not exceed 85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. The placing temperature shall not exceed 95 degrees F at any time.

PART 2 PRODUCTS

2.1 CONCRETE

Provide concrete conforming to the applicable requirements of Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE except as otherwise specified. Concrete shall have a minimum compressive strength of 3500 psi at 28 days. Maximum size of aggregate shall be 1-1/2 inches.

2.1.1 Air Content

Mixtures shall have air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.

2.1.2 Slump

The concrete slump shall be 2 inches plus or minus 1 inch where determined in accordance with ASTM C 143/C 143M.

2.1.3 Reinforcement Steel

Reinforcement bars shall conform to ASTM A615/A615M. Wire mesh reinforcement shall conform to ASTM A185/A185M.

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Impervious sheet materials shall conform to ASTM C 171, type optional,

except that polyethylene film, if used, shall be white opaque.

2.2.2 Burlap

Burlap shall conform to [AASHTO M 182](#).

2.2.3 White Pigmented Membrane-Forming Curing Compound

White pigmented membrane-forming curing compound shall conform to [ASTM C 309](#), Type 2.

2.3 CONCRETE PROTECTION MATERIALS

Concrete protection materials shall be a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the Contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

2.4 JOINT FILLER STRIPS

2.4.1 Contraction Joint Filler for Curb and Gutter

Contraction joint filler for curb and gutter shall consist of hard-pressed fiberboard.

2.4.2 Expansion Joint Filler, Premolded

Expansion joint filler, premolded, shall conform to [ASTM D 1751](#) or [ASTM D 1752](#), [1/2 inch](#) thick, unless otherwise indicated.

2.5 JOINT SEALANTS

Joint sealant, cold-applied shall conform to [ASTM C 920](#) or [ASTM D5893/D5893M](#).

2.6 FORM WORK

Design and construct form work to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete. Wood forms shall be surfaced plank, [2 inches](#) nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Wood forms shall have a nominal length of [10 feet](#). Radius bends may be formed with [3/4 inch](#) boards, laminated to the required thickness. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Ends of steel forms shall be interlocking and self-aligning. Steel forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms shall have a nominal length of [10 feet](#) with a minimum of 3 welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.6.1 Sidewalk Forms

Sidewalk forms shall be of a height equal to the full depth of the finished sidewalk.

2.6.2 Curb and Gutter Forms

Curb and gutter outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. Rigid forms shall be provided for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1-1/2 inch benders, for the full height of the curb, cleated together. In lieu of inside forms for curbs, a curb "mule" may be used for forming and finishing this surface, provided the results are approved.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

The subgrade shall be constructed to the specified grade and cross section prior to concrete placement. Subgrade shall be placed and compacted as directed .

3.1.1 Sidewalk Subgrade

The subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

3.1.2 Curb and Gutter Subgrade

The subgrade shall be tested for grade and cross section by means of a template extending the full width of the curb and gutter. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3 Maintenance of Subgrade

The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected to produce a subgrade free from frost when the concrete is deposited.

3.2 FORM SETTING

Set forms to the indicated alignment, grade and dimensions. Hold forms rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Clamps, spreaders, and braces shall be used where required to ensure rigidity in the forms. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete found defective after form removal shall be promptly and satisfactorily repaired. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.2.1 Sidewalks

Set forms for sidewalks with the upper edge true to line and grade with an allowable tolerance of $1/8$ inch in any 10 foot long section. After forms are set, grade and alignment shall be checked with a 10 foot straightedge. Forms shall have a transverse slope as indicated with the low side adjacent to the roadway. Side forms shall not be removed for 12 hours after finishing has been completed.

3.2.2 Curbs and Gutters

The forms of the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished, as specified for concrete finishing. Gutter forms shall not be removed while the concrete is sufficiently plastic to slump in any direction.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Place concrete in the forms in one layer. When consolidated and finished, the sidewalks shall be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated by tamping and spading or with an approved vibrator, and the surface shall be finished to grade with a strike off.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, finish the surface with a wood or magnesium float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

3.3.3 Edge and Joint Finishing

All slab edges, including those at formed joints, shall be finished with an edger having a radius of $1/8$ inch. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

3.3.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than $5/16$ inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to $1/4$ inch.

3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Curb and Gutter

Concrete shall be placed to the section required in a single lift.

Consolidation shall be achieved by using approved mechanical vibrators. Curve shaped gutters shall be finished with a standard curb "mule".

3.4.2 Curb and Gutter Finishing

Approved slipformed curb and gutter machines may be used in lieu of hand placement.

3.4.3 Concrete Finishing

Exposed surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of $1/2$ inch. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The front curb surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float.

3.4.4 Joint Finishing

Curb edges at formed joints shall be finished as indicated.

3.4.5 Surface and Thickness Tolerances

Finished surfaces shall not vary more than $1/4$ inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to $1/4$ inch.

3.5 SIDEWALK JOINTS

Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 10 feet or more in width. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated. Expansion joints are not required between sidewalks and curb that abut the sidewalk longitudinally.

3.5.1 Sidewalk Contraction Joints

The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a $1/8$ inch blade to the depth indicated. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.

3.5.2 Sidewalk Expansion Joints

Expansion joints shall be formed with 1/2 inch joint filler strips. Joint filler in expansion joints surrounding structures and features within the sidewalk may consist of preformed filler material conforming to ASTM D 1752 or building paper. Joint filler shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 1/8 inch, and concrete over the joint filler shall be removed. At the end of the curing period, expansion joints shall be cleaned and filled with cold-applied joint sealant. Joint sealant shall be gray or stone in color. Joints shall be sealed as specified in Section 32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS.

3.5.3 Reinforcement Steel Placement

Reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.

3.6 CURB AND GUTTER JOINTS

Curb and gutter joints shall be constructed at right angles to the line of curb and gutter.

3.6.1 Contraction Joints

Contraction joints shall be constructed directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length.

a. Contraction joints (except for slip forming) shall be constructed by means of 1/8 inch thick separators and of a section conforming to the cross section of the curb and gutter. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

b. When slip forming is used, the contraction joints shall be cut in the top portion of the gutter/curb hardened concrete in a continuous cut across the curb and gutter, using a power-driven saw. The depth of cut shall be at least one-fourth of the gutter/curb depth and 1/8 inch in width.

3.6.2 Expansion Joints

Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement, and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints at least 1/2 inch in width shall be provided at intervals not less than 30 feet nor greater than 120 feet. Expansion joints shall be provided in nonreinforced concrete gutter at locations indicated. Expansion joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. Joints shall be sealed as specified in Section 32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN

RIGID PAVEMENTS.

3.7 CURING AND PROTECTION

3.7.1 General Requirements

Protect concrete against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

3.7.1.1 Mat Method

The entire exposed surface shall be covered with 2 or more layers of burlap. Mats shall overlap each other at least 6 inches. The mat shall be thoroughly wetted with water prior to placing on concrete surface and shall be kept continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

3.7.1.2 Impervious Sheeting Method

The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 12 inches when a continuous sheet is not used. The curing medium shall not be less than 18-inches wider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or a bank of moist earth placed along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

3.7.1.3 Membrane Curing Method

A uniform coating of white-pigmented membrane-curing compound shall be applied to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Formed surfaces shall be coated immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Concrete shall not be allowed to dry before the application of the membrane. If any drying has occurred, the surface of the concrete shall be moistened with a fine spray of water and the curing compound applied as soon as the free water disappears. Curing compound shall be applied in two coats by hand-operated pressure sprayers at a coverage of approximately 200 square feet/gallon for the total of both coats. The second coat shall be applied in a direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, an additional coat shall be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be resprayed. Necessary precautions shall be taken to insure that the concrete is properly cured at sawed joints, and that no

curing compound enters the joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed before the concrete in the region of the joint is resprayed with curing compound. The method used for sealing the joint groove shall prevent loss of moisture from the joint during the entire specified curing period. Approved standby facilities for curing concrete pavement shall be provided at a location accessible to the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from any other possible damage to the continuity of the membrane.

3.7.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

3.7.3 Protection

Completed concrete shall be protected from damage until accepted. Repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

3.7.4 Protective Coating

Protective coating, of linseed oil mixture, shall be applied to the exposed-to-view concrete surface after the curing period, if concrete will be exposed to de-icing chemicals within 6 weeks after placement. Concrete to receive a protective coating shall be moist cured.

3.7.4.1 Application

Curing and backfilling operation shall be completed prior to applying two coats of protective coating. Concrete shall be surface dry and clean before each application. Coverage shall be by spray application at not more than 50 square yards/gallon for first application and not more than 70 square yards/gallon for second application, except that the number of applications and coverage for each application for commercially prepared mixture shall be in accordance with the manufacturer's instructions. Coated surfaces shall be protected from vehicular and pedestrian traffic until dry.

3.7.4.2 Precautions

Protective coating shall not be heated by direct application of flame or electrical heaters and shall be protected from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Material shall not be applied at ambient or material temperatures lower than 50 degrees F.

3.8 FIELD QUALITY CONTROL

3.8.1 General Requirements

Perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met.

3.8.2 Concrete Testing

3.8.2.1 Strength Testing

Provide molded concrete specimens for strength tests. Samples of concrete placed each day shall be taken not less than once a day nor less than once for every 250 cubic yards of concrete. The samples for strength tests shall be taken in accordance with ASTM C172/C172M. Cylinders for acceptance shall be molded in conformance with ASTM C 31/C 31M by an approved testing laboratory. Each strength test result shall be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.

3.8.2.2 Air Content

Determine air content in accordance with ASTM C 173/C 173M or ASTM C231/C231M. ASTM C231/C231M shall be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each shift. Additional tests shall be made when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.8.2.3 Slump Test

Two slump tests shall be made on randomly selected batches of each class of concrete for every 250 cubic yards, or fraction thereof, of concrete placed during each shift. Additional tests shall be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

3.8.3 Thickness Evaluation

The anticipated thickness of the concrete shall be determined prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, the subgrade shall be true to grade prior to concrete placement and the thickness will be determined by measuring each edge of the completed slab.

3.8.4 Surface Evaluation

The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks.

3.9 SURFACE DEFICIENCIES AND CORRECTIONS

3.9.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than $1/4$ inch the deficient section will be removed, between regularly scheduled joints, and replaced.

3.9.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed $1/4$ inch. Pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

3.9.3 Appearance

Exposed surfaces of the finished work will be inspected by the Government and any deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

-- End of Section --

SECTION 32 17 24.00 10

PAVEMENT MARKINGS

04/08

PART 1 GENERAL

1.1 UNIT PRICES

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 247 (2009) Standard Specification for Glass
Beads Used in Pavement Markings

ASTM INTERNATIONAL (ASTM)

ASTM D 4280 (2008) Extended Life Type, Nonplowable,
Raised, Retroreflective Pavement Markers

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-B-1325 (Rev D) Beads (Glass Spheres)
Retro-Reflective (Metric)

FS TT-P-1952 (Rev E) Paint, Traffic and Airfield
Markings, Waterborne

1.3 SYSTEM DESCRIPTION

All machines, tools and equipment used in the performance of the work shall be approved and maintained in satisfactory operating condition. Equipment operating on roads and runways shall display low speed traffic markings and traffic warning lights.

1.3.1 Paint Application Equipment

1.3.1.1 Self-Propelled or Mobile-Drawn Pneumatic Spraying Machines

The equipment to apply paint to pavements shall be a self-propelled or mobile-drawn pneumatic spraying machine with suitable arrangements of atomizing nozzles and controls to obtain the specified results. The machine shall have a speed during application not less than 5 mph, and shall be capable of applying the stripe widths indicated, at the paint coverage rate specified in paragraph APPLICATION, and of even uniform thickness with clear-cut edges. The equipment used to apply the paint binder to airfield pavements shall be a self-propelled or mobile-drawn pneumatic spraying machine with an arrangement of atomizing nozzles capable of applying a line width at any one time in multiples of 6 inches, from 6 inches to 36 inches. The paint applicator shall have paint reservoirs or tanks of sufficient capacity and suitable gauges to apply paint in

accordance with requirements specified. Tanks shall be equipped with suitable air-driven mechanical agitators. The spray mechanism shall be equipped with quick-action valves conveniently located, and shall include necessary pressure regulators and gauges in full view and reach of the operator. Paint strainers shall be installed in paint supply lines to ensure freedom from residue and foreign matter that may cause malfunction of the spray guns. The paint applicator shall be readily adaptable for attachment of an air-actuated dispenser for the reflective media approved for use. Pneumatic spray guns shall be provided for hand application of paint in areas where the mobile paint applicator cannot be used.

1.3.1.2 Hand-Operated, Push-Type Machines

All machines, tools, and equipment used in performance of the work shall be approved and maintained in satisfactory operating condition. Hand-operated push-type machines of a type commonly used for application of paint to pavement surfaces will be acceptable for marking small streets and parking areas. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles, and shall be capable of applying paint uniformly at coverage specified. Sandblasting equipment shall be provided as required for cleaning surfaces to be painted. Hand-operated spray guns shall be provided for use in areas where push-type machines cannot be used.

1.3.2 Reflective Media Dispenser

The dispenser for applying the reflective media shall be attached to the paint dispenser and shall operate automatically and simultaneously with the applicator through the same control mechanism. The dispenser shall be capable of adjustment and designed to provide uniform flow of reflective media over the full length and width of the stripe at the rate of coverage specified in paragraph APPLICATION, at all operating speeds of the applicator to which it is attached.

1.3.3 Surface Preparation Equipment

1.3.3.1 Sandblasting Equipment

Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall be capable of furnishing not less than 150 cfm of air at a pressure of not less than 90 psi at each nozzle used, and shall be equipped with traps that will maintain the compressed air free of oil and water.

1.3.3.2 Waterblast Equipment

The water pressure shall be specified at 2600 psi at 140 degrees F in order to adequately clean the surfaces to be marked.

1.3.4 Marking Removal Equipment

Equipment shall be mounted on rubber tires and shall be capable of removing markings from the pavement without damaging the pavement surface or joint sealant. Waterblasting equipment shall be capable of producing an adjustable, pressurized stream of water. Sandblasting equipment shall include an air compressor, hoses, and nozzles. The compressor shall be equipped with traps to maintain the air free of oil and water.

1.3.4.1 Shotblasting Equipment

Shotblasting equipment shall be capable of producing an adjustable depth of removal of marking and pavement. Each unit shall be self-cleaning and self-contained, shall be able to confine dust and debris from the operation, and shall be capable of recycling the abrasive for reuse.

1.3.4.2 Chemical Equipment

Chemical equipment shall be capable of application and removal of chemicals from the pavement surface, and shall leave only non-toxic biodegradable residue.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment; G

Lists of proposed equipment, including descriptive data, and notifications of proposed Contractor actions as specified in this section. List of removal equipment shall include descriptive data indicating area of coverage per pass, pressure adjustment range, tank and flow capacities, and safety precautions required for the equipment operation.

Composition Requirements

Manufacturer's current printed product description and Material Safety Data Sheets (MSDS) for each type paint/color proposed for use.

Qualifications

Documentation on personnel qualifications, as specified.

SD-06 Test Reports

Sampling and Testing

Certified copies of the test reports, prior to the use of the materials at the jobsite. Testing shall be performed in an approved independent laboratory.

SD-07 Certificates

Volatile Organic Compound (VOC)

Certificate stating that the proposed pavement marking paint meets the VOC regulations of the local Air Pollution Control District having jurisdiction over the geographical area in which the project is located.

1.5 QUALITY ASSURANCE

1.5.1 Qualifications

Submit documentation certifying that pertinent personnel are qualified for equipment operation and handling of chemicals.

1.5.2 Traffic Controls

Suitable warning signs shall be placed near the beginning of the worksite and well ahead of the worksite for alerting approaching traffic from both directions. Small markers shall be placed along newly painted lines or freshly placed raised markers to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Painting equipment shall be marked with large warning signs indicating slow-moving painting equipment in operation.

1.5.3 Maintenance of Traffic

1.5.3.1 Airfield

The performance of work in the controlled zones of airfields shall be coordinated with the Contracting Officer and with the Flight Operations Officer. Verbal communications shall be maintained with the control tower before and during work in the controlled zones of the airfield. The control tower shall be advised when the work is completed. A radio for this purpose shall be provided by the Contractor and approved by the Contracting Officer.

1.5.3.2 Roads, Streets, and Parking Areas

When traffic must be rerouted or controlled to accomplish the work, the necessary warning signs, flagpersons, and related equipment for the safe passage of vehicles shall be provided.

1.6 DELIVERY, STORAGE, AND HANDLING

All materials shall be delivered and stored in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's name, and directions, all of which shall be plainly legible at time of use.

1.7 ENVIRONMENTAL REQUIREMENTS

Pavement surface shall be free of snow, ice, or slush. Surface temperature shall be at least 40 degrees F and rising at the beginning of operations, except those involving shot or sand blasting. Operation shall cease during thunderstorms. Operation shall cease during rainfall, except for waterblasting and removal of previously applied chemicals. Waterblasting shall cease where surface water accumulation alters the effectiveness of material removal.

PART 2 PRODUCTS

2.1 PAINT

The paint shall be homogeneous, easily stirred to smooth consistency, and shall show no hard settlement or other objectionable characteristics during a storage period of 6 months. Paints for airfields, roads, parking areas,

and streets shall conform to [FS TT-P-1952](#), color as indicated . Pavement marking paints shall comply with applicable state and local laws enacted to ensure compliance with Federal Clean Air Standards. Paint materials shall conform to the restrictions of the local Air Pollution Control District.

2.2 RAISED REFLECTIVE MARKERS

Either metallic or nonmetallic markers of the button or prismatic reflector type may be used. Markers shall be of permanent colors, as specified for pavement marking, and shall retain the color and brightness under the action of traffic. Button markers shall have a diameter of not less than [4 inches](#), and shall be spaced not more than [40 feet](#) apart on solid longitudinal lines. Broken centerline marker spacings shall be in segments indicated with gaps indicated between segments. Markers shall have rounded surfaces presenting a smooth contour to traffic and shall not project more than [3/4 inch](#) above level of pavement. Pavement markers and adhesive epoxy shall conform to [ASTM D 4280](#).

2.3 REFLECTIVE MEDIA

Reflective media for airfields shall conform to [FS TT-B-1325](#), Type I, Gradation A. Reflective media for roads and streets shall conform to [FS TT-B-1325](#), Type I, Gradation A or [AASHTO M 247](#), Type I.

2.4 SAMPLING AND TESTING

Materials proposed for use shall be stored on the project site in sealed and labeled containers, or segregated at source of supply, sufficiently in advance of needs to allow 60 days for testing. Upon notification by the Contractor that the material is at the site or source of supply, a sample shall be taken by random selection from sealed containers in the presence of the Contracting Officer. Samples shall be clearly identified by designated name, specification number, batch number, manufacturer's formulation number, project contract number, intended use, and quantity involved. Testing shall be performed in an approved independent laboratory. If materials are approved based on reports furnished by the Contractor, samples will be retained by the Government for possible future testing should the material appear defective during or after application.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Thoroughly clean surfaces to be marked before application of the pavement marking material. Dust, dirt, and other granular surface deposits shall be removed by sweeping, blowing with compressed air, rinsing with water or a combination of these methods as required. Rubber deposits, surface laitance, existing paint markings, and other coatings adhering to the pavement shall be completely removed with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion as directed. Areas of old pavement affected with oil or grease shall be scrubbed with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinsed thoroughly after each application. After cleaning, oil-soaked areas shall be sealed with cut shellac to prevent bleeding through the new paint. Pavement surfaces shall be allowed to dry, when water is used for cleaning, prior to striping or marking. Surfaces shall be re-cleaned, when work has been stopped due to rain.

3.1.1 Pretreatment for Early Painting

Where early painting is required on rigid pavements, apply a pretreatment with an aqueous solution, containing 3 percent phosphoric acid and 2 percent zinc chloride, to prepared pavement areas prior to painting.

3.1.2 Cleaning Existing Pavement Markings

In general, markings shall not be placed over existing pavement marking patterns. Remove existing pavement markings, which are in good condition but interfere or conflict with the newly applied marking patterns. Deteriorated or obscured markings that are not misleading or confusing or interfere with the adhesion of the new marking material do not require removal. New preformed and thermoplastic pavement markings shall not be applied over existing preformed or thermoplastic markings. Whenever grinding, scraping, sandblasting or other operations are performed the work must be conducted in such a manner that the finished pavement surface is not damaged or left in a pattern that is misleading or confusing. When these operations are completed the pavement surface shall be blown off with compressed air to remove residue and debris resulting from the cleaning work.

3.1.3 Cleaning Concrete Curing Compounds

On new portland cement concrete pavements, cleaning operations shall not begin until a minimum of 30 days after the placement of concrete. All new concrete pavements shall be cleaned by either sandblasting or water blasting. When water blasting is performed, thermoplastic and preformed markings shall be applied no sooner than 24 hours after the blasting has been completed. The extent of the blasting work shall be to clean and prepare the concrete surface as follows:

- a. There is no visible evidence of curing compound on the peaks of the textured concrete surface.
- b. There are no heavy puddled deposits of curing compound in the valleys of the textured concrete surface.
- c. All remaining curing compound is intact; all loose and flaking material is removed.
- d. The peaks of the textured pavement surface are rounded in profile and free of sharp edges and irregularities.
- e. The surface to be marked is dry.

3.2 APPLICATION

All pavement markings and patterns shall be placed as shown on the plans.

3.2.1 Paint

Paint shall be applied to clean, dry surfaces, and only when air and pavement temperatures are above 40 degrees F and less than 95 degrees F. Paint temperature shall be maintained within these same limits. New asphalt pavement surfaces and new Portland concrete cement shall be allowed to cure for a period of not less than 30 days before applications of paint. Paint shall be applied pneumatically with approved equipment at rate of coverage specified. Provide guide lines and templates as

necessary to control paint application. Special precautions shall be taken in marking numbers, letters, and symbols. Edges of markings shall be sharply outlined.

3.2.1.1 Rate of Application

- a. Reflective Markings: Pigmented binder shall be applied evenly to the pavement area to be coated at a rate of 105 plus or minus 5 square feet/gallon. Glass spheres shall be applied uniformly to the wet paint on airfield pavement at a rate of 8 plus or minus 0.5 pounds of glass spheres per gallon of paint.
- b. Nonreflective Markings: Paint shall be applied evenly to the pavement surface to be coated at a rate of 105 plus or minus 5 square feet/gallon.

3.2.1.2 Drying

The maximum drying time requirements of the paint specifications will be strictly enforced to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. If there is a delay in drying of the markings, painting operations shall be discontinued until cause of the slow drying is determined and corrected.

3.2.2 Raised Reflective Markers

Prefabricated markers shall be aligned carefully at the required spacing and permanently fixed in place by means of epoxy resin adhesives. To insure good bond, pavement in areas where markers will be set shall be thoroughly cleaned by sandblasting and use of compressed air prior to applying adhesive.

3.2.3 Reflective Media

Application of reflective media shall immediately follow application of pigmented binder. Drop-on application of glass spheres shall be accomplished to insure that reflective media is evenly distributed at the specified rate of coverage. Should there be malfunction of either paint applicator or reflective media dispenser, operations shall be discontinued immediately until deficiency is corrected.

3.3 MARKING REMOVAL

Pavement marking, shall be removed in the areas shown on the drawings. Removal of marking shall be as complete as possible without damage to the surface. Aggregate shall not be exposed by the removal process. After the markings are removed, the cleaned pavement surfaces shall exhibit adequate texture for remarking as specified in paragraph SURFACE PREPARATION. Demonstrate removal of pavement marking in an area designated by the Contracting Officer. The demonstration area will become the standard for the remainder of the work.

3.3.1 Equipment Operation

Equipment shall be controlled and operated to remove markings from the pavement surface, prevent dilution or removal of binder from underlying pavement, and prevent emission of blue smoke from asphalt or tar surfaces.

3.3.2 Cleanup and Waste Disposal

The worksite shall be kept clean of debris and waste from the removal operations. Cleanup shall immediately follow removal operations in areas subject to air traffic. Debris shall be disposed of at approved sites.

-- End of Section --

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

08/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

- | | |
|-----------------|---|
| ASTM A116 | (2005) Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric |
| ASTM A153/A153M | (2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| ASTM A702 | (1989; R 2006) Standard Specification for Steel Fence Posts and Assemblies, Hot Wrought |
| ASTM A780/A780M | (2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings |
| ASTM A90/A90M | (2009) Standard Test Method for Weight of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings |
| ASTM C 94/C 94M | (2010a) Standard Specification for Ready-Mixed Concrete |
| ASTM F 1043 | (2011) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework |
| ASTM F 1083 | (2010) Standard Specification for Pipe, Steel, Hot-Dipped Zinc Coated (Galvanized) Welded, for Fence Structures |
| ASTM F 567 | (2011) Standard Practice for Installation of Chain Link Fence |
| ASTM F 626 | (2008) Standard Specification for Fence Fittings |
| ASTM F 883 | (2009) Padlocks |

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

- | | |
|---------------|--|
| FS RR-F-191/3 | (Rev E; Am 1) Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces) |
|---------------|--|

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fence Assembly; G

Location of Gate, Corner, End, and Pull Posts; G

Gate Assembly; G

Gate Hardware and Accessories; G

Erection/Installation Drawings; G

SD-03 Product Data

Fence Assembly; G

Gate Assembly; G

Gate Hardware and Accessories; G

Recycled Material Content; G

Zinc Coating; G

PVC Coating; G

Aluminum Alloy Coating; G

Fabric; G

Stretcher Bars; G

Concrete; G

SD-04 Samples

Fabric; G

Posts; G

Braces; G

Line Posts; G

Sleeves; G

Top Rail; G

Bottom Rail; G

Tension Wire; G

Stretcher Bars; G

Gate Posts; G

Gate Hardware and Accessories; G

Padlocks; G

Wire Ties; G

SD-07 Certificates

Certificates of Compliance; G

SD-08 Manufacturer's Instructions

Fence Assembly; G

Gate Assembly; G

Hardware Assembly; G

Accessories; G

1.3 ASSEMBLY AND INSTALLATION INSTRUCTIONS

Submit manufacturer's [erection/installation drawings](#) and instructions that detail proper assembly and materials in the design for fence, gate, hardware and accessories.

Submit erection/installation drawings along with manufacturer's catalog data for complete [fence assembly](#), [gate assembly](#), [hardware assembly](#) and [accessories](#).

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to site in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact.

1.5 QUALITY ASSURANCE

1.5.1 Required Report Data

Submit reports of listing of chain-link fencing and accessories regarding weight in [ounces](#) for zinc coating, thickness of [PVC coating](#), and chemical composition and thickness of [aluminum alloy coating](#).

1.5.2 Certificates of Compliance

Submit [certificates of compliance](#) in accordance with the applicable reference standards and descriptions of this section for the following:

- a. Zinc coating
- b. PVC coating
- c. Aluminum alloy coating

- d. Fabric
- e. Stretcher bars
- f. Gate hardware and accessories
- g. Concrete

PART 2 PRODUCTS

2.1 GENERAL

Provide fencing materials conforming to the requirements of [ASTM A116](#), [ASTM A702](#), [ASTM F 626](#), and as specified.

Submit manufacturer's data indicating percentage of [recycled material content](#) in protective fence materials, including chain link fence, fabric, and gates to verify affirmative procurement compliance.

2.2 ZINC COATING

Provide hot-dip galvanized (after fabrication) ferrous-metal components and accessories, except as otherwise specified.

Provide zinc coating of weight not less than [1.94 ounces per square foot](#), as determined from the average result of two specimens, when tested in accordance with [ASTM A90/A90M](#).

Provide zinc coating conforming to the requirements of the following:

- a. Pipe: [FS RR-F-191/3](#) Class 1 Grade A in accordance with [ASTM F 1083](#) .
- b. Hardware and accessories: [ASTM A153/A153M](#), Table 1
- c. Surface: [ASTM F 1043](#)
- d. External: Type B-B surface zinc with organic coating, [0.97 ounce per square foot](#) minimum thickness of acrylated polymer.
- e. Internal: Surface zinc coating of [0.97 ounce per square foot](#) minimum.

Provide galvanizing repair material that is cold-applied zinc-rich coating conforming to [ASTM A780/A780M](#).

2.3 FABRIC

Provide fabric consisting of [No. 9-gage](#) wires woven into a [1-inch](#) diamond mesh, with dimensions of fabric and wire conforming to [ASTM A116](#), [ASTM A702](#) and [ASTM F 626](#), with [2.0 ounces per square foot](#) zinc galvanizing.

Provide one-piece fabric widths for fence heights up to [12 feet](#).

2.4 TOP AND BOTTOM SELVAGES

Provide knuckled selvages at top and bottom for fabric with [2 inch](#) mesh and up to [60 inches](#) high, and if over [60 inches](#) high, provide twisted and barbed top selvage and knuckled bottom selvage.

Knuckle top and bottom selvages for 1-3/4-inch and 1-inch mesh fabric.

2.5 LINE POSTS

Minimum acceptable line posts are as follows:

Up to 6-feet high:

Grade A: 1.900 inch O.D. pipe weighing 2.72 pounds per linear foot.

Grade B: 2.375 inch O.D. pipe weighing 3.12 pounds per linear foot.

Over 6-feet high:

2.0 inch O.D. pipe weighing 3.65 pounds per linear foot.

2.6 END, CORNER, AND PULL POSTS

Provide minimally acceptable end, corner, and pull posts as follows:

Up to 6 feet high:

Grade A: 2.375 inch O.D. pipe weighing 3.65 pounds per linear foot.

Grade B: 2.375 inch O.D. pipe weighing 3.12 pounds per linear foot.

Over 6 feet high:

Grade A: 2.875 inch O.D. pipe weighing 5.79 pounds per linear foot.

Grade B: 2.875 inch O.D. pipe weighing 4.64 pounds per linear foot.

2.7 SLEEVES

Provide sleeves for setting into concrete construction of the same material as post sections, sized 1-inch greater than the diameter or dimension of the post. Weld flat plates to each sleeve base to provide anchorage and prevent intrusion of concrete.

2.8 TOP RAIL

Provide a minimum of 1.660 inches O.D. pipe rails. Provide expansion couplings 6-inches long at each joint in top rails.

2.9 CENTER RAILS BETWEEN LINE POSTS

For fencing over 6-feet high, provide 1.660 inches O.D. pipe center rails, Grade A weighing 2.27 pounds per linear foot

2.10 POST-BRACE ASSEMBLY

Provide bracing consisting of 1.660 inches O.D. pipe Grade A weighing 2.27 pounds per linear foot and 3/8 inch adjustable truss rods and turnbuckles.

2.11 TENSION WIRE

Provide galvanized wire, No. 7-gage, coiled spring wire, provided at the bottom of the fabric only. Provide zinc coating that weighs not less than 2.0 ounces per square foot.

2.12 STRETCHER BARS

Provide bars that have one-piece lengths equal to the full height of the fabric with a minimum cross section of 3/16 by 3/4 inch, in accordance with ASTM A116, ASTM A702 and ASTM F 626.

2.13 POST TOPS

Provide tops that are steel, wrought iron, or malleable iron designed as a weathertight closure cap. Provide one cap for each post, unless equal protection is provided by a combination post-cap and barbed-wire supporting arm. Provide caps with an opening to permit through passage of the top rail.

2.14 STRETCHER BAR BANDS

Provide bar bands for securing stretcher bars to posts that are steel, wrought iron, or malleable iron spaced not over 15 inches on center. Bands may also be used in conjunction with special fittings for securing rails to posts. Provide bands with projecting edges chamfered or eased.

2.15 GATE POSTS

Provide a gate post for supporting each gate leaf as follows:

Up to 6-feet wide:

2.875 inch O.D. pipe Grade A weighing 5.79 pounds per linear foot.

Over 6 feet wide and up to 13 feet wide:

2.875 inch O.D. pipe Grade A weighing 5.79 pounds per linear foot.

Over 13-feet and up to 18-feet wide:

Provide 6.625 inch O.D. pipe weighing 18.97 pounds per linear foot.

Over 18-feet wide:

Provide 8.625 inch O.D. pipe weighing 24.70 pounds per linear foot.

2.16 GATES

For gate leaves up to 6-feet high or 6-feet wide, provide perimeter gate frames of 1.66 inch O.D. pipe Grade A weighing 2.27 pounds per linear foot.

For gate leaves over 6 feet high or 6 feet wide, provide perimeter gate frames of 1.90 inch O.D. pipe Grade A weighing 2.72 pounds per linear foot.

Provide gate frame assembly that is welded or assembled with special malleable or pressed-steel fittings and rivets to provide rigid connections. Install fabric with stretcher bars at vertical edges; stretcher bars may also be used at top and bottom edges. Attach stretcher bars and fabric to gate frames on all sides at intervals not exceeding 15 inches. Attach hardware with rivets or by other means which provides equal security against breakage or removal.

Provide diagonal cross-bracing, consisting of 3/8-inch diameter adjustable-length truss rods on welded gate frames, where necessary to

obtain frame rigidity without sag or twist. Provide nonwelded gate frames with diagonal bracing.

2.17 GATE HARDWARE AND ACCESSORIES

Provide gate hardware and accessories that conforms to [ASTM A116](#), [ASTM A702](#), [ASTM F 626](#), and be as specified:

Provide forged steel hinges to suit gate size, non-lift-off type, offset to permit 180-degree opening.

Provide latch that permits operation from either side of the gate, with a padlock eye provided as an integral part of the latch.

Provide stops and holders of malleable iron for vehicular gates. Provide stops that automatically engage the gate and hold it in the open position until manually released.

Provide manufacturer's standard heavy-duty track ball bearing hanger sheaves, overhead framing and supports, guides, stays, bracing, and accessories as required for easy operation of manual sliding gates.

2.18 MISCELLANEOUS HARDWARE

Provide miscellaneous hot-dip galvanized hardware as required.

2.19 WIRE TIES

Provide 16-gage galvanized steel wire for tying fabric to line posts, spaced 12 inches on center. For tying fabric to rails and braces, space wire ties 24 inches on center. For tying fabric to tension wire, space 0.105-inch hog rings 24 inches on center.

Manufacturer's standard procedure will be accepted if of equal strength and durability.

Provide wire ties constructed of the same material as the fencing fabric. Provide accessories with polyvinyl (PVC) coatings similar to that specified for chain-link fabric or framework.

2.20 CONCRETE

Provide concrete conforming to [ASTM C 94/C 94M](#), and obtaining a minimum 28-day compressive strength of 3,000 psi.

2.21 GROUT

Provide grout of proportions one part portland cement to three parts clean, well-graded sand and a minimum amount of water to produce a workable mix.

2.22 PADLOCKS

Provide padlocks conforming to [ASTM F 883](#), with chain.

PART 3 EXECUTION

Provide complete installation conforming to [ASTM F 567](#).

3.1 GENERAL

Ensure final grading and established elevations are complete prior to commencing fence installation.

3.2 EXCAVATION

Provide excavations for post footings which are drilled holes in virgin or compacted soil, of minimum sizes as indicated.

Space footings for line posts **10 feet** on center maximum and at closer intervals when indicated, with bottoms of the holes approximately **3-inches** below the bottoms of the posts. Set bottom of each post not less than **36-inches** below finished grade when in firm, undisturbed soil. Set posts deeper, as required, in soft and problem soils and for heavy, lateral loads.

Remove excavated soil from Government property.

When solid rock is encountered near the surface, drill into the rock at least **12 inches** for line posts and at least **18 inches** for end, pull, corner, and gate posts. Drill holes at least **1 inch** greater in diameter than the largest dimension of the placed post.

If solid rock is below the soil overburden, drill to the full depth required except that penetration into rock need not exceed the minimum depths specified above.

3.3 SETTING POSTS

Remove loose and foreign materials from holes and the soil moistened prior to placing concrete.

Provide tops of footings that are trowel finished and sloped or domed to shed water away from posts. Set hold-open devices, sleeves, and other accessories in concrete.

Keep exposed concrete moist for at least 7 calendar days after placement or cured with a membrane curing material, as approved.

Grout all posts set into sleeved holes in concrete with an approved grouting material.

Maintain vertical alignment of posts set in concrete construction until concrete has set.

3.3.1 Earth and Bedrock

Provide concrete bases of dimensions indicated except in bedrock. Compact concrete to eliminate voids, and finish to a dome shape. In bedrock, set posts with a minimum of **1 inch** of grout around each post. Work grout into hole to eliminate voids, and finish to a dome shape.

3.3.2 Concrete Slabs and Walls

Set posts into zinc-coated sleeves, set in concrete slab or wall, to a minimum depth of **12 inches**. Fill sleeve joint with lead, nonshrink grout, or other approved material. Set posts for support of removable fence sections into sleeves that provide a tight sliding joint and hold posts aligned and plumb without use of lead or setting material.

3.3.3 Bracing

Brace gate, corner, end, and pull posts to nearest post with a horizontal brace used as a compression member, placed at least 12 inches below top of fence, and a diagonal tension rod .

3.4 CONCRETE STRENGTH

Provide concrete that has attained at least 75 percent of its minimum 28-day compressive strength, but in no case sooner than 7 calendar days after placement, before rails, tension wire, or fabric are installed. Do not stretch fabric and wires or hang gates until the concrete has attained its full design strength.

Take samples and test concrete to determine strength as specified.

3.5 TOP RAILS

Provide top rails that run continuously through post caps or extension arms, bending to radius for curved runs. Provide expansion couplings as recommended by the fencing manufacturer.

3.6 BRACE ASSEMBLY

Provide bracing assemblies at end and gate posts and at both sides of corner and pull posts, with the horizontal brace located at midheight of the fabric.

Install brace assemblies so posts are plumb when the diagonal rod is under proper tension.

Provide two complete brace assemblies at corner and pull posts where required for stiffness and as indicated.

3.7 TENSION WIRE INSTALLATION

Install tension wire by weaving them through the fabric and tying them to each post with not less than 7-gage galvanized wire or by securing the wire to the fabric with 10-gage ties or clips spaced 24 inches on center.

3.8 FABRIC INSTALLATION

Provide fabric in single lengths between stretch bars with bottom barbs placed approximately 1-1/2-inches above the ground line. Pull fabric taut and tied to posts, rails, and tension wire with wire ties and bands.

Install fabric on the security side of fence, unless otherwise directed.

Ensure fabric remains under tension after the pulling force is released.

3.9 STRETCHER BAR INSTALLATION

Thread stretcher bars through or clamped to fabric 4 inches on center and secured to posts with metal bands spaced 15 inches on center.

3.10 GATE INSTALLATION

Install gates plumb, level, and secure, with full opening without

interference. Install ground set items in concrete for anchorage as recommended by the fence manufacturer. Adjust hardware for smooth operation and lubricated where necessary.

3.11 TIE WIRES

Provide tie wires that are U-shaped to the pipe diameters to which attached. Twist ends of tie wires not less than two full turns and bent so as not to present a hazard.

3.12 FASTENERS

Install nuts for tension bands and hardware on the side of the fence opposite the fabric side. Peen ends of bolts to prevent removal of nuts.

3.13 ZINC-COATING REPAIR

Clean and repair galvanized surfaces damaged by welding or abrasion, and cut ends of fabric, or other cut sections with specified galvanizing repair material applied in strict conformance with the manufacturer's printed instructions.

3.14 TOLERANCES

Provide posts that are straight and plumb within a vertical tolerance of **1/4 inch** after the fabric has been stretched. Provide fencing and gates that are true to line with no more than **1/2 inch** deviation from the established centerline between line posts. Repair defects as directed.

3.15 SITE PREPARATION

3.15.1 Clearing and Grading

Clear fence line of trees, brush, and other obstacles to install fencing. Establish a graded, compacted fence line prior to fencing installation.

3.16 FENCE INSTALLATION

Install fence on prepared surfaces to line and grade indicated. Install fence in accordance with fence manufacturer's written installation instructions except as modified herein.

3.16.1 Post Spacing

Provide line posts spaced equidistantly apart, not exceeding **10 feet** center. Provide gate posts spaced as necessary for size of gate openings. Do not exceed **500 feet** on straight runs between braced posts. Provide corner or pull posts, with bracing in both directions, for changes in direction of **15 degrees** or more, or for abrupt changes in grade. Provide drawings showing **location of gate, corner, end, and pull posts**.

3.16.2 Top and Bottom Tension Wire

Install bottom tension wires before installing chain-link fabric, and pull wires taut. Place top and bottom tension wires within **8 inches** of respective fabric line.

3.17 ACCESSORIES INSTALLATION

3.17.1 Post Caps

Install post caps as recommended by the manufacturer.

3.17.2 Padlocks

Provide padlocks for gate openings and provide chains that are securely attached to gate or gate posts. Provide padlocks keyed alike, and provide two keys for each padlock.

3.18 GROUNDING

Ground fencing as indicated on drawings and specified.

Ground fences on each side of all gates, at each corner, at the closest approach to each building located within 50 feet of the fence, and where the fence alignment changes more than 15 degrees. Grounding locations can not exceed 650 feet. Bond each gate panel with a flexible bond strap to its gate post. Ground fences crossed by powerlines of 600 volts or more at or near the point of crossing and at distances not exceeding 150 feet on each side of crossing. Provide ground conductor consisting of No. 8 AWG solid copper wire. Provide copper-clad steel rod grounding electrodes 3/4 inch by 10 foot long. Drive electrodes into the earth so that the top of the electrode is at least 6 inches below the grade. Where driving is impracticable, bury electrodes a minimum of 12 inches deep and radially from the fence, with top of the electrode not less than 2 feet or more than 8 feet from the fence. Clamp ground conductor to the fence and electrodes with bronze grounding clamps to create electrical continuity between fence posts, fence fabric, and ground rods. Total resistance of the fence to ground cannot exceed 25 ohms

3.19 CLEANUP

Remove waste fencing materials and other debris from the work site.

-- End of Section --

SECTION 32 92 19

SEEDING

10/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 602	(2007) Agricultural Liming Materials
ASTM D 4427	(2007) Peat Samples by Laboratory Testing
ASTM D 4972	(2001; R 2007) pH of Soils

U.S. DEPARTMENT OF AGRICULTURE (USDA)

AMS Seed Act	(1940; R 1988; R 1998) Federal Seed Act
DOA SSIR 42	(1996) Soil Survey Investigation Report No. 42, Soil Survey Laboratory Methods Manual, Version 3.0

1.2 DEFINITIONS

1.2.1 Stand of Turf

95 percent ground cover of the established species.

1.3 RELATED REQUIREMENTS

Section 31 00 00 EARTHWORK, , , Section 32 92 23 SODDING, , , and Section 32 05 33 LANDSCAPE ESTABLISHMENT applies to this section for pesticide use and plant establishment requirements, with additions and modifications herein.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Wood cellulose fiber mulch

Fertilizer

Include physical characteristics, and recommendations.

SD-06 Test Reports

Topsoil composition tests (reports and recommendations).

SD-07 Certificates

State certification and approval for seed

SD-08 Manufacturer's Instructions

Erosion Control Materials

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

1.5.1.1 Seed Protection

Protect from drying out and from contamination during delivery, on-site storage, and handling.

1.5.1.2 Fertilizer Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer may be furnished in bulk with certificate indicating the above information.

1.5.2 Storage

1.5.2.1 Seed, Fertilizer Storage

Store in cool, dry locations away from contaminants.

1.5.2.2 Topsoil

Prior to stockpiling topsoil, treat growing vegetation with application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil.

1.5.2.3 Handling

Do not drop or dump materials from vehicles.

1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS

1.6.1 Restrictions

Do not plant when the ground is frozen, snow covered, muddy, or when air temperature exceeds 90 degrees Fahrenheit.

1.7 TIME LIMITATIONS

1.7.1 Seed

Apply seed within twenty four hours after seed bed preparation.

PART 2 PRODUCTS

2.1 SEED

2.1.1 Classification

Provide State-certified seed of the latest season's crop delivered in original sealed packages, bearing producer's guaranteed analysis for percentages of mixtures, purity, germination, weedseed content, and inert material. Label in conformance with **AMS Seed Act** and applicable state seed laws. Wet, moldy, or otherwise damaged seed will be rejected. Field mixes will be acceptable when field mix is performed on site in the presence of the Contracting Officer .

2.1.2 Planting Dates

<u>Planting Season</u>	<u>Planting Dates</u>
[Season 1]	[_____]
[Season 2]	[_____]
[Temporary Seeding]	[_____]

2.1.3 Seed Purity

Botanical Name	Common Name	Min. Percent Pure Seed	Min. Percent Germination and Hard Seed	Max. Percent Weed Seed
[_____]	[_____]	[_____]	[_____]	[_____]
[_____]	[_____]	[_____]	[_____]	[_____]
[_____]	[_____]	[_____]	[_____]	[_____]

2.1.4 Seed Mixture by Weight

<u>Planting Season</u>	<u>Variety</u>	<u>Percent (by Weight)</u>
[Season 1]	[_____] [_____]	[_____] [_____]
[Season 2]	[_____] [_____]	[_____] [_____]
[Temporary Seeding]	[_____] [_____]	[_____] [_____]

Proportion seed mixtures by weight. Temporary seeding must later be replaced by [Season 1][Season 2] plantings for a permanent stand of grass. The same requirements of turf establishment for [Season 1][Season 2] apply for temporary seeding.

2.2 TOPSOIL

2.2.1 On-Site Topsoil

Surface soil stripped and stockpiled on site and modified as necessary to meet the requirements specified for topsoil in paragraph entitled "Composition." When available topsoil shall be existing surface soil stripped and stockpiled on-site in accordance with Section 31 00 00

EARTHWORK.

2.2.2 Off-Site Topsoil

Conform to requirements specified in paragraph entitled "Composition."
Additional topsoil shall be obtained from topsoil borrow areas indicated.

2.2.3 Composition

Containing from 5 to 10 percent organic matter as determined by the [topsoil composition tests](#) of the Organic Carbon, 6A, Chemical Analysis Method described in [DOA SSIR 42](#). Maximum particle size, [3/4 inch](#), with maximum 3 percent retained on [1/4 inch](#) screen. The pH shall be tested in accordance with [ASTM D 4972](#). Topsoil shall be free of sticks, stones, roots, and other debris and objectionable materials. Other components shall conform to the following limits:

Silt	7 to 17 percent
Clay	4 to 12 percent
Sand	70 to 82 percent
pH	5.5 to 7.0
Soluble Salts	600 ppm maximum

2.3 SOIL CONDITIONERS

Add conditioners to topsoil as required to bring into compliance with "composition" standard for topsoil as specified herein.

2.3.1 Lime

Commercial grade hydrate or burnt limestone containing a calcium carbonate equivalent (C.C.E.) as specified in [ASTM C 602](#) of not less than [_____] percent.

2.3.2 Aluminum Sulfate

Commercial grade.

2.3.3 Sulfur

100 percent elemental

2.3.4 Iron

100 percent elemental

2.3.5 Peat

Natural product of peat moss derived from a freshwater site and conforming to [ASTM D 4427](#). Shred and granulate peat to pass a [1/2 inch](#) mesh screen and condition in storage pile for minimum 6 months after excavation.

2.3.6 Sand

Clean and free of materials harmful to plants.

2.3.7 Perlite

Horticultural grade.

2.3.8 Composted Derivatives

Ground bark, nitrolized sawdust, humus or other green wood waste material free of stones, sticks, and soil stabilized with nitrogen and having the following properties:

2.3.8.1 Particle Size

Minimum percent by weight passing:

No. 4 mesh screen	95
No. 8 mesh screen	80

2.3.8.2 Nitrogen Content

Minimum percent based on dry weight:

Fir Sawdust	0.7
Fir or Pine Bark	1.0

2.3.9 Gypsum

Coarsely ground gypsum comprised of calcium sulfate dihydrate 61 percent, calcium 22 percent, sulfur 17 percent; minimum 96 percent passing through 20 mesh screen, 100 percent passing thru 16 mesh screen.

2.3.10 Calcined Clay

Calcined clay shall be granular particles produced from montmorillonite clay calcined to a minimum temperature of 1200 degrees F. Gradation: A minimum 90 percent shall pass a No. 8 sieve; a minimum 99 percent shall be retained on a No. 60 sieve; and a maximum 2 percent shall pass a No. 100 sieve. Bulk density: A maximum 40 pounds per cubic foot.

2.4 FERTILIZER

2.4.1 Hydroseeding Fertilizer

Controlled release fertilizer, to use with hydroseeding and composed of pills coated with plastic resin to provide a continuous release of nutrients for at least 6 months and containing the following minimum percentages, by weight, of plant food nutrients.

[_____]	percent available nitrogen
[_____]	percent available phosphorus
[_____]	percent available potassium
[[_____]	percent sulfur]
[[_____]	percent iron]

2.5 MULCH

Mulch shall be not be permitted on site.

2.6 WATER

Source of water shall be approved by Contracting Officer and of suitable quality for irrigation, containing no elements toxic to plant life.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 EXTENT OF WORK

Provide soil preparation (including soil conditioners as required), fertilizing, seeding, and surface topdressing of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

3.1.1.1 Topsoil

Provide 4 inches of on-site topsoil to meet indicated finish grade. After areas have been brought to indicated finish grade, incorporate fertilizer into soil a minimum depth of 4 inches by disking, harrowing, tilling or other method approved by the Contracting Officer. Remove debris and stones larger than 3/4 inch in any dimension remaining on the surface after finish grading. Correct irregularities in finish surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.

3.1.1.2 Fertilizer Application Rates

Apply fertilizer at rates as determined by laboratory soil analysis of the soils at the job site. For bidding purposes only apply at rates for the following:

Organic Granular Fertilizer [[_____] pounds per acre] [[_____] pounds per 1000 square feet.]

3.2 SEEDING

3.2.1 Seed Application Seasons and Conditions

Immediately before seeding, restore soil to proper grade. Do not seed when ground is muddy frozen, snow covered or in an unsatisfactory condition for seeding. If special conditions exist that may warrant a variance in the above seeding dates or conditions, submit a written request to the Contracting Officer stating the special conditions and proposed variance. Apply seed within twenty four hours after seedbed preparation. Sow seed by approved sowing equipment. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing.

3.2.2 Seed Application Method

Seeding method shall be hydroseeding.

3.2.2.1 Hydroseeding

First, mix water and fiber. Wood cellulose fiber, paper fiber, or recycled paper shall be applied as part of the hydroseeding operation. Fiber shall be added at 1,000 pounds, dry weight, per acre. Then add and mix seed and fertilizer to produce a homogeneous slurry. Seed shall be mixed to ensure broadcasting at the rate of pounds per 1000 square feet. When hydraulically sprayed on the ground, material shall form a blotter like cover impregnated uniformly with grass seed. Spread with one application

with no second application of mulch.

13.2.3 Rolling

Immediately after seeding, firm entire area except for slopes in excess of 3 to 1 with a roller not exceeding 90 pounds for each foot of roller width. If seeding is performed with cultipacker-type seeder or by hydroseeding, rolling may be eliminated.

3.2.4 Erosion Control Material

Install in accordance with manufacturer's instructions, where indicated or as directed by the Contracting Officer.

3.2.5 Watering

Start watering areas seeded as required by temperature and wind conditions. Apply water at a rate sufficient to insure thorough wetting of soil to a depth of 2 inches without run off. During the germination process, seed is to be kept actively growing and not allowed to dry out.

3.3 PROTECTION OF TURF AREAS

Immediately after turfing, protect area against traffic and other use.

3.4 RESTORATION

Restore to original condition existing turf areas which have been damaged during turf installation operations at the Contractor's expense. Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean other paving when work in adjacent areas is complete.

-- End of Section --

SECTION 32 92 23

SODDING

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

- ASTM C 602 (2007) Agricultural Liming Materials
ASTM D 4427 (2007) Peat Samples by Laboratory Testing
ASTM D 4972 (2001; R 2007) pH of Soils

TURFGRASS PRODUCERS INTERNATIONAL (TPI)

- TPI GSS (1995) Guideline Specifications to Turfgrass Sodding

U.S. DEPARTMENT OF AGRICULTURE (USDA)

- DOA SSIR 42 (1996) Soil Survey Investigation Report No. 42, Soil Survey Laboratory Methods Manual, Version 3.0

1.2 DEFINITIONS

1.2.1 Stand of Turf

100 percent ground cover of the established species.

1.3 RELATED REQUIREMENTS

Section 31 00 00 EARTHWORK, , , Section 32 92 19 SEEDING, , , and Section 32 05 33 LANDSCAPE ESTABLISHMENT applies to this section for pesticide use and plant establishment requirements, with additions and modifications herein.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fertilizer

Include physical characteristics, and recommendations.

SD-06 Test Reports

Topsoil composition tests (reports and recommendations).

SD-07 Certificates

Sod farm certification for sods. Indicate type of sod in accordance with TPI GSS.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

1.5.1.1 Sod Protection

Protect from drying out and from contamination during delivery, on-site storage, and handling.

1.5.1.2 Fertilizer Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer may be furnished in bulk with certificate indicating the above information.

1.5.2 Storage

1.5.2.1 Sod Storage

Lightly sprinkle with water, cover with moist burlap, straw, or other approved covering; and protect from exposure to wind and direct sunlight until planted. Provide covering that will allow air to circulate so that internal heat will not develop. Do not store sod longer than 24 hours. Do not store directly on concrete or bituminous surfaces.

1.5.2.2 Topsoil

Prior to stockpiling topsoil, treat growing vegetation with application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil.

1.5.2.3 Handling

Do not drop or dump materials from vehicles.

1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS

1.6.1 Restrictions

Do not plant when the ground is frozen, snow covered, muddy, or when air temperature exceeds 90 degrees Fahrenheit.

1.7 TIME LIMITATIONS

1.7.1 Sod

Place sod a maximum of thirty six hours after initial harvesting, in accordance with TPI GSS as modified herein.

PART 2 PRODUCTS

2.1 SODS

2.1.1 Classification

Nursery grown, certified as classified in the TPI GSS. Machine cut sod at a uniform thickness of 3/4 inch within a tolerance of 1/4 inch, excluding top growth and thatch. Each individual sod piece shall be strong enough to support its own weight when lifted by the ends. Broken pads, irregularly shaped pieces, and torn or uneven ends will be rejected. Wood pegs and wire staples for anchorage shall be as recommended by sod supplier.

2.1.2 Purity

Sod species shall be genetically pure, free of weeds, pests, and disease.

2.1.3 Planting Dates

Lay sod from [] to [] for warm season spring planting and from [] to [] for cool season fall planting.

2.1.4 Composition

2.1.4.1 Proportion

Proportion grass species as follows.

Botanical Name	Common Name	Percent:
[]	[]	[]
[]	[]	[]

2.1.4.2 Sod Farm Overseeding

At the sod farm provide sod with overseeding of type recommended by seed producer.

2.2 TOPSOIL

2.2.1 On-Site Topsoil

Surface soil stripped and stockpiled on site and modified as necessary to meet the requirements specified for topsoil in paragraph entitled "Composition." When available topsoil shall be existing surface soil stripped and stockpiled on-site in accordance with Section 31 00 00 EARTHWORK.

2.2.2 Off-Site Topsoil

Conform to requirements specified in paragraph entitled "Composition." Additional topsoil shall be obtained from topsoil borrow areas indicated.

2.2.3 Composition

Containing from 5 to 10 percent organic matter as determined by the topsoil composition tests of the Organic Carbon, 6A, Chemical Analysis Method

described in DOA SSIR 42. Maximum particle size, 3/4 inch, with maximum 3 percent retained on 1/4 inch screen. The pH shall be tested in accordance with ASTM D 4972. Topsoil shall be free of sticks, stones, roots, and other debris and objectionable materials. Other components shall conform to the following limits:

Silt	7 to 17 percent
Clay	4 to 12 percent
Sand	70 to 82 percent
pH	5.5 to 7.0
Soluble Salts	600 ppm maximum

2.3 SOIL CONDITIONERS

Add conditioners to topsoil as required to bring into compliance with "composition" standard for topsoil as specified herein.

2.3.1 Lime

Commercial grade hydrate or burnt limestone containing a calcium carbonate equivalent (C.C.E.) as specified in ASTM C 602 of not less than [_____] percent.

2.3.2 Aluminum Sulfate

Commercial grade.

2.3.3 Sulfur

100 percent elemental

2.3.4 Iron

100 percent elemental

2.3.5 Peat

Natural product of peat moss derived from a freshwater site and conforming to ASTM D 4427 . Shred and granulate peat to pass a 1/2 inch mesh screen and condition in storage pile for minimum 6 months after excavation.

2.3.6 Sand

Clean and free of materials harmful to plants.

2.3.7 Perlite

Horticultural grade.

2.3.8 Composted Derivatives

Ground bark, nitrolized sawdust, humus or other green wood waste material free of stones, sticks, and soil stabilized with nitrogen and having the following properties:

2.3.8.1 Particle Size

Minimum percent by weight passing:

No. 4 mesh screen	95
No. 8 mesh screen	80

2.3.8.2 Nitrogen Content

Minimum percent based on dry weight:

Fir Sawdust	0.7
Fir or Pine Bark	1.0

2.3.9 Gypsum

Coarsely ground gypsum comprised of calcium sulfate dihydrate 91 percent, calcium 22 percent, sulfur 17 percent; minimum 96 percent passing through 20 mesh screen, 100 percent passing thru 16 mesh screen.

2.3.10 Calcined Clay

Calcined clay shall be granular particles produced from montmorillonite clay calcined to a minimum temperature of 1200 degrees F. Gradation: A minimum 90 percent shall pass a No. 8 sieve; a minimum 99 percent shall be retained on a No. 60 sieve; and a maximum 2 percent shall pass a No. 100 sieve. Bulk density: A maximum 40 pounds per cubic foot.

2.4 FERTILIZER

2.4.1 Granular Fertilizer

Organic, granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients:

- [_____] percent available nitrogen
- [_____] percent available phosphorus
- [_____] percent available potassium
- [_____] percent sulfur
- [[_____] percent iron]

2.5 WATER

Source of water shall be approved by Contracting Officer and of suitable quality for irrigation containing no element toxic to plant life.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Extent Of Work

Provide soil preparation (including soil conditioners), fertilizing, and sodding of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

3.1.2 Soil Preparation

Provide 4 inches of on-site topsoil to meet indicated finish grade. After areas have been brought to indicated finish grade, incorporate fertilizer into soil a minimum depth of 4 inches by disking, harrowing, tilling or other method approved by the Contracting Officer. Remove debris and stones

larger than $3/4$ inch in any dimension remaining on the surface after finish grading. Correct irregularities in finish surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.

3.1.2.1 Fertilizer Application Rates

Apply fertilizer at rates as determined by laboratory soil analysis of the soils at the job site. For bidding purposes only apply at rates for the following:

Organic Granular Fertilizer [[_____] pounds per acre] [[_____] pounds per 1000 square feet.]

3.2 SODDING

3.2.1 Finished Grade and Topsoil

Prior to the commencement of the sodding operation, the Contractor shall verify that finished grades are as indicated on drawings; the placing of topsoil, smooth grading, and compaction requirements have been completed in accordance with Section 31 00 00 EARTHWORK.

The prepared surface shall be a maximum 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas. The prepared surface shall be completed with a light raking to remove from the surface debris and stones over a minimum $5/8$ inch in any dimension.

3.2.2 Placing

Place sod a maximum of 36 hours after initial harvesting, in accordance with TPI GSS as modified herein.

3.2.3 Sodding Slopes and Ditches

For slopes 2:1 and greater, lay sod with long edge perpendicular to the contour. For V-ditches and flat bottomed ditches, lay sod with long edge perpendicular to flow of water. Anchor each piece of sod with wood pegs or wire staples maximum 2 feet on center. On slope areas, start sodding at bottom of the slope.

3.2.4 Finishing

After completing sodding, blend edges of sodded area smoothly into surrounding area. Air pockets shall be eliminated and a true and even surface shall be provided. Frayed edges shall be trimmed and holes and missing corners shall be patched with sod.

3.2.5 Rolling

Immediately after sodding, firm entire area except for slopes in excess of 3 to 1 with a roller not exceeding 90 pounds for each foot of roller width.

3.2.6 Watering

Start watering areas sodded as required by daily temperature and wind conditions. Apply water at a rate sufficient to ensure thorough wetting of soil to minimum depth of 6 inches. Run-off, puddling, and wilting shall be prevented. Unless otherwise directed, watering trucks shall not be driven

over turf areas. Watering of other adjacent areas or plant material shall be prevented.

3.3 PROTECTION OF TURF AREAS

Immediately after turfing, protect area against traffic and other use.

3.4 RESTORATION

Restore to original condition existing turf areas which have been damaged during turf installation operations. Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean other paving when work in adjacent areas is complete.

-- End of Section --

SECTION 33 05 23.19

TRENCHLESS EXCAVATION USING MICROTUNNELING

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN PETROLEUM INSTITUTE (API)

- API Spec 13A (2010) Specification for Drilling-Fluid Materials
- API Spec 5L (2007; Errata 2009; Addenda 1 2009; Addenda 2 2010; 44th Ed) Specification for Line Pipe

AMERICAN WATER WORKS ASSOCIATION (AWWA)

- AWWA C104/A21.4 (2008; Errata 2010) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
- AWWA C111/A21.11 (2007) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- AWWA C150/A21.50 (2008) Thickness Design of Ductile-Iron Pipe
- AWWA C151/A21.51 (2009) Ductile-Iron Pipe, Centrifugally Cast, for Water
- AWWA C203 (2008) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied

ASTM INTERNATIONAL (ASTM)

- ASTM A 139/A 139M (2004; R 2010) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)
- ASTM A 53/A 53M (2010) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- ASTM C 443 (2005ae1) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
- ASTM C 497 (2005) Concrete Pipe, Manhole Sections, or Tile

ASTM C 76	(2010a) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM D 1248	(2005) Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable

1.2 DESIGN REQUIREMENTS

1.2.1 Pipe Casing

Provide pipe casing of concrete or steel pipe. Provide utility line accessories, and manholes as specified and where indicated. Submit design calculations of pipe casing.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Microtunneling Boring Machine equipment to be used

SD-03 Product Data

Piping casing, joints, fittings, valves, and couplings

Bentonite

Submit manufacturer's standard drawings or catalog cuts, except submit both drawings and cuts for push-on and rubber-gasketed bell-and-spigot joints. Include information concerning gaskets with submittal for joints and couplings.

SD-05 Design Data

Design calculations of pipe casing

SD-07 Certificates

Piping casing piping, fittings, joints, valves, and coupling

Shop-applied linings

Certificates shall attest that tests set forth in each applicable referenced publication have been performed, whether specified in that publication to be mandatory or otherwise and that production control tests have been performed at the intervals or frequency specified in the publication. Other tests shall have been performed within 3 years of the date of submittal or certificates on the same type, class, grade, and size of material as is being provided for the project.

SD-08 Manufacturer's Instructions

Installation procedures for pipe casing

1.4 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, free of dirt and debris.

1.4.1 Handling

Handle pipe, fittings, valves, hydrants, and other accessories in a manner to ensure delivery to the excavation in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make satisfactory repairs if coatings or linings are damaged. Carry, do not drag pipe to the excavation. Store rubber gaskets that are not to be installed immediately, under cover out of direct sunlight. Handle steel pipe with coating in accordance with the provisions for handling coal-tar enamel coated pipe in [AWWA C203](#).]

1.5 QUALITY ASSURANCE

1.5.1 Design Calculations of Pipe Casing

Submit [design calculations of pipe casing](#) demonstrating that the pipe casing selected has been designed to support the maximum anticipated earth loads and superimposed live loads, both static and dynamic, which may be imposed on the pipe casing.

PART 2 PRODUCTS

2.1 PIPING CASING MATERIALS

2.1.1 Piping Casing

2.1.1.1 Ductile-Iron Piping

- a. Pipe and Fittings: Pipe, [AWWA C151/A21.51](#) [Pressure Class as [determined by through caclculations](#). The outside diameter of ductile iron microtunneling pipe shall be in accordance with [AWWA C150/A21.50](#).

(1) Deflection: The maximum allowable deflection shall not exceed three percent of the outside diameter of the pipe barrel for pipe manufactured with a rigid lining and/or rigid coating nor five percent for pipe manufactured with a flexible lining and/or flexible coating.

(2) [Linings](#): Cement mortar shall be in accordance with latest version of [AWWA C104/A21.4](#) Polyethylene lining shall be virgin polyethylene complying with [ASTM D 1248](#) compounded with an inert filler and with sufficient carbon black to resist ultraviolet rays.

(3) End Squareness: The ends of the pipe shall be perpendicular to the longitudinal axis of the pipe with a maximum deviation of not more than [0.25 inches](#).

(4) Hydrostatic Test: Each pipe section shall be subject to a hydrostatic test of not less than 500 psi as per the requirements of AWWA C151/A21.51. Non-standard joint lengths shall be cut only from full length pipe having satisfactorily passed the required 500 psi hydrostatic test.

(5) Material Properties: The following are representative minimum values for the physical properties of ductile iron for use as microtunneling pipe for pressure or gravity service.

(a) Tensile strength: Minimum 60,000 psi

(b) Tensile yield strength: Minimum 42,000 psi

(c) Compressive strength: The compressive yield strength of ductile iron is 10 to 20 percent higher than the tensile yield strength. The ultimate strength in compression is not normally determined for ductile metals, though apparent strength in tests may be several times the tensile strength value.

(d) Elongation: Minimum 10 percent.

(e) Modulus of Elasticity: 24,000,000 psi (tension or compression).

(f) Poisson's ratio: 0.28

(6) Spigot End Outside Diameter: The Spigot end outside diameter must be within the following ranges: 3 to 12 inches, ± 0.06 inches 14 to 24 inches, ± 0.05 inches] 30 to 48 inches, ± 0.08 inches 54 to 64 inches, ± 0.04 inches.

b. Joints and Jointing Material:

(1) Joints: Pressure and gravity microtunneling pipe shall have either an integral-bell push-on or rubber gasket coupled joint meeting the following criteria:

(a) Integral-bell push-on joint microtunneling pipe shall consist of a rubber-gasket joint manufactured to conform with AWWA C111/A21.11 and the dimensions shown in AWWA C151/A21.51. The exterior of the pipe shall be coated with a durable cement-mortar or concrete coating applied in such a manner as to provide a uniform outside diameter.

(b) Cement-mortar or concrete strength, reinforcement and method of placement shall be in accordance with manufacturer's recommendations. Durable Coatings of other types may be substituted provided they maintain a uniform outside diameter and they are approved by the designer. Rubber gasket coupled microtunneling joint shall be manufactured so as to provide a joint which has the same nominal outside diameter as the pipe barrel.

2.1.1.2 Reinforced Concrete Pipe

a. Pipe: Pipe, class V, in accordance with ASTM C 76.

(1) Internal Diameter: The internal diameter of 12 to 24 inches

pipe shall not vary by more than $\pm 1/4$ inch from the design diameter 27 inch and larger pipe shall not vary from the design diameter by more than \pm one percent or $\pm 3/8$ inch, whichever is less.

(2) Wall Thickness: At any location along the length of the pipe, or at any point around its circumference, the wall thickness shall not vary by more than \pm five percent.

(3) End Squareness: Each pipe end shall lie within two planes perpendicular to the longitudinal center line of the pipe, spaced at $3/8$ inches apart. The tongue or spigot end shall be square within $3/16$ inches and the groove or bell end of the pipe shall be square within $3/16$ inches.

(4) Hydrostatic Test: Each pipe section shall be subject to a hydrostatic test of not less than 10 psi for straightalignment as per the requirements of section 10 of ASTM C 443 and section 8 of ASTM C 497. Non-standard joint lengths shall be cut only from full length pipe having satisfactory passed the required 10 psi hydrostatic test.

(5) Roundness: The outside diameter of the pipe shall not vary from a true circle by more than 1.0 percent. The out-of-round dimensions shall be one half the difference between the maximum and minimum outer diameter of the pipe at any one location along the barrel.

(6) Length of Pipe: Finished pipe length shall not deviate from design length by more than $\pm 1/8$ inch per foot with a maximum variation of $1/2$ inch in any length of pipe.

(7) Length of two opposite sides: Variations in laying length of two opposite sides of the pipe shall not be more than $1/4$ inch for all sizes through 24 inches internal diameter and $1/8$ inch per foot for all sizes larger than 24 inches in internal diameter, with a maximum of $3/8$ inches in any length of pipe.

b. Joints and Jointing Material:

(1) Joints: Joint shall [be formed entirely of concrete and as detailed in the contract drawings, [may] [shall] utilize a rubber gasket or mastic to provide the seal]. [Incorporate an assembly of [steel bands] [or] [steel bell ends] and spigot rings and rubber gaskets in accordance with contract drawings].

2.1.1.3 Steel Pipe

- a. Pipe: Steel pipe shall be in conformance with ASTM A 139/A 139M, Grade B with a minimum yield strength of 35,000 psi [API Spec 5L Grade B ASTM A 53/A 53M [. Steel pipe shall be welded, seamless, square cut with even lengths and shall comply of Articles 4.2, 4.3, and 4.4 of the API Spec 5L.

(1) Roundness: The difference between the major and minor outside diameters shall not exceed one percent of the specified nominal outside diameter of 0.25 inch whichever is less. For pipe exceeding 48 inches in diameter, a maximum deviation of $1/2$ inch shall be permitted provided the circumference tolerance is maintained within $1/4$ inch.

(2) Circumference: The outside circumference shall be within ± 1 percent of the nominal circumference or within ± 0.50 inches, whichever is less.

(3) Straightness: The maximum allowable straightness deviation in any 10 foot length shall be $1/8$ inch. For lengths over 10 feet, the maximum deviation of the entire length may be computed by the following formula, but not to exceed $3/8$ inch in any 40 foot length:

$$(1/8) \times (\text{total length in feet})/10 = \text{Maximum Deviation in inches}$$

(4) Pipe ends: The end of the pipe shall be perpendicular to the longitudinal axis of the pipe and within $1/16$ inches per foot of diameter, with a maximum allowable deviation of $1/4$ inch measured with a square and straightedge across the end of the pipe.

- b. Joints: The connection of adjacent pieces of microtunneling steel pipe may be accomplished by field butt welding, internal weld sleeves, integral press fit connectors, as long as loading and installation design criteria are met.

2.2 CONCRETE

Concrete shall be 3000 psi and conform with Section 03 30 00 CAST-IN-PLACE CONCRETE of this specification.

2.3 BENTONITE

Bentonite shall conform with API Spec 13A and have the capacity of mixing with water to form a stable and homogeneous suspension.

2.4 BACKFILL

Reuse excavated sand for backfill that conforms with Section 31 00 00 EXCAVATION.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Access Shafts

- a. Construction methods required to provide access shafts for microtunneling shall be subject to approval of the Contracting Officer. Acceptable construction methods may include the use of interlocked steel sheetpiling or precast circular concrete segments lowered in place during excavation.
- b. Final dimensions of access shafts selected by the Contractor shall be modified as required following installation of pipe casings to the size and shape of acceptable manhole designs shown on the Contract Drawings to permit installation of conveyance piping.
- c. Shafts shall be of a size commensurate with safe working practices and located as shown on plans. With the approval of the Contracting officer, the Contractor may relocate shafts to better suit the capabilities of the microtunneling method proposed.

Where no locations are given, the Contractor shall determine such locations with the approval of the Contracting Officer.

- d. Shaft locations shall, where possible, be kept clear of road intersections and within a single traffic lane, in order to minimize disruption to the flow of traffic. Support equipment, spoil piles, and materials shall also be located such as to minimize disruption to traffic and are subject to the approval of the Contracting Officer.
- e. The Contractor shall properly support all excavations and prevent movement of the soil, pavement, utilities or structures outside of the excavation. The Contractor shall furnish, place and maintain sheeting, bracing, and lining required to support the sides and floor of all pits and to provide adequate protection of the work, personnel, and the general public. Design loads on the sides of the jacking and receiving pit walls are dependent on the construction method and flexibility of the wall systems.
- f. Construct a starter shaft to accommodate the installation of pipe casings, slurry shield and piping jacking device. Install thrust block as required and consolidate the ground (grout) where the casings exit the shaft.
- g. Construct a receiver shaft to accommodate the installation of pipe casings and the slurry shield. Consolidate the ground (grout) where the casings enter the shaft.
- h. The Contractor shall furnish, install, and maintain equipment to keep the jacking shaft free of excess water. The Contractor shall also provide surface protection during the period of construction to ensure that surface runoff does not enter driving shaft(s). Groundwater dewatering shall comply with the approved dewatering plan and shall not affect surrounding soils or structures beyond the tolerances stated in paragraph entitled "Settlement, Alignment and Tolerances."
- i. Provide security fence around all access shaft areas and provide shaft cover(s) when the shaft area is not in use.
- j. Design of the jacking and receiving pit supports should also take into account the loading from shield or pipe jacking where appropriate, as well as special provisions and reinforcement around the breakout location. The base of the pits shall be designed to withstand uplift forces from the full design head of water, unless approved dewatering or other ground modification methods are employed.
- k. Where a thrust block is required to transfer jacking loads into the soil, it shall be properly designed and constructed by the Contractor. The backstop shall be normal (square) with the proposed pipe alignment and shall be designed to withstand the maximum jacking pressure to be used with a factor of safety of at least 2.0. It shall also be designed to minimize excessive deflections in such a manner as to avoid disturbance of adjacent structures or utilities or excessive ground movement. If a concrete thrust block or treated soil zone is utilized to transfer jacking loads into the soil, the tunnel boring is not to be jacked until the concrete or other materials have attained the required

strength.

1. Pit Backfill and Compaction: Upon completion of the pipe drive and approval of the installed pipeline by the Contracting Officer, remove all equipment, debris, and unacceptable materials from the pits and commence backfilling operation. Backfilling, compaction and pavement repairs shall be completed in accordance with Section 31 00 00 EXCAVATION.
- [m. If tremie concrete sealing slabs are placed within the earth support system to prevent groundwater inflow when access shafts are dewatered, the sealing slabs shall be of sufficient thickness to provide a factor of safety equal to 1.2 against hydrostatic uplift in order to prevent bottom blowout when the excavation is completely dewatered.]

3.2 INSTALLATION

3.2.1 Installation of Tracer Wire

Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such a manner that will not be displaced during construction operations.

3.2.2 Connections to Existing Lines

Make connections to existing lines after Government approval is obtained and with a minimum interruption of service on the existing line. Make connections to existing lines under pressure [in accordance with the recommended procedures of the manufacturer of the pipe being tapped] [as indicated].

3.2.3 Settlement, Alignment and Tolerances

- a. Settlement or heave of ground surface along centerline of microtunneling alignments during and after installation of pipe casings shall not exceed 0.5 inches.
- b. No more than 24 inch lateral and 12 inch vertical deviation shall be permitted in the position of the completed jacked pipe casings. Water shall be free draining between any two points at the pipe invert. No reverse grades will be allowed.

3.2.4 Microtunneling

- a. The microtunneling boring machine shall be an unmanned mechanical type earth pressure counter-balanced bentonite slurry shield system. The machine shall be laser guided and monitored continuously, with a closed circuit television system. The machine shall be capable of fully supporting the face both during excavation and during shutdown and shall have the capability, of positively measuring the earth pressure at the face. Excavation face pressure shall be maintained at all times between the measured active earth pressure and 50 percent of the computed passive earth pressure. Fluid pressure applied at the face to stabilize the excavation shall be maintained at a level slightly in excess of normal hydrostatic pressure and shall be monitored

continuously. The machine shall be operated so as to prevent either surface heave or loss of ground during tunneling and shall be steerable and capable of controlling the advance of the heading to maintain line and grade within the tolerances specified in paragraph entitled "Settlement, Alignment and Tolerances." The machine shall be capable of handling and removing materials of high water content from the machine head.

- b. Each pipe casing section shall be jacked forward as the excavation progresses in such a way to provide complete and adequate, ground support at all times. A bentonite slurry (driller's mud) shall be applied to the external surface of the pipe to reduce skin friction. A jacking frame shall be provided for developing a uniform distribution of jacking forces around the periphery of the pipe. A plywood spacer shall be placed on the outer shoulder of the pipe casing joint. The thrust reaction backstop shall be properly designed and constructed.
- c. The backstop shall be normal (square) with the proposed pipe casing alignment and shall be designed to support the maximum obtainable jacking pressure with a safety factor at least 2.0.
- d. The jacking system shall be capable of continuously monitoring the jacking pressure and rate of advancement. Special care shall be taken when setting the pipe guard rails in the starter shaft to ensure correctness of the alignment, grade and stability.
- k. All excavated material from tunnel and shaft construction shall be disposed of away from the construction site.
- l. Monitor ground movements associated with the project and make suitable changes in the construction methods that control ground movements and prevent damage or detrimental movement to the work and adjacent structures and pavements.
- m. Install instrumentation, take readings and provide the Contracting Officer with weekly reports containing measurements data with weekly reports to inspector. These actions are meant to supplement the Contractor's monitoring system and do not relieve the Contractor of his responsibility, nor place on the Contracting Officer, responsibility for control of ground movement and protection of the project and adjacent structures. Instrumentation readings shall be continued for a period of 4 weeks after pipe casings have been installed to establish that detrimental settlement has not occurred.
- n. Unprotected mining of the tunnel bore is not permitted. The tunnel face and bore shall be fully supported at all times.
- o. A topographic survey will be performed by the Contractor before and after microtunneling under the existing runway and at 4week intervals for a period of 16 weeks. Survey markers will be installed by the contractor at grid points located at 10 foot spacing over an area 200 square foot centered on the proposed tunnel alignments. Perform all remedial work including repaired

if heave or settlement greater than 0.5 inches is recorded.

- p. Approval by the Contracting Officer of the topographic survey and final set of readings provided by the Contractor will constitute partial approval of the microtunneling phase of work.

3.2.5 Ventilation

- a. Adequate ventilation shall be provided for all cased tunnels and shafts. Follow confined space entry procedures. The design of ventilating system shall include such factors as the volume required to furnish fresh air in the shafts, and the volume to remove dust that may be caused by the cutting of the face and other operations which may impact the laser guidance system. The minimum amount of fresh air to be supplied shall be _____ CFM.

3.2.6 Lighting

Adequate lighting shall be provided for the nature of the activity being conducted by workers for the microtunneling. Both power and lighting circuits shall be separated and thoroughly insulated with ground fault interrupters are required. Lights shall comply with requirements with regards to shatter resistance and illumination requirements.

3.2.7 Spoil Transportation

The soil transportation system shall match the excavation rate with rate of spoil removal. The system must also be capable of balancing groundwater pressures and adjustment to maintain face stability for the particular soil conditions of this project.

3.2.8 Pipe Jacking Equipment

The main jacking equipment installed must have a capacity greater than the anticipated jacking load. Intermediate jacking stations shall be provided by the Contractor when the total anticipated jacking force needed to complete the installation may exceed the capacity of the main jacks or the designed maximum jacking force for the pipe. The jacking system shall develop a uniform distribution of jacking forces on the end of the pipe by use of thruster rings and cushioning material.

3.2.9 Jacking Pipe

In general, pipe used for jacking shall be smooth, round, have an even outer surface, and joints that allow for easy connections between pipes. Pipe ends shall be square and smooth so that jacking loads are minimized when the pipe is jacking. Pipe used for pipe jacking shall be capable of withstanding the jacking forces that will be imposed by the process or installation, as well as the final place loading conditions. The driving ends of the pipe and intermediate joints shall be protected from damage.

- a. Any pipe showing signs of failure may be jacked through to the receiving shaft and removed. Other methods of repairing the damaged pipe may be used, as recommended by the manufacturer and subject to approval by the Contracting Officer.
- b. The pipe manufacturer's design jacking loads shall not be exceeded during the installation process. The pipe shall be designed to take full account of all temporary installation loads.

3.3 FIELD QUALITY CONTROL

3.3.1 Field Tests and Inspections

The Contractor shall perform field tests, and provide labor, equipment, and incidentals required for testing . The Contractor will product evidence, when required, that any item of work has been constructed in accordance with drawings and specifications.

3.3.2 Testing Requirements

For pressure test, use a hydrostatic pressure 50 psi greater than the maximum working pressure of the system. Hold this pressure for not less than 2 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

-- End of Section --

SECTION 33 11 00

WATER DISTRIBUTION

02/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(2010) Hypochlorites
AWWA B301	(2010) Liquid Chlorine
AWWA C104/A21.4	(2008; Errata 2010) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105/A21.5	(2010) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110/A21.10	(2008) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2007) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151/A21.51	(2009) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C153/A21.53	(2006) Ductile-Iron Compact Fittings for Water Service
AWWA C203	(2008) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C500	(2009) Metal-Seated Gate Valves for Water Supply Service
AWWA C502	(2005) Dry-Barrel Fire Hydrants
AWWA C503	(2005) Wet-Barrel Fire Hydrants
AWWA C509	(2009) Resilient-Seated Gate Valves for Water Supply Service
AWWA C600	(2010) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C605	(2005) Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water

AWWA C651	(2005; Errata 2005) Standard for Disinfecting Water Mains
AWWA C700	(2009) Standard for Cold Water Meters - Displacement Type, Bronze Main Case
AWWA C701	(2007) Standard for Cold-Water Meters - Turbine Type for Customer Service
AWWA C702	(2010) Cold-Water Meters - Compound Type
AWWA C703	(1996; R 2004) Cold-Water Meters - Fire Service Type
AWWA C704	(2008) Propeller-Type Meters for Waterworks Applications
AWWA C706	(2010) Direct-Reading, Remote-Registration Systems for Cold-Water Meters
AWWA C800	(2005) Underground Service Line Valves and Fittings
AWWA C900	(2007; Errata 2008) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution
AWWA C901	(2008) Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13mm) Through 3 In. (76 mm), for Water Service
AWWA C909	(2009) Molecularly Oriented Polyvinyl Chloride (PVC0) Pressure Pipe, 4 IN through 24 IN (100 mm Through 600 mm), for Water, Wastewater, and Reclaimed Water Service
AWWA M23	(2002; 2nd Ed) Manual: PVC Pipe - Design and Installation

ASME INTERNATIONAL (ASME)

ASME B16.15	(2006) Cast Bronze Alloy Threaded Fittings Classes 125 and 250
ASME B16.18	(2001; R 2005) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.22	(2001; R 2010) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(2006) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B18.2.2	(2010) Standard for Square and Hex Nuts

ASME B18.5.2.1M (2006) Metric Round Head Short Square Neck Bolts

ASME B18.5.2.2M (1982; R 2005) Metric Round Head Square Neck Bolts

ASTM INTERNATIONAL (ASTM)

ASTM A307 (2010) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM A47/A47M (1999; R 2009) Standard Specification for Ferritic Malleable Iron Castings

ASTM A536 (1984; R 2009) Standard Specification for Ductile Iron Castings

ASTM A563 (2007a) Standard Specification for Carbon and Alloy Steel Nuts

ASTM B 32 (2008) Standard Specification for Solder Metal

ASTM B 42 (2010) Standard Specification for Seamless Copper Pipe, Standard Sizes

ASTM B 61 (2008) Standard Specification for Steam or Valve Bronze Castings

ASTM B 62 (2009) Standard Specification for Composition Bronze or Ounce Metal Castings

ASTM B 88 (2009) Standard Specification for Seamless Copper Water Tube

ASTM C 94/C 94M (2010a) Standard Specification for Ready-Mixed Concrete

ASTM D 1784 (2008) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

ASTM D 1785 (2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120

ASTM D 2241 (2009) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

ASTM D 2464 (2006) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

ASTM D 2466 (2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40

- ASTM D 2467 (2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
- ASTM D 2564 (2004; R 2009e1) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
- ASTM D 2657 (2007) Heat Fusion Joining Polyolefin Pipe and Fittings
- ASTM D 2774 (2008) Underground Installation of Thermoplastic Pressure Piping
- ASTM D 2855 (1996; R 2010) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
- ASTM D 3139 (1998; R 2005) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
- ASTM F 1483 (2005) Oriented Poly(Vinyl Chloride), PVC0, Pressure Pipe
- ASTM F 402 (2005) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
- ASTM F 477 (2010) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

- MSS SP-80 (2008) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 24 (2010) Standard for the Installation of Private Fire Service Mains and Their Appurtenances
- NFPA 704 (2007) Standard System for the Identification of the Hazards of Materials for Emergency Response

UNDERWRITERS LABORATORIES (UL)

- UL 246 (1993; Reprint Jun 2008) Hydrants for Fire-Protection Service
- UL 262 (2004; Reprint Jun 2008) Gate Valves for Fire-Protection Service
- UL 789 (2004; Reprint Aug 2008) Standard for

Indicator Posts for Fire-Protection Service

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-3

(1992) Recommended Practice for the Installation of Polyvinyl Chloride (PVC) Pressure Pipe (Nominal Diameters 4-36 Inch)

1.2 UNIT PRICES

Measurement and payment will be based on completed work performed in accordance with the drawings, specifications, and the contract payment schedules. Payment will not be made under this section for excavation, trenching, or backfilling.

1.3 DESIGN REQUIREMENTS

1.3.1 Water Distribution Mains

Provide water distribution mains indicated as 4 through 12 inch diameter pipe sizes of polyvinyl chloride (PVC) plastic pipe. Provide ductile iron pipe for 12 inch diameter or larger pipe sizes. Also provide water main accessories, gate valves as specified and where indicated.

1.3.2 Water Service Lines

Provide water service lines indicated as less than 4 inch lines from water distribution main to building service at the points indicated. Water service lines shall be copper tubing. Provide water service line appurtenances as specified and where indicated.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Piping Materials

Water distribution main piping, fittings, joints, valves, and coupling

Water service line piping, fittings, joints, valves, and coupling

Hydrants

Indicator posts

Corporation stops

Valve boxes

Submit manufacturer's standard drawings or catalog cuts, except

submit both drawings and cuts for push-on and rubber-gasketed bell-and-spigot joints. Include information concerning gaskets with submittal for joints and couplings.

SD-05 Design Data

Design calculations of water piping

SD-06 Test Reports

Bacteriological Disinfection; G; .

Test results from commercial laboratory verifying disinfection

SD-07 Certificates

Water distribution main piping, fittings, joints, valves, and coupling

Water service line piping, fittings, joints, valves, and coupling

Shop-applied lining and coating

Lining

Fire hydrants

Displacement Type Meters

Compound Type Meters

Certificates shall attest that tests set forth in each applicable referenced publication have been performed, whether specified in that publication to be mandatory or otherwise and that production control tests have been performed at the intervals or frequency specified in the publication. Other tests shall have been performed within 3 years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

SD-08 Manufacturer's Instructions

Delivery, storage, and handling

Installation procedures for water piping

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store plastic piping, jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, valves and hydrants free of dirt and debris.

1.5.2 Handling

Handle pipe, fittings, valves, hydrants, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make repairs if coatings or linings are damaged. Do not place any other material or pipe inside a pipe or fitting after the coating has been applied. Carry, do not drag pipe to the trench. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Store rubber gaskets that are not to be installed immediately, under cover out of direct sunlight.

1.5.2.1 Polyethylene (PE) Pipe, Fittings, and Accessories

Handle PE pipe, fittings, and accessories in accordance with [AWWA C901](#).

1.5.2.2 Miscellaneous Plastic Pipe and Fittings

Handle Polyvinyl Chloride (PVC), pipe and fittings in accordance with the manufacturer's recommendations. Store plastic piping and jointing materials that are not to be installed immediately under cover out of direct sunlight.

Storage facilities shall be classified and marked in accordance with [NFPA 704](#).

PART 2 PRODUCTS

2.1 WATER DISTRIBUTION MAIN MATERIALS

2.1.1 Piping Materials

2.1.1.1 Ductile-Iron Piping

- a. Pipe and Fittings: Pipe, [AWWA C151/A21.51](#), Pressure Class 200 . Fittings, [AWWA C110/A21.10](#) or [AWWA C153/A21.53](#) ; fittings with push-on joint ends conforming to the same requirements as fittings with mechanical-joint ends, except that the bell design shall be modified, as approved, for push-on joint. Fittings shall have pressure rating at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the specified joints. Pipe and fittings shall have cement-mortar lining, [AWWA C104/A21.4](#), standard thickness.
- b. Joints and Jointing Material:
 - (1) Joints: Joints for pipe and fittings shall be push-on joints or mechanical joints unless otherwise indicated. Provide mechanical joints where indicated.
 - (2) Push-On Joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly, [AWWA C111/A21.11](#).

2.1.1.2 Polyvinyl Chloride (PVC) Plastic Piping

- a. Pipe and Fittings: Pipe, [AWWA C900](#), shall be plain end or gasket bell end, Pressure Class 200 (DR 14) with cast-iron-pipe-equivalent OD. Molecularly Oriented Polyvinyl Chloride (PVC) pressure pipe, [AWWA C909](#), shall be plain end or gasket bell end, Pressure Class 150 with cast-iron-pipe-equivalent outside diameter.
- c. Fittings for PVC pipe: Fittings shall be gray iron or ductile iron, [AWWA C110/A21.10](#) or [AWWA C153/A21.53](#), and have cement-mortar lining, [AWWA C104/A21.4](#), standard thickness. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that bell design shall be modified, as approved, for push-on joint suitable for use with PVC plastic pipe specified in this paragraph. Iron fittings and specials shall be cement-mortar lined in accordance with [AWWA C104/A21.4](#). Pipe, couplings and fittings for PVC plastic pipe shall be manufactured of material conforming to [ASTM F 1483](#) and [ASTM D 1784](#), Class 12454-B.
- d. Joints and Jointing Material: Joints for pipe shall be push-on joints, [ASTM D 3139](#). Joints between pipe and metal fittings, valves, and other accessories shall be push-on joints [ASTM D 3139](#), or compression-type joints/mechanical joints, [ASTM D 3139](#) and [AWWA C111/A21.11](#). Provide each joint connection with an elastomeric gasket suitable for the bell or coupling with which it is to be used. Gaskets for push-on joints for pipe, [ASTM F 477](#). Gaskets for push-on joints and compression-type joints/mechanical joints for joint connections between pipe and metal fittings, valves, and other accessories, [AWWA C111/A21.11](#), respectively, for push-on joints and mechanical joints. Mechanically coupled joints using a sleeve-type mechanical coupling, as specified in paragraph entitled "Sleeve-Type Mechanical Couplings," may be used as an optional jointing method in lieu of push-on joints on plain-end PVC plastic pipe, subject to the limitations specified for mechanically coupled joints using a sleeve-type mechanical coupling and to the use of internal stiffeners as specified for compression-type joints in [ASTM D 3139](#).

2.1.2 Valves, Hydrants, and Other Water Main Accessories

2.1.2.1 Gate Valves on Buried Piping

[AWWA C500](#), [AWWA C509](#), or [UL 262](#). Unless otherwise specified, valves conforming to: (1) [AWWA C500](#) shall be nonrising stem type with double-disc gates and mechanical-joint ends or push-on joint ends as appropriate for the adjoining pipe, (2) [AWWA C509](#) shall be nonrising stem type with mechanical-joint ends or resilient-seated gate valves 3 to 12 inches in size, and (3) [UL 262](#) shall be inside-screw type with operating nut, double-disc or split-wedge type gate, designed for a hydraulic working pressure of 250 psi, and shall have mechanical-joint ends or push-on joint ends as appropriate for the pipe to which it is joined. Materials for [UL 262](#) valves shall conform to the reference standards specified in [AWWA C500](#). Valves shall open by counterclockwise rotation of the valve stem. Stuffing boxes shall have O-ring stem seals. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. In lieu of mechanical-joint ends and push-on joint ends, valves may have special ends for connection to sleeve-type mechanical coupling. Valve ends and gaskets for connection to sleeve-type mechanical coupling shall conform to the applicable requirements specified for the joint or

coupling. Where a post indicator is shown, the valve shall have an indicator post flange; indicator post flange for AWWA C500 valve shall conform to the applicable requirements of UL 262. Valves shall be of one manufacturer.

2.1.2.2 Fire Hydrants

Dry-barrel type . Paint hydrants with at least one coat of primer and two coats of yellow enamel paint, except use red enamel paint for tops of hydrants in non-potable water systems. Stencil hydrant number and main size on the hydrant barrel using black stencil paint.

- a. Dry-Barrel Type Fire Hydrants: Dry-barrel type hydrants, AWWA C502 or UL 246, "Base Valve" design, shall have 6 inch inlet, 5 1/4 inch valve opening, one 4 1/2 inch pumper connection, and two 2 1/2 inch hose connections. Inlet shall have mechanical-joint end only , except where flanged end is indicated; end shall conform to the applicable requirements as specified for the joint. Size and shape of operating nut, cap nuts, and threads on hose and pumper connections shall be as specified in AWWA C503 or UL 246 . Hydrants indicated as "traffic type," shall have breakable features as mentioned in AWWA C503. The traffic type hydrant shall have special couplings joining upper and lower sections of hydrant barrel and upper and lower sections of hydrant stem and shall be designed to have the special couplings break from a force not less than that which would be imposed by a moving vehicle; hydrant shall operate properly under normal conditions.
- b. Flush-Type Fire Hydrants: Hydrants shall conform to the applicable requirements of AWWA C502, except that they shall be of a design that will permit placement of hydrant below surface of pavement. Hydrants shall have 6 inch inlet, 4 1/4 inch minimum valve opening, one 4 1/2 inch pumper connection, and one 2 1/2 inch hose connection. Hose and pumper connections and operating nuts shall be readily accessible, and enclosed in a cast iron box with top flush with pavement and having cast-iron cover with flush lifting handle. Inlet shall have mechanical-joint or push-on joint end , except where flanged end is indicated. Size and shape of operating nut and cap nuts and threads on hose and pumper connections shall be as specified in AWWA C502 .

2.1.2.3 Indicator Posts

UL 789. Provide for gate valves where indicated.

2.1.2.4 Valve Boxes

Provide a valve box for each gate valve on buried piping , except where indicator post is shown. Valve boxes shall be of cast iron of a size suitable for the valve on which it is to be used and shall be adjustable. Cast-iron boxes shall have a minimum cover and wall thickness of 3/16 inch. Provide a round head. Cast the word "WATER" on the lid. The least diameter of the shaft of the box shall be 5 1/4 inches. as indicated. Cast-iron box shall have a heavy coat of bituminous paint.

2.1.2.5 Valve Pits

Valve pits shall be constructed at locations indicated or as required above and in accordance with the details shown.

2.1.2.6 Turbine Type Meters

Turbine type meters shall conform to [AWWA C701](#) Class I . The main casing shall be bronze with stainless steel external fasteners. Registers shall be straight-reading type, shall be permanently sealed and shall read in [U.S. gallons](#) . Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register designed in accordance with [AWWA C706](#) . Meters shall comply with the accuracy and capacity requirements of [AWWA C701](#).

2.1.2.7 Propeller Type Meters

Propeller type meters shall conform to [AWWA C704](#). Registers shall be straight-reading type, shall be permanently sealed and shall read in [U.S. gallons](#) . Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct-reading remote register designed in accordance with [AWWA C706](#) . Meters shall comply with the accuracy and capacity requirements of [AWWA C703](#).

2.1.2.8 Meter Vaults

Large meters shall be installed in reinforced concrete vaults manufactured in accordance with Section [03 40 00.00 10](#) PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION. Large meters shall be installed in reinforced concrete vaults in accordance with the details shown on the drawings.

2.1.2.9 Sleeve-Type Mechanical Couplings

Couplings shall be designed to couple plain-end piping by compression of a ring gasket at each end of the adjoining pipe sections. The coupling shall consist of one middle ring flared or beveled at each end to provide a gasket seat; two follower rings; two resilient tapered rubber gaskets; and bolts and nuts to draw the follower rings toward each other to compress the gaskets. The middle ring and the follower rings shall be true circular sections free from irregularities, flat spots, and surface defects; the design shall provide for confinement and compression of the gaskets. For ductile iron and PVC plastic pipe, the middle ring shall be of cast-iron . Malleable and ductile iron shall, conform to [ASTM A47/A47M](#) and [ASTM A536](#), respectively. Gaskets shall be designed for resistance to set after installation and shall meet the applicable requirements specified for gaskets for mechanical joint in [AWWA C111/A21.11](#). Bolts shall be track-head type, [ASTM A307](#), Grade A, with nuts, [ASTM A563](#), Grade A; or round-head square-neck type bolts, [ASME B18.5.2.1M](#) and [ASME B18.5.2.2M](#) with hex nuts, [ASME B18.2.2](#). Bolts shall be [5/8 inch](#) in diameter. Bolt holes in follower rings shall be of a shape to hold fast the necks of the bolts used. Mechanically coupled joints using a sleeve-type mechanical coupling shall not be used as an optional method of jointing except where pipeline is adequately anchored to resist tension pull across the joint. Mechanical couplings shall provide a tight flexible joint under all reasonable conditions, such as pipe movements caused by expansion, contraction, slight setting or shifting in the ground, minor variations in trench gradients, and traffic vibrations. Couplings shall be of strength not less than the adjoining pipeline.

2.1.2.10 Tracer Wire for Nonmetallic Piping

Provide bare copper or aluminum wire not less than [0.10 inch](#) in diameter in

sufficient length to be continuous over each separate run of nonmetallic pipe.

2.2 WATER SERVICE LINE MATERIALS

2.2.1 Piping Materials

2.2.1.1 Copper Pipe and Associated Fittings

Pipe, [ASTM B 42](#), regular, threaded ends. Fittings shall be brass or bronze, [ASME B16.15](#), 125 pound.

2.2.1.2 Copper Tubing and Associated Fittings

Tubing, [ASTM B 88](#), Type K. Fittings for solder-type joint, [ASME B16.18](#) or [ASME B16.22](#); fittings for compression-type joint, [ASME B16.26](#), flared tube type.

2.2.1.3 Plastic Piping

Plastic pipe and fittings shall bear the seal of the National Sanitation Foundation (NSF) for potable water service. Plastic pipe and fittings shall be supplied from the same manufacturer.

- a. Polyvinyl Chloride (PVC) Plastic Piping with Screw Joints: [ASTM D 1785](#), Schedule 40; or [ASTM D 2241](#), with SDR as necessary to provide 150 psi minimum pressure rating. Fittings, [ASTM D 2466](#) or [ASTM D 2467](#). Pipe and fittings shall be of the same PVC plastic material and shall be one of the following pipe/fitting combinations, as marked on the pipe and fitting, respectively: PVC 1120/PVC I; PVC 1220/PVC 12; PVC 2120/PVC II; PVC 2116/PVC II. Solvent cement for jointing, [ASTM D 2564](#). Pipe couplings, when used shall be tested as required by [ASTM D 2464](#).
- b. Polyvinyl Chloride (PVC) Plastic Piping with Elastomeric-Gasket Joints:
Pipe shall conform to dimensional requirements of [ASTM D 1785](#) Schedule 40, with joints meeting the requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified.
- c. Polyvinyl Chloride (PVC) Plastic Piping with Solvent Cement Joints:
Pipe shall conform to dimensional requirements of [ASTM D 1785](#) or [ASTM D 2241](#) with joints meeting the requirements of 150 psi working pressure and 200 psi hydrostatic test pressure.
- d. Polyethylene (PE) Plastic Pipe: Pipe tubing, and heat fusion fitting shall conform to [AWWA C901](#).
- e. Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe: [AWWA C909](#), plain end or gasket bell end, Pressure Class 150 with cast iron pipe equivalent outside diameter.

2.2.1.4 Insulating Joints

Joints between pipe of dissimilar metals shall have a rubber-gasketed or other suitable approved type of insulating joint or dielectric coupling which will effectively prevent metal-to-metal contact between adjacent sections of piping.

2.2.2 Water Service Line Appurtenances

2.2.2.1 Corporation Stops

Ground key type; bronze, ASTM B 61 or ASTM B 62; and suitable for the working pressure of the system. Ends shall be suitable for solder-joint, or flared tube compression type joint. Threaded ends for inlet and outlet of corporation stops, AWWA C800; coupling nut for connection to flared copper tubing, ASME B16.26.

2.2.2.2 Curb or Service Stops

Ground key, round way, inverted key type; made of bronze, ASTM B 61 or ASTM B 62; and suitable for the working pressure of the system. Ends shall be as appropriate for connection to the service piping. Arrow shall be cast into body of the curb or service stop indicating direction of flow.

2.2.2.3 Service Clamps

Service clamps used for repairing damaged cast-iron, steel, PVC or asbestos-cement pipe shall have a pressure rating not less than that of the pipe to be connected and shall be either the single or double flattened strap type. Clamps shall have a galvanized malleable-iron body with cadmium plated straps and nuts. Clamps shall have a rubber gasket cemented to the body.

2.2.2.4 Goosenecks

Type K copper tubing. Joint ends for goosenecks shall be appropriate for connecting to corporation stop and service line. Where multiple gooseneck connections are required for an individual service, goosenecks shall be connected to the service line through a suitable approved brass or bronze branch connection; the total clear area of the branches shall be at least equal to the clear area of the service line. Length of goosenecks shall be in accordance with standard practice.

2.2.2.5 Dielectric Fittings

Dielectric fittings shall be installed between threaded ferrous and nonferrous metallic pipe, fittings and valves, except where corporation stops join mains. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure.

2.2.2.6 Gate Valves 3 Inch Size and Larger on Buried Piping

Gate valves 3 inch size and larger AWWA C500 or UL 262 and of one manufacturer. Valves, AWWA C500, nonrising stem type with double-disc gates. Valves, UL 262, inside-screw type with operating nut, split wedge or double disc type gate, and designed for a hydraulic working pressure of 175 psi. Materials for UL 262 valves conforming to the reference standards specified in AWWA C500. Valves shall open by counterclockwise rotation of the valve stem. Stuffing boxes shall have O-ring stem seals and shall be bolted and constructed so as to permit easy removal of parts for repair. Valves on service lines shall have ends suitable for joining to the pipe used; push-on joint ends or mechanical-joint ends for joining to ductile-iron pipe or push-on joint ends or mechanical-joint ends for joining to PVC plastic water main pipe; gaskets and pipe ends,

AWWA C111/A21.11.

2.2.2.7 Gate Valves Smaller than 3 Inch in Size on Buried Piping

Gate valves smaller than 3 inch size on Buried Piping MSS SP-80, Class 150, solid wedge, nonrising stem. Valves shall have flanged or threaded end connections, with a union on one side of the valve. Provide handwheel operators.

2.2.2.8 Curb Boxes

Provide a curb box for each curb or service stop. Curb boxes shall be of cast iron of a size suitable for the stop on which it is to be used. Provide a round head. Cast the word "WATER" on the lid. Each box shall have a heavy coat of bituminous paint.

2.2.2.9 Valve Boxes

Provide a valve box for each gate valve on buried piping. Valve boxes shall be of cast iron of a size suitable for the valve on which it is to be used and shall be adjustable. Provide a round head. Cast the word "WATER" on the lid. The least diameter of the shaft of the box shall be 5 1/4 inches as indicated. Cast-iron box shall have a heavy coat of bituminous paint.

2.2.2.10 Tapping Sleeves

Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 150 psi. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pretorqued to 50 foot-pound.

2.2.2.11 Displacement Type Meters

Displacement type meters shall conform to AWWA C700. Registers shall be straight-reading and shall read in cubic meters U.S. gallon . Meters in sizes 13 through 1/2 through 1 shall be frost-protection design. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register designed in accordance with AWWA C706 . Meters shall comply with the accuracy and capacity requirements of AWWA C700.

2.2.2.12 Compound Type Meters

Compound type meters shall conform to AWWA C702 and shall be furnished with strainers. The main casing shall be bronze with stainless steel external fasteners. The main casing shall be tapped for field testing purposes. Registers shall be straight-reading type, shall be permanently sealed and shall read in U.S. gallons . The meter shall be equipped with a coordinating register. Connections shall be suitable to the type of pipe

and conditions encountered. Register type shall be a direct reading remote register designed in accordance with [AWWA C706](#) . Meters shall comply with the accuracy and capacity requirements of [AWWA C702](#).

2.2.2.13 Fire Service Type Meters

Fire service type meters shall be proportional type conforming to [AWWA C703](#) and shall be furnished with strainers. The main casing shall be bronze with stainless steel external fasteners. Registers shall be straight-reading type, shall be permanently sealed and shall read in [U.S. gallons](#) . The meter shall be equipped with a coordinating register. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register designed in accordance with [AWWA C706](#) . Meters shall comply with the accuracy and capacity requirements of [AWWA C703](#). When turbine type main line meters are used, the meter shall be supplied with a separate check valve, as a unit.

2.2.2.14 Meter Boxes

Meter boxes shall be of cast iron, concrete, or plastic. Concrete meter boxes shall be manufactured in accordance with Section [03 40 00.00 10](#) PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION. The boxes shall be of sufficient size to completely enclose the meter and shutoff valve or service stop. Meter boxes set in paved areas subject to vehicular traffic shall be cast iron, or concrete with cast iron lid and cast iron meter reader lid. Boxes set in sidewalks, not subject to vehicular traffic, shall use concrete covers with cast iron meter reader lids . Plastic boxes and lids shall be used in unpaved areas or grass areas not subject to vehicular traffic. Box height shall extend from invert of the meter to final grade at the meter location. The lid shall have the word "WATER" cast in it.

2.2.2.15 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: [AWWA B301](#).

Hypochlorite, Calcium and Sodium: [AWWA B300](#).

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to all pipeline [installation](#) except where specific exception is made in the "Special Requirements..." paragraphs.

3.1.1.1 Location of Water Lines

Terminate the work covered by this section at a point approximately [5 feet](#) from the building , unless otherwise indicated. Where the location of the water line is not clearly defined by dimensions on the drawings, do not lay water line closer horizontally than [10 feet](#) from any sewer line. Where water lines cross under gravity sewer lines, encase sewer line fully in concrete for a distance of at least [10 feet](#) on each side of the crossing,

unless sewer line is made of pressure pipe with rubber-gasketed joints and no joint is located within **3 feet** horizontally of the crossing. Lay water lines which cross sewer force mains and inverted siphons at least **2 feet** above these sewer lines; when joints in the sewer line are closer than **3 feet** horizontally from the water line, encase these joints in concrete. Do not lay water lines in the same trench with gas lines fuel lines or electric wiring. Copper tubing shall not be installed in the same trench with ferrous piping materials. Where nonferrous metallic pipe, e.g. copper tubing, cross any ferrous piping, provide a minimum vertical separation of **12 inches** between pipes.

Where water piping is required to be installed within 1 m 3 feet of existing structures, the water pipe shall be sleeved as required in Paragraph "Casting Pipe". The Contractor shall install the water pipe and sleeve ensuring that there will be no damage to the structures and no settlement or movement of foundations or footings.

Terminate the work covered by this section at a point approximately **5 feet** from the building , unless otherwise indicated. Do not lay water lines in the same trench with gas lines fuel lines or electric wiring.

a. Water Piping Installation Parallel With Sewer Piping

- (1) Normal Conditions: Lay water piping at least **10 feet** horizontally from a sewer or sewer manhole whenever possible. Measure the distance edge-to-edge.
- (2) Unusual Conditions: When local conditions prevent a horizontal separation of **10 feet**, the water piping may be laid closer to a sewer or sewer manhole provided that:
 - (a) The bottom (invert) of the water piping shall be at least **18 inches** above the top (crown) of the sewer piping.
 - (b) Where this vertical separation cannot be obtained, the sewer piping shall be constructed of AWWA-approved water pipe and pressure tested in place without leakage prior to backfilling. Approved waste water disposal method shall be utilized.
 - (c) The sewer manhole shall be of watertight construction and tested in place.

b. Installation of Water Piping Crossing Sewer Piping

- (1) Normal Conditions: Water piping crossing above sewer piping shall be laid to provide a separation of at least **18 inches** between the bottom of the water piping and the top of the sewer piping.
- (2) Unusual Conditions: When local conditions prevent a vertical separation described above, use the following construction:
 - (a) Sewer piping passing over or under water piping shall be constructed of AWWA-approved ductile iron water piping, pressure tested in place without leakage prior to backfilling.
 - (b) Water piping passing under sewer piping shall, in addition, be protected by providing a vertical separation of at least **18 inches** between the bottom of the sewer piping and the top of the

water piping; adequate structural support for the sewer piping to prevent excessive deflection of the joints and the settling on and breaking of the water piping; and that the length, minimum 20 feet, of the water piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer piping.

- c. Sewer Piping or Sewer Manholes: No water piping shall pass through or come in contact with any part of a sewer manhole.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 31 00 00 EARTHWORK.

3.1.1.3 Pipe Laying and Jointing

Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories, and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Do not under any circumstances drop or dump pipe, fittings, valves, or any other water line material into trenches. Cut pipe in a neat workmanlike manner accurately to length established at the site and work into place without springing or forcing. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material. Blocking or wedging between bells and spigots will not be permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade the pipeline in straight lines; avoid the formation of dips and low points. Support pipe at proper elevation and grade. Secure firm, uniform support. Wood support blocking will not be permitted. Lay pipe so that the full length of each section of pipe and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports where indicated and where necessary for fastening work into place. Make proper provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been properly made. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevent installation. Depth of cover over top of pipe shall not be less than 2 1/2 feet.

3.1.1.4 Installation of Tracer Wire

Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.

3.1.1.5 Connections to Existing Water Lines

Make connections to existing water lines after approval is obtained and with a minimum interruption of service on the existing line. Make connections to existing lines under pressure in accordance with the recommended procedures of the manufacturer of the pipe being tapped .

3.1.1.6 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

3.1.1.7 Flanged Pipe

Flanged pipe shall only be installed above ground or with the flanges in valve pits.

3.1.2 Special Requirements for Installation of Water Mains

3.1.2.1 Installation of Ductile-Iron Piping

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the requirements of [AWWA C600](#) for pipe installation, joint assembly, valve-and-fitting installation, and thrust restraint.

- a. **Jointing:** Make push-on joints with the gaskets and lubricant specified for this type joint; assemble in accordance with the applicable requirements of [AWWA C600](#) for joint assembly. Make mechanical joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of [AWWA C600](#) for joint assembly and the recommendations of Appendix A to [AWWA C111/A21.11](#). Make flanged joints with the gaskets, bolts, and nuts specified for this type joint. Make flanged joints up tight; avoid undue strain on flanges, fittings, valves, and other equipment and accessories. Align bolt holes for each flanged joint. Use full size bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange. When flanged pipe or fitting has dimensions that do not allow the making of a proper flanged joint as specified, replace it by one of proper dimensions. Use setscrewed flanges to make flanged joints where conditions prevent the use of full-length flanged pipe and assemble in accordance with the recommendations of the setscrewed flange manufacturer. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer.
- b. **Allowable Deflection:** The maximum allowable deflection shall be as given in [AWWA C600](#). If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.
- c. **Pipe Anchorage:** Provide concrete thrust blocks (reaction backing) for pipe anchorage, except where metal harness is indicated. Thrust blocks shall be in accordance with the requirements of [AWWA C600](#) for thrust restraint, except that size and positioning of thrust blocks shall be as indicated. Use concrete, [ASTM C 94/C 94M](#), having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength. Metal harness shall be in accordance with the requirements of [AWWA C600](#) for thrust restraint, using tie rods and clamps as shown in [NFPA 24](#), except as otherwise indicated.
- d. **Exterior Protection:** Completely encase buried ductile iron pipelines with polyethylene tube or sheet, using Class A polyethylene film, in accordance with [AWWA C105/A21.5](#).

3.1.2.2 Installation of PVC Plastic Water Main Pipe

Installation of PVC Plastic Water Main Pipe and Associated Fittings: Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines"; with the requirements of [UBPPA UNI-B-3](#) for laying of pipe, joining PVC pipe to fittings and accessories, and setting of hydrants, valves, and fittings; and with the recommendations for pipe joint assembly and appurtenance installation in [AWWA M23](#), Chapter 7, "Installation."

- a. Jointing: Make push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel; for push-on joint connections to metal fittings, valves, and other accessories, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of [UBPPA UNI-B-3](#) for laying the pipe and the recommendations in [AWWA M23](#), Chapter 7, "Installation," for pipe joint assembly. Assemble push-on joints for connection to fittings, valves, and other accessories in accordance with the requirements of [UBPPA UNI-B-3](#) for joining PVC pipe to fittings and accessories and with the applicable requirements of [AWWA C600](#) for joint assembly. Make compression-type joints/mechanical joints with the gaskets, glands, bolts, nuts, and internal stiffeners previously specified for this type joint; assemble in accordance with the requirements of [UBPPA UNI-B-3](#) for joining PVC pipe to fittings and accessories, with the applicable requirements of [AWWA C600](#) for joint assembly, and with the recommendations of Appendix A to [AWWA C111/A21.11](#). Cut off spigot end of pipe for compression-type joint/mechanical-joint connections and do not re-bevel. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer using internal stiffeners as previously specified for compression-type joints.
- b. Offset: Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but shall not exceed 5 degrees.
- c. Pipe Anchorage: Provide concrete thrust blocks (reaction backing) metal harness for pipe anchorage, except where metal harness is indicated. Thrust blocks shall be in accordance with the requirements of [UBPPA UNI-B-3](#) for reaction or thrust blocking and plugging of dead ends, except that size and positioning of thrust blocks shall be as indicated. Use concrete, [ASTM C 94/C 94M](#), having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength. Metal harness shall be as indicated.
- d. Fittings: Install in accordance with [AWWA C605](#).

3.1.2.3 Installation of Polyethylene (PE) Plastic Piping

- a. General Installation:

PE pipes shall be installed in accordance with [ASTM D 2774](#).

b. Jointing:

Jointing shall comply with [ASTM D 2657](#), Technique I-Socket Fusion or Technique II-Butt Fusion.

c. Offsets:

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but shall not exceed 5 degrees.

3.1.2.4 Installation of Molecularly Oriented Polyvinyl Chloride (PVC) Pressure Piping

a. General Installation:

Install PVC Pressure piping in accordance with [AWWA C605](#).

b. Jointing:

As required for PVC piping.

c. Anchorage:

As required for PVC piping.

d. Offsets:

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but shall not exceed 5 degrees.

3.1.2.5 Installation of Valves and Hydrants

- a. Installation of Valves: Install gate valves, [AWWA C500](#) and [UL 262](#), in accordance with the requirements of [AWWA C600](#) for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to [AWWA C500](#). Install gate valves, [AWWA C509](#), in accordance with the requirements of [AWWA C600](#) for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to [AWWA C509](#). Install gate valves on PVC water mains in accordance with the recommendations for appurtenance installation in [AWWA M23](#), Chapter 7, "Installation." Make and assemble joints to gate valves as specified for making and assembling the same type joints between pipe and fittings.

- b. Installation of Hydrants: Install hydrants in accordance with [AWWA C600](#) for hydrant installation and as indicated. Make and assemble joints as specified for making and assembling the same type joints between pipe and fittings. Provide metal harness as specified under pipe anchorage requirements for the respective pipeline material to which hydrant is attached. Install hydrants with the 4 1/2 inch connections facing the adjacent paved surface. If there are two paved adjacent surfaces, contact the Contracting Officer for further instructions.

3.1.3 Installation of Water Service Piping

3.1.3.1 Location

Connect water service piping to the building service where the building service has been installed. Where building service has not been installed, terminate water service lines approximately 5 feet from the building line at the points indicated; such water service lines shall be closed with plugs or caps.

3.1.3.2 Service Line Connections to Water Mains

Connect service lines to the main by a corporation stop and gooseneck and install a service stop below the frostline .

3.1.4 Special Requirements for Installation of Water Service Piping

3.1.4.1 Installation of Metallic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the applicable requirements of AWWA C600 for pipe installation, unless otherwise specified.

a. Jointing:

- (1) Screwed Joints: Make screwed joints up tight with a stiff mixture of graphite and oil, inert filler and oil, or graphite compound; apply to male threads only. Threads shall be full cut; do not leave more than three threads on the pipe exposed after assembling the joint.
- (2) Joints for Copper Tubing: Cut copper tubing with square ends; remove fins and burrs. Handle tubing carefully; replace dented, gouged, or otherwise damaged tubing with undamaged tubing. Make solder joints using ASTM B 32, 95-5 tin-antimony or Grade Sn96 solder. Solder and flux shall contain not more than 0.2 percent lead. Before making joint, clean ends of tubing and inside of fitting or coupling with wire brush or abrasive. Apply a rosin flux to the tubing end and on recess inside of fitting or coupling. Insert tubing end into fitting or coupling for the full depth of the recess and solder. For compression joints on flared tubing, insert tubing through the coupling nut and flare tubing.
- (3) Flanged Joints: Make flanged joints up tight, taking care to avoid undue strain on flanges, valves, fittings, and accessories.

- b. Protection of Buried Steel Service Line Piping: Unless otherwise specified, prepare, prime, and coat exterior surface of zinc-coated steel pipe and associated fittings to be buried with hot-applied coal-tar enamel with a bonded single layer of felt wrap in accordance with AWWA C203 . For the felt wrap material, use fibrous-glass mat as specified in AWWA C203; use of asbestos felt will not be permitted. Use solvent wash only to remove oil, grease, and other extraneous matter from zinc-coated pipe and fittings.

3.1.4.2 Installation of Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the applicable

requirements of [ASTM D 2774](#) and [ASTM D 2855](#), unless otherwise specified. Handle solvent cements used to join plastic piping in accordance with [ASTM F 402](#).

- a. Jointing: Make solvent-cemented joints for PVC plastic piping using the solvent cement previously specified for this material; assemble joints in accordance with [ASTM D 2855](#). Make plastic pipe joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.
- b. Plastic Pipe Connections to Appurtenances: Connect plastic pipe service lines to corporation stops and gate valves in accordance with the recommendations of the plastic pipe manufacturer.

3.1.4.3 Service Lines for Sprinkler Supplies

Water service lines used to supply building sprinkler systems for fire protection shall be connected to the water distribution main in accordance with [NFPA 24](#).

3.1.4.4 Location of Meters

Meters and meter boxes shall be installed at the locations shown on the drawings. The meters shall be centered in the boxes to allow for reading and ease of removal or maintenance.

3.1.5 Disinfection

Prior to disinfection, obtain Contracting Officer approval of the proposed method for disposal of waste water from disinfection procedures. Disinfect new water piping and existing water piping affected by Contractor's operations in accordance with [AWWA C651](#). Fill piping systems with solution containing minimum of 50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 and 0.5 parts per million, or the residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit the results prior to the new water piping being placed into service. Disinfection of systems supplying nonpotable water is not required.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

Prior to hydrostatic testing, obtain Contracting Officer approval of the proposed method for disposal of waste water from hydrostatic testing. The Contracting Officer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests, and provide labor, equipment, and incidentals required for testing. The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with the drawings and specifications. Do not begin testing on any section of a pipeline where concrete thrust blocks have been provided until at least 5 days after placing of the concrete.

3.2.2 Testing Procedure

Test water mains and water service lines in accordance with the applicable

specified standard, except for the special testing requirements given in paragraph entitled "Special Testing Requirements." Test ductile-iron water mains and water service lines in accordance with the requirements of **AWWA C600** for hydrostatic testing. The amount of leakage on ductile-iron pipelines with mechanical-joints or push-on joints shall not exceed the amounts given in **AWWA C600**; no leakage will be allowed at joints made by any other method. Test PVC plastic water mains and water service lines made with PVC plastic water main pipe in accordance with the requirements of **UBPPA UNI-B-3** for pressure and leakage tests. The amount of leakage on pipelines made of PVC plastic water main pipe shall not exceed the amounts given in **UBPPA UNI-B-3**, except that at joints made with sleeve-type mechanical couplings, no leakage will be allowed. Test water service lines in accordance with applicable requirements of **AWWA C600** for hydrostatic testing. No leakage will be allowed at copper pipe joints copper tubing joints (soldered, compression type, brazed) and flanged joints .

3.2.3 Special Testing Requirements

For pressure test, use a hydrostatic pressure **50 psi** greater than the maximum working pressure of the system, except that for those portions of the system having pipe size larger than **2 inches** in diameter, hydrostatic test pressure shall be not less than **200 psi**. Hold this pressure for not less than 2 hours. Prior to the pressure test, fill that portion of the pipeline being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

3.3 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

-- End of Section --

SECTION 33 30 00

SANITARY SEWERS
04/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

- ACPA 01-102 (2000) Concrete Pipe Handbook
ACPA 01-103 (2000) Concrete Pipe Installation Manual

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION
(AREMA)

- AREMA Eng Man (2010) Manual for Railway Engineering

AMERICAN WATER WORKS ASSOCIATION (AWWA)

- AWWA C104/A21.4 (2008; Errata 2010) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105/A21.5 (2010) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110/A21.10 (2008) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11 (2007) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15 (2005) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151/A21.51 (2009) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C153/A21.53 (2006) Ductile-Iron Compact Fittings for Water Service
AWWA C600 (2010) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C605 (2005) Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
AWWA C900 (2007; Errata 2008) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated

Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution

AWWA M23 (2002; 2nd Ed) Manual: PVC Pipe - Design and Installation

AWWA M9 (20083rd Ed) Manual: Concrete Pressure Pipe

ASME INTERNATIONAL (ASME)

ASME B1.20.1 (1983; R 2006) Pipe Threads, General Purpose (Inch)

ASME B16.1 (2010) Gray Iron Threaded Fittings; Classes 25, 125 and 250

ASME B18.2.2 (2010) Standard for Square and Hex Nuts

ASME B18.5.2.1M (2006) Metric Round Head Short Square Neck Bolts

ASME B18.5.2.2M (1982; R 2005) Metric Round Head Square Neck Bolts

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M (2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A307 (2010) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM A47/A47M (1999; R 2009) Standard Specification for Ferritic Malleable Iron Castings

ASTM A48/A48M (2003; R 2008) Standard Specification for Gray Iron Castings

ASTM A536 (1984; R 2009) Standard Specification for Ductile Iron Castings

ASTM A563 (2007a) Standard Specification for Carbon and Alloy Steel Nuts

ASTM A746 (2009) Standard Specification for Ductile Iron Gravity Sewer Pipe

ASTM C 12 (2009) Standard Practice for Installing Vitrified Clay Pipe Lines

ASTM C 150/C 150M (2009) Standard Specification for Portland Cement

ASTM C 270 (2010) Standard Specification for Mortar for Unit Masonry

ASTM C 33/C 33M	(2011) Standard Specification for Concrete Aggregates
ASTM C 443	(2010) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C 478	(2009) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 828	(2011) Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C 923	(2008) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C 924	(2002; R 2009) Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C 94/C 94M	(2010a) Standard Specification for Ready-Mixed Concrete
ASTM C 969	(2002; R 2009) Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C 972	(2000; R 2006) Compression-Recovery of Tape Sealant
ASTM C 990	(2009) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM D 1784	(2008) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(2009) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2321	(2011) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2412	(2010a) Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D 2464	(2006) Standard Specification for Threaded

	Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2680	(2001; R 2009) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 2751	(2005) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 2996	(2001; R 2007e1) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 2997	(2001; R 2007e1) Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 3034	(2008) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3139	(1998; R 2005) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(2007) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3262	(2006) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe
ASTM D 3350	(2010a) Polyethylene Plastics Pipe and Fittings Materials
ASTM D 3753	(2005e1) Glass-Fiber-Reinforced Polyester Manholes and Wetwells
ASTM D 3840	(2010) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Fittings for Nonpressure Applications
ASTM D 4101	(2010a) Standard Specification for Polypropylene Injection and Extrusion Materials
ASTM D 412	(2006ae2) Standard Test Methods for

Vulcanized Rubber and Thermoplastic
Elastomers - Tension

- ASTM D 4161 (2010) "Fiberglass"
(Glass-Fiber-Reinforced
Thermosetting-Resin) Pipe Joints Using
Flexible Elastomeric Seals
- ASTM D 624 (2000; R 2007) Tear Strength of
Conventional Vulcanized Rubber and
Thermoplastic Elastomers
- ASTM F 402 (2005) Safe Handling of Solvent Cements,
Primers, and Cleaners Used for Joining
Thermoplastic Pipe and Fittings
- ASTM F 477 (2010) Standard Specification for
Elastomeric Seals (Gaskets) for Joining
Plastic Pipe
- ASTM F 714 (2010) Polyethylene (PE) Plastic Pipe
(SDR-PR) Based on Outside Diameter
- ASTM F 894 (2007) Polyethylene (PE) Large Diameter
Profile Wall Sewer and Drain Pipe
- ASTM F 949 (2010) Poly(Vinyl Chloride) (PVC)
Corrugated Sewer Pipe with a Smooth
Interior and Fittings

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

- CID A-A-60005 (Basic; Notice 2) Frames, Covers,
Gratings, Steps, Sump And Catch Basin,
Manhole

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

- 29 CFR 1910.27 Fixed Ladders

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

- UBPPA UNI-B-6 (1998) Recommended Practice for
Low-Pressure Air Testing of Installed
Sewer Pipe

1.2 SYSTEM DESCRIPTION

1.2.1 Sanitary Sewer Gravity Pipeline

Provide mains and laterals of polyvinyl chloride (PVC) plastic pipe.
Provide building connections 4 inch lines of polyvinyl chloride (PVC)
plastic pipe.

1.2.2 Sanitary Sewer Pressure Lines

Provide pressure lines of ductile iron pressure pipe .

1.2.3 USACE Project

The construction required herein shall include appurtenant structures and building sewers to points of connection with the building drains 5 feet outside the building to which the sewer system is to be connected. Replace damaged material and redo unacceptable work at no additional cost to the Government. Backfilling shall be accomplished after inspection by the Contracting Officer. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Existing Conditions

SD-02 Shop Drawings

Drawings
Precast concrete manhole
Metal items
Frames, covers, and gratings

SD-03 Product Data

Pipeline materials

SD-06 Test Reports

Reports

SD-07 Certificates

Portland Cement
Gaskets

1.4 QUALITY ASSURANCE

1.4.1 Installer Qualifications

Install specified materials by a licensed underground utility Contractor licensed for such work in the state where the work is to be performed. Installing Contractor's License shall be current and be state certified or state registered.

1.4.2 Drawings

- a. Submit Installation Drawings showing complete detail, both plan and side view details with proper layout and elevations.
- b. Submit As-Built Drawings for the complete sanitary sewer system showing complete detail with all dimensions, both above and below grade, including invert elevation.
- c. Sign and seal As-Built Drawings by a Professional Surveyor and Mapper. Include the following statement: "All potable water lines crossed by sanitary hazard mains are in accordance with the permitted utility separation requirements."

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

1.5.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.5.1.2 Metal Items

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.5.1.3 Cement, Aggregate, and Reinforcement

As specified in Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE .

1.5.2 Handling

Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. Take special care not to damage linings of pipe and fittings; if lining is damaged, make satisfactory repairs. Carry, do not drag, pipe to trench.

1.6 PROJECT/SITE CONDITIONS

Submit drawings of [existing conditions](#), after a thorough inspection of the area in the presence of the Contracting Officer. Details shall include the environmental conditions of the site and adjacent areas. Submit copies of the records for verification before starting work.

PART 2 PRODUCTS

2.1 PIPELINE MATERIALS

Pipe shall conform to the respective specifications and other requirements specified below. Submit manufacturer's standard drawings or catalog cuts.

2.1.1 Ductile Iron Gravity Sewer Pipe and Associated Fittings

2.1.1.1 Ductile Iron Gravity Pipe and Fittings

Ductile iron pipe shall conform to [ASTM A746](#), Thickness Class 50. Fittings shall conform to [AWWA C110/A21.10](#) or [AWWA C153/A21.53](#). Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, . Fittings shall have strength at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the joints specified hereinafter. Pipe and fittings shall have cement-mortar lining conforming to [AWWA C104/A21.4](#), standard thickness.

2.1.1.2 Ductile Iron Gravity Joints and Jointing Materials

Pipe and fittings shall have push-on joints , except as otherwise specified in this paragraph. Mechanical joints only shall be used where indicated. Push-on joint pipe ends and fitting ends, gaskets, and lubricant for joint assembly shall conform to [AWWA C111/A21.11](#). Mechanical joint requirements for pipe ends, glands, bolts and nuts, and gaskets shall conform to [AWWA C111/A21.11](#).

2.1.2 Ductile Iron Pressure Piping

2.1.2.1 Ductile Iron Pressure Pipe and Fittings

Ductile-iron pipe shall conform to [AWWA C151/A21.51](#), Thickness Class 50. Fittings shall conform to [AWWA C110/A21.10](#) or [AWWA C153/A21.53](#). Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that the bell design shall be modified, as approved, for push-on joint. Fittings shall have pressure rating at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the joints specified hereinafter. Pipe and fittings shall have cement-mortar lining conforming to [AWWA C104/A21.4](#), standard thickness.

2.1.2.2 Ductile Iron Pressure Joints and Jointing Materials

- a. Joints, general: Joints for pipe and fittings shall be push-on joints or mechanical joints except as otherwise specified in this paragraph. Joints shall be mechanical-joints where indicated.
- b. Push-on joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly shall conform to [AWWA C111/A21.11](#).
- c. Mechanical joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets shall conform to [AWWA C111/A21.11](#).
- d. Flanged joints: Bolts, nuts, and gaskets for flanged connections shall be as recommended in the Appendix to [AWWA C115/A21.15](#). Flange for setscrewed flanges shall be of ductile iron, [ASTM A536](#), Grade 65-45-12, and shall conform to the applicable requirements of [ASME B16.1](#), Class 250. Setscrews for setscrewed flanges shall be 190,000 psi tensile strength, heat treated, and zinc-coated steel. Gasket for setscrewed flanges shall conform to the applicable requirements for mechanical-joint gaskets specified in [AWWA C111/A21.11](#). Design of setscrewed gasket shall provide for confinement and compression of gasket when joint to adjoining flange is made.
- e. Joints made with sleeve-type mechanical couplings: Couplings shall be

designed to couple plain-end piping by compression of a ring gasket at each end of the adjoining pipe sections. The coupling shall consist of one middle ring flared or beveled at each end to provide a gasket seat, two follower rings, two resilient tapered rubber gaskets, and bolts and nuts to draw the follower rings toward each other to compress the gaskets. The middle ring and the follower rings shall be true circular sections free from irregularities, flat spots, and surface defects; the design shall provide for confinement and compression of the gaskets. Middle ring shall be of cast-iron, and the follower rings shall be of malleable iron or ductile iron. Cast iron shall conform to [ASTM A48/A48M](#) and shall be not less than Class 25. Malleable iron shall conform to [ASTM A47/A47M](#). Ductile iron shall conform to [ASTM A536](#). Gaskets shall be designed for long life and resistance to set after installation and shall meet the applicable requirements specified for gaskets for mechanical joint in [AWWA C111/A21.11](#). Bolts shall be track-head type; bolts and nuts shall be either of the following: bolts conforming to the tensile requirements of [ASTM A307](#), Grade A, with nuts conforming to the tensile requirements of [ASTM A563](#), Grade A; or round-head square-neck type bolts conforming to [ASME B18.5.2.1M](#) and [ASME B18.5.2.2M](#) with hex nuts conforming to [ASME B18.2.2](#). Bolts shall be 5/8 inch in diameter. Bolt holes in follower rings shall be of a shape to hold fast the necks of the bolts used. Sleeve-type mechanical couplings shall not be used as an optional method of jointing except where pipeline is adequately anchored to resist tension pull across the joint.

2.1.3 PVC Plastic Gravity Sewer Piping

2.1.3.1 PVC Plastic Gravity Pipe and Fittings

[ASTM D 3034](#), SDR 35, or [ASTM F 949](#) with ends suitable for elastomeric gasket joints.

2.1.3.2 PVC Plastic Gravity Joints and Jointing Material

Joints shall conform to [ASTM D 3212](#). Gaskets shall conform to [ASTM F 477](#).

2.1.4 PVC Plastic Pressure Pipe and Associated Fittings

2.1.4.1 PVC Plastic Pressure Pipe and Fittings

- a. Pipe and Fittings Less Than 4 inch Diameter: Pipe, couplings and fittings shall be manufactured of materials conforming to [ASTM D 1784](#), Class 12454B.

- (1) Screw-Joint: Pipe shall conform to dimensional requirements of [ASTM D 1785](#), Schedule 80, with joints meeting requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified. Fittings for threaded pipe shall conform to requirements of [ASTM D 2464](#), threaded to conform to the requirements of [ASME B1.20.1](#) for use with Schedule 80 pipe and fittings. Pipe couplings when used, shall be tested as required by [ASTM D 2464](#).
- (2) Push-On Joint: [ASTM D 3139](#), with [ASTM F 477](#) gaskets. Fittings for push-on joints shall be iron conforming to [AWWA C110/A21.10](#) or [AWWA C111/A21.11](#). Iron fittings and specials shall shall be

cement-mortar lined (standard thickness) in accordance with [AWWA C104/A21.4](#).

- (3) Solvent Cement Joint: Pipe shall conform to dimensional requirements of [ASTM D 1785](#) or [ASTM D 2241](#) with joints meeting the requirements of 150 psi working pressure and 200 psi hydrostatic test pressure. Fittings for solvent cement jointing shall conform to [ASTM D 2466](#) or [ASTM D 2467](#).

- b. Pipe and Fittings 4 inch Diameter to 12 inch: Pipe shall conform to [AWWA C900](#) and shall be plain end or gasket bell end, Pressure Class 150 (DR 18), with cast-iron-pipe-equivalent OD. Fittings shall be gray-iron or ductile-iron conforming to [AWWA C110/A21.10](#) or [AWWA C153/A21.53](#) and shall have cement-mortar lining conforming to [AWWA C104/A21.4](#), standard thickness. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that bell design shall be modified, as approved, for push-on joint suitable for use with the PVC plastic pressure pipe specified in this paragraph.

2.1.4.2 PVC Plastic Pressure Joints and Jointing Material

Joints for pipe, 4 inch to 12 inch diameter, shall be push-on joints as specified in [ASTM D 3139](#). Joints between pipe and fittings shall be push-on joints as specified in [ASTM D 3139](#) or shall be compression-type joints/mechanical-joints as respectively specified in [ASTM D 3139](#) and [AWWA C111/A21.11](#). Each joint connection shall be provided with an elastomeric gasket suitable for the bell or coupling with which it is to be used. Gaskets for push-on joints for pipe shall conform to [ASTM F 477](#). Gaskets for push-on joints and compression-type joints/mechanical-joints for joint connections between pipe and fittings shall be as specified in [AWWA C111/A21.11](#), respectively, for push-on joints and mechanical-joints.

2.1.5 High Density Polyethylene Pipe

[ASTM F 894](#), Class 63, size 18 inch through 120 inch. [ASTM F 714](#), size 4 inch through 48 inch. The polyethylene shall be certified by the resin producer as meeting the requirements of [ASTM D 3350](#), cell Class 334433C. The pipe stiffness shall be greater than or equal to 1170/D for cohesionless material pipe trench backfills. Fittings for High Density Polyethylene Pipe: [ASTM F 894](#). Joints for high density polyethylene pipe: Rubber gasket joints shall conform to [ASTM C 443](#).

2.1.6 Reinforced Plastic Mortar Pipe (RPMP)

Reinforced plastic mortar pipe shall be produced be in accordance with [ASTM D 3262](#) and shall have an outside diameter equal to ductile iron pipe dimensions from 18 inch to 48 inch. The inner surface of the pipe shall have a smooth uniform continuous resin-rich surface liner. The minimum pipe stiffness shall be 36 psi. RPMP shall be in accordance with [ASTM D 3262](#). Fittings for RPMP: [ASTM D 3840](#). Joints for RPMP: Bell and spigot gasket coupling utilizing an elastomeric gasket in accordance with [ASTM D 4161](#) and [ASTM F 477](#).

2.1.7 Reinforced Thermosetting Resin Pipe (RTRP)

RTRP pipe: [ASTM D 3262](#). Fittings for RTRP: [ASTM D 3262](#). Joints for RTRP: Bell and spigot type utilizing an elastomeric gasket in accordance with [ASTM F 477](#).

2.1.7.1 Filament Wound RTRP-I

RTRP-I shall conform to [ASTM D 2996](#), except pipe shall have an outside diameter equal to cast iron outside diameter or standard weight steel pipe. The pipe shall be suitable for a normal working pressure of [150 psi](#) at [73 degrees F](#). The inner surface of the pipe shall have a smooth uniform continuous resin-rich surface liner conforming to [ASTM D 2996](#).

2.1.7.2 Centrifugally Cast RTRP-II

RTRP-II shall conform to [ASTM D 2997](#). Pipe shall have an outside diameter equal to standard weight steel pipe.

2.1.8 Piping Beneath Railroad Right-of-Way

Where pipeline passes under the right-of-way of a commercial railroad, piping shall conform to the specifications for pipelines conveying nonflammable substances in [AREMA Eng Man](#), except as otherwise specified in this paragraph. For casing pipe provide ductile-iron pipe in lieu of cast-iron soil pipe. Ductile-iron pipe shall conform to and have strength computed in accordance with [ASTM A746](#).

2.2 CONCRETE MATERIALS

2.2.1 Cement Mortar

Cement mortar shall conform to [ASTM C 270](#), Type M with Type II cement.

2.2.2 Portland Cement

Submit certificates of compliance stating the type of cement used in manufacture of concrete pipe, fittings and precast manholes. Portland cement shall conform to [ASTM C 150/C 150M](#), Type II for concrete used in concrete pipe, concrete pipe fittings, and manholes and type optional with the Contractor for cement used in concrete cradle, concrete encasement, and thrust blocking. Where aggregates are alkali reactive, as determined by Appendix XI of [ASTM C 33/C 33M](#), a cement containing less than 0.60 percent alkalis shall be used.

2.2.3 Portland Cement Concrete

Portland cement concrete shall conform to [ASTM C 94/C 94M](#), compressive strength of [4000 psi](#) at 28 days, except for concrete cradle and encasement or concrete blocks for manholes. Concrete used for cradle and encasement shall have a compressive strength of [2500 psi](#) minimum at 28 days. Concrete in place shall be protected from freezing and moisture loss for 7 days.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Precast Concrete Manholes & Glass-Fiber-Reinforced Polyester Manholes

[Precast concrete manhole](#) risers, base sections, and tops shall conform to [ASTM C 478](#) and be manufactured in accordance with Section [03 40 00.00 10](#) PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION; base and first riser shall be monolithic. Glass-Fiber-Reinforced Polyester Manholes shall conform to [ASTM D 3753](#).

2.3.2 Gaskets and Connectors

Gaskets for joints between manhole sections shall conform to [ASTM C 443](#). Resilient connectors for making joints between manhole and pipes entering manhole shall conform to [ASTM C 923](#) or [ASTM C 990](#).

2.3.3 External Preformed Rubber Joint Seals

An external preformed rubber joint seal shall be an accepted method of sealing cast iron covers to precast concrete sections to prevent ground water infiltration into sewer systems. All finished and sealed manholes constructed in accordance with paragraph entitled "Manhole Construction" shall be tested for leakage in the same manner as pipelines as described in paragraph entitled "Leakage Tests." The seal shall be multi-section with a neoprene rubber top section and all lower sections made of Ethylene Propylene Diene Monomer (EPDM) rubber with a minimum thickness of 60 mils. Each unit shall consist of a top and bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be a non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. Extension sections shall cover up to two more adjusting rings. Properties and values are listed in the following tables:

Properties, Test Methods and Minimum Values for
Rubber used in Preformed Joint Seals

Physical Properties	Test Methods	EPDM	Neoprene	Butyl mastic
Tensile, psi	ASTM D 412	1840	2195	-
Elongation percent	ASTM D 412	553	295	350
Tear Resistance, ppi	ASTM D 624 (Die B)	280	160	-
Rebound, percent, 5 minutes	ASTM C 972 (mod.)	-	-	11
Rebound, percent, 2 hours	ASTM C 972	-	-	12

2.3.4 Metal Items

2.3.4.1 Frames, Covers, and Gratings for Manholes

[CID A-A-60005](#), cast iron; figure numbers shall be as indicated:

- a. Traffic manhole: Provide in paved areas.

Frame: Figure 1, Size 22A
Cover: Figure 8, Size 22A
Steps: Figure 19

- b. Non-traffic manhole:

Frame: Figure 4, Size 22
Cover: Figure 12, Size 22
Steps: Figure 19

Frames and covers shall be cast iron, ductile iron or reinforced concrete. Cast iron frames and covers shall be as indicated or shall be of type suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 400 pounds. Reinforced concrete frames and covers shall be as indicated or shall conform to ASTM C 478. The word "Sanitary Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.3.4.2 Manhole Steps

as indicated conforming to 29 CFR 1910.27. As an option, plastic or rubber coating pressure-molded to the steel may be used. Plastic coating shall conform to ASTM D 4101, copolymer polypropylene. Rubber shall conform to ASTM C 443, except shore A durometer hardness shall be 70 plus or minus 5. Aluminum steps or rungs will not be permitted. Steps are not required in manholes less than 4 feet deep.

2.3.4.3 Manhole Ladders

A steel ladder shall be provided where the depth of a manhole exceeds 12 feet. The ladder shall not be less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum 3/8 inch thick and 2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A123/A123M.

2.4 REPORTS

Submit Test Reports. Compaction and density test shall be in accordance with Section 31 00 00 EARTHWORK. Submit Inspection Reports for daily activities during the installation of the sanitary system. Information in the report shall be detailed enough to describe location of work and amount of pipe laid in place, measured in linear feet.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION

3.1.1 General Requirements for Installation of Pipelines

These general requirements apply except where specific exception is made in the following paragraphs entitled "Special Requirements."

3.1.1.1 Location

The work covered by this section shall terminate at a point approximately 5 feet from the building, unless otherwise indicated. Where the location of the sewer is not clearly defined by dimensions on the drawings, do not lay sewer line closer horizontally than 10 feet to a water main or service line. Install pressure sewer lines beneath water lines only, with the top of the sewer line being at least 2 feet below bottom of water line. Where sanitary sewer lines pass above water lines, encase sewer in concrete for a distance of 10 feet on each side of the crossing, or substitute rubber-gasketed pressure pipe for the pipe being used for the same distance. Where sanitary sewer lines pass below water lines, lay pipe so that no joint in the sewer line will be closer than 3 feet, horizontal distance, to the water line.

- a. Sanitary piping installation parallel with water line:

- (1) Normal conditions: Sanitary piping or manholes shall be laid at least 10 feet horizontally from a water line whenever possible. The distance shall be measured edge-to-edge.
- (2) Unusual conditions: When local conditions prevent a horizontal separation of 10 feet, the sanitary piping or manhole may be laid closer to a water line provided that:
 - (a) The top (crown) of the sanitary piping shall be at least 18 inches below the bottom (invert) of the water main.
 - (b) Where this vertical separation cannot be obtained, the sanitary piping shall be constructed of AWWA-approved ductile iron water pipe pressure tested in place without leakage prior to backfilling.
 - (c) The sewer manhole shall be of watertight construction and tested in place.

b. Installation of sanitary piping crossing a water line:

- (1) Normal conditions: Lay sanitary sewer piping by crossing under water lines to provide a separation of at least 18 inches between the top of the sanitary piping and the bottom of the water line whenever possible.
- (2) Unusual conditions: When local conditions prevent a vertical separation described above, use the following construction:
 - (a) Sanitary piping passing over or under water lines shall be constructed of AWWA-approved ductile iron water pipe, pressure tested in place without leakage prior to backfilling.
 - (b) Sanitary piping passing over water lines shall, in addition, be protected by providing:
 - (1) A vertical separation of at least 18 inches between the bottom of the sanitary piping and the top of the water line.
 - (2) Adequate structural support for the sanitary piping to prevent excessive deflection of the joints and the settling on and breaking of the water line.
 - (3) That the length, minimum 20 feet, of the sanitary piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the water line.

c. Sanitary sewer manholes: No water piping shall pass through or come in contact with any part of a sanitary sewer manhole.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 31 00 00 EARTHWORK.

3.1.1.3 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper facilities for lowering sections of pipe into trenches. Lay nonpressure pipe with the

bell ends in the upgrade direction. Adjust spigots in bells to give a uniform space all around. Blocking or wedging between bells and spigots will not be permitted. Replace by one of the proper dimensions, pipe or fittings that do not allow sufficient space for installation of joint material. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not more than 25 feet apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batterboards for the same purpose. Branch connections shall be made by use of regular fittings or solvent cemented saddles as approved. Saddles for ABS and PVC composite pipe shall conform to Figure 2 of [ASTM D 2680](#); saddles for ABS pipe shall comply with Table 3 of [ASTM D 2751](#); and saddles for PVC pipe shall conform to Table 4 of [ASTM D 3034](#).

3.1.1.4 Connections to Existing Lines

Obtain approval from the Contracting Officer before making connection to existing line. Conduct work so that there is minimum interruption of service on existing line.

3.1.2 Special Requirements

3.1.2.1 Installation of Cast Iron Soil Piping

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations of the pipe manufacturer. Make joints with the rubber gaskets specified for cast iron soil pipe joints and assemble in accordance with the recommendations of the pipe manufacturer.

3.1.2.2 Installation of Clay Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of [ASTM C 12](#) for pipe laying. Make joints with a compression joint material specified for clay pipe joints and assemble in accordance with the recommendations of the manufacturer of the pipe.

3.1.2.3 Installation of Concrete Gravity Sewer Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the provisions for rubber gasket jointing and jointing procedures of [ACPA 01-103](#) or of [ACPA 01-102](#), Chapter 9, "Installation, Inspection and Construction Testing." Make joints with the gaskets specified for concrete gravity sewer pipe joints. Clean and dry surfaces receiving lubricants, cements, or adhesives. Affix gaskets to pipe not more than 24 hours prior to the installation of the pipe. Protect gaskets from sun, blowing dust, and other deleterious agents at all times. Before installation of the pipe, inspect gaskets and remove and replace loose or improperly affixed gaskets. Align each pipe section with the previously installed pipe section, and pull the joint together. If, while pulling the joint, the gasket becomes loose and can be seen through the exterior joint recess when the pipe is pulled up to within 1 inch of closure, remove the pipe and remake the joint.

3.1.2.4 Installation of Concrete Pressure Lines

Unless otherwise specified, install pipe and fittings in accordance with

paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the laying and joining requirements specified in the guide specifications for installation of pipe given in [AWWA M9](#), Chapter 14, "Guide Specifications for Installation of Pipe."

- a. Joints: Make joints with the gaskets specified for concrete pressure pipe joints, using an approved lubricant recommended by the pipe manufacturer. Assemble these joints in accordance with the joining requirements specified in the guide specifications for installation of pipe given in [AWWA M9](#), Chapter 14, "Guide Specifications for Installation of Pipe," and with the recommendations given for laying the pipe in [AWWA M9](#), Chapter 6, "Installation by Trenching or Tunneling -- Methods and Equipment."
- b. Pipe anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Size and position thrust blocks as indicated. Use concrete conforming to [ASTM C 94/C 94M](#) having a minimum compressive strength of 2,000 psi at 28 days; or use concrete of a mix not leaner than one part cement 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

3.1.2.5 Installation of Ductile Iron Gravity Sewer Pipe

Unless otherwise specified, install pipe and associated fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of [AWWA C600](#) for pipe installation and joint assembly.

- a. Make push-on joints with the gaskets and lubricant specified for this type joint and assemble in accordance with the applicable requirements of [AWWA C600](#) for joint assembly. Make mechanical-joints with the gaskets, glands, bolts, and nuts specified for this type joint and assemble in accordance with the applicable requirements of [AWWA C600](#) for joint assembly and the recommendations of Appendix A to [AWWA C111/A21.11](#).
- b. Exterior protection: Completely encase buried ductile iron pipelines with polyethylene tube or sheet in accordance with [AWWA C105/A21.5](#), using Class A polyethylene film.

3.1.2.6 Installation of Ductile-Iron Pressure Lines

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of [AWWA C600](#) for pipe installation, joint assembly, and valve-and-fitting installation.

- a. Make push-on joints with the gaskets and lubricant specified for this type joint and assemble in accordance with the applicable requirements of [AWWA C600](#) for joint assembly. Make mechanical-joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of [AWWA C600](#) for joint assembly and the recommendations of Appendix A to [AWWA C111/A21.11](#). Make flanged joints with gaskets, bolts, and nuts specified for this type joint. Make flanged joints up tight, taking care to avoid undue strain on flanges, fittings, and other accessories. Align bolt holes for each flanged joint. Use full size bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not be

permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange. When flanged pipe or fittings have dimensions that do not allow the making of a proper flanged joint as specified, replace it by one of proper dimensions. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer, as approved.

- b. Exterior protection: Completely encase buried ductile iron pipelines with polyethylene tube or sheet in accordance with [AWWA C105/A21.5](#), using Class A polyethylene film.
- c. Pipe anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Size and position thrust blocks as indicated. Use concrete conforming to [ASTM C 94/C 94M](#) having a minimum compressive strength of [2,000 psi](#) at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

3.1.2.7 Installation of ABS Composite Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations of the plastic pipe manufacturer. Make joints with the primer and solvent cement specified for this joint and assemble in accordance with the recommendations of the pipe manufacturer. Handle solvent cement in accordance with [ASTM F 402](#).

3.1.2.8 Installation of ABS Solid-Wall Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations of the plastic pipe manufacturer. Make solvent cement joints with the solvent cement previously specified for this type joint. Make elastomeric joints with the gaskets specified for this type joint and assemble in accordance with the recommendations of the pipe manufacturer. Handle solvent cement in accordance with [ASTM F 402](#).

3.1.2.9 Installation of PVC Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of [ASTM D 2321](#) for laying and joining pipe and fittings. Make joints with the gaskets specified for joints with this piping and assemble in accordance with the requirements of [ASTM D 2321](#) for assembly of joints. Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.1.2.10 Installation of PVC Plastic Pressure Pipe and Fittings

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section; with the requirements of [AWWA C605](#) for laying of pipe, joining PVC pipe to fittings and accessories, and setting of hydrants, valves, and fittings; and with the recommendations for pipe joint assembly and appurtenance installation in [AWWA M23](#), Chapter 7, "Installation."

- a. Pipe Less Than [4 Inch](#) Diameter:

- (1) Threaded joints shall be made by wrapping the male threads with joint tape or by applying an approved thread lubricant, then threading the joining members together. The joints shall be tightened with strap wrenches which will not damage the pipe and fittings. The joint shall be tightened no more than 2 threads past hand-tight.
 - (2) Push-On Joints: The ends of pipe for push-on joints shall be beveled to facilitate assembly. Pipe shall be marked to indicate when the pipe is fully seated. The gasket shall be lubricated to prevent displacement. Care shall be exercised to ensure that the gasket remains in proper position in the bell or coupling while making the joint.
 - (3) Solvent-weld joints shall comply with the manufacturer's instructions.
- b. Pipe 4 Inch Diameter Joints: Make push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel; for push-on joint connections to fittings, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of [AWWA C605](#) for laying the pipe and the recommendations in [AWWA M23](#), Chapter 7, "Installation," for pipe joint assembly. Assemble push-on joints for connection to fittings in accordance with the requirements of [AWWA C605](#) for joining PVC pipe to fittings and accessories and with the applicable requirements of [AWWA C600](#) for joint assembly. Make compression-type joints/mechanical-joints with the gaskets, glands, bolts, nuts, and internal stiffeners specified for this type joint and assemble in accordance with the requirements of [AWWA C605](#) for joining PVC pipe to fittings and accessories, with the applicable requirements of [AWWA C600](#) for joint assembly, and with the recommendations of Appendix A to [AWWA C111/A21.11](#). Cut off spigot end of pipe for compression-type joint/mechanical-joint connections and do not re-bevel.
- c. Pipe anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Size and position thrust blocks as indicated. Use concrete conforming to [ASTM C 94/C 94M](#) having a minimum compressive strength of 2,000 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

3.1.2.11 Pipeline Installation Beneath Railroad Right-of-Way

Where pipeline passes under the right-of-way of a commercial railroad, install piping in accordance with the specifications for pipelines conveying nonflammable substances in [AREMA Eng Man](#).

3.1.3 Concrete Work

Cast-in-place concrete is included in Section [03 30 00.00 10 CAST-IN-PLACE CONCRETE](#). The pipe shall be supported on a concrete cradle, or encased in concrete where indicated or directed.

3.1.4 Manhole Construction

Construct base slab of cast-in-place concrete or use precast concrete base sections. Make inverts in cast-in-place concrete and precast concrete bases with a smooth-surfaced semi-circular bottom conforming to the inside contour of the adjacent sewer sections. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit. For cast-in-place concrete construction, either pour bottom slabs and walls integrally or key and bond walls to bottom slab. No parging will be permitted on interior manhole walls. For precast concrete construction, make joints between manhole sections with the gaskets specified for this purpose; install in the manner specified for installing joints in concrete piping. Parging will not be required for precast concrete manholes. Cast-in-place concrete work shall be in accordance with the requirements specified under paragraph entitled "Concrete Work" of this section. Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose; install in accordance with the recommendations of the connector manufacturer. Where a new manhole is constructed on an existing line, remove existing pipe as necessary to construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding into the manhole. Use resilient connectors as previously specified for pipe connectors to concrete manholes.

3.1.5 Miscellaneous Construction and Installation

3.1.5.1 Connecting to Existing Manholes

Pipe connections to existing manholes shall be made so that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. The connection shall be centered on the manhole. Holes for the new pipe shall be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

3.1.5.2 Metal Work

- a. Workmanship and finish: Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined lines and arises. Provide necessary rabbets, lugs, and brackets wherever necessary for fitting and support.
- b. Field painting: After installation, clean cast-iron frames, covers, gratings, and steps not buried in concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. Do not paint surfaces subject to abrasion.

3.1.6 Sewage Absorption Trench Construction

Grade pipe lines uniformly downward to the outlet. Lay perforated pipe with the perforations downward. Lay drain tile with 1/4 inch open joints.

Cover open joints of drain tile with the cover material specified so that it extends not less than 100 degrees on each side of the vertical center line of the tile. Wire covering in place.

3.1.7 Installations of Wye Branches

Cutting into piping for connections shall not be done except in special approved cases. When the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, the pipe shall be encased in concrete backfill or supported on a concrete cradle as directed. Concrete required because of conditions resulting from faulty construction methods or negligence shall be installed at no additional cost to the Government. The installation of wye branches in an existing sewer shall be made by a method which does not damage the integrity of the existing sewer. One acceptable method consists of removing one pipe section, breaking off the upper half of the bell of the next lower section and half of the running bell of wye section. After placing the new section, it shall be rotated so that the broken half of the bell will be at the bottom. The two joints shall then be made with joint packing and cement mortar.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

The Contracting Officer will conduct field inspections and witness field tests specified in this section. Perform field tests and provide labor, equipment, and incidentals required for testing. Be able to produce evidence, when required, that each item of work has been constructed in accordance with the drawings and specifications.

3.2.2 Tests for Nonpressure Lines

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; it shall show a practically full circle of light through the pipeline when viewed from the adjoining end of line. When pressure piping is used in a nonpressure line for nonpressure use, test this piping as specified for nonpressure pipe.

3.2.2.1 Leakage Tests

Test lines for leakage by either infiltration tests or exfiltration tests, or by low-pressure air tests. Prior to testing for leakage, backfill trench up to at least lower half of pipe. When necessary to prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When leakage or pressure drop exceeds the allowable amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

- a. Infiltration tests and exfiltration tests: Perform these tests for sewer lines made of the specified materials, not only concrete, in accordance with ASTM C 969. Make calculations in accordance with the Appendix to ASTM C 969.
- b. Low-pressure air tests: Perform tests as follows:
 - (1) Clay pipelines: Test in accordance with ASTM C 828. Allowable pressure drop shall be as given in ASTM C 828. Make calculations in accordance with the Appendix to ASTM C 828.

- (2) Concrete pipelines: Test in accordance with [ASTM C 924](#). Allowable pressure drop shall be as given in [ASTM C 924](#). Make calculations in accordance with the Appendix to [ASTM C 924](#).
- (3) Ductile-iron pipelines: Test in accordance with the applicable requirements of [ASTM C 924](#). Allowable pressure drop shall be as given in [ASTM C 924](#). Make calculations in accordance with the Appendix to [ASTM C 924](#).
- (4) ABS composite plastic pipelines: Test in accordance with the applicable requirements of [UBPPA UNI-B-6](#). Allowable pressure drop shall be as given in [UBPPA UNI-B-6](#). Make calculations in accordance with the Appendix to [UBPPA UNI-B-6](#).
- (5) PVC plastic pipelines: Test in accordance with [UBPPA UNI-B-6](#). Allowable pressure drop shall be as given in [UBPPA UNI-B-6](#). Make calculations in accordance with the Appendix to [UBPPA UNI-B-6](#).

3.2.2.2 Deflection Testing

Perform a deflection test on entire length of installed plastic pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads determined in accordance with [ASTM D 2412](#).

Deflection of pipe in the installed pipeline under external loads shall not exceed 4.5 percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection measuring device.

- a. Pull-through device: This device shall be a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. Circular sections shall be so spaced on the shaft that distance from external faces of front and back sections will equal or exceed diameter of the circular section. Pull-through device may also be of a design promulgated by the Uni-Bell Plastic Pipe Association, provided the device meets the applicable requirements specified in this paragraph, including those for diameter of the device, and that the mandrel has a minimum of 9 arms. Ball, cylinder, or circular sections shall conform to the following:
 - (1) A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.
 - (2) Homogeneous material throughout, shall have a density greater than 1.0 as related to water at [39.2 degrees F](#), and shall have a surface Brinell hardness of not less than 150.
 - (3) Center bored and through-bolted with a [1/4 inch](#) minimum diameter steel shaft having a yield strength of not less than [70,000 psi](#), with eyes or loops at each end for attaching pulling cables.
 - (4) Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.
- b. Deflection measuring device: Sensitive to 1.0 percent of the diameter of the pipe being tested and shall be accurate to 1.0 percent of the

indicated dimension. Deflection measuring device shall be approved prior to use.

- c. Pull-through device procedure: Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions.
- d. Deflection measuring device procedure: Measure deflections through each run of installed pipe. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, replace pipe which has excessive deflection and completely retest in same manner and under same conditions.

3.2.3 Tests for Pressure Lines

Test pressure lines in accordance with the applicable standard specified in this paragraph, except for test pressures. For hydrostatic pressure test, use a hydrostatic pressure 50 psi in excess of the maximum working pressure of the system, but not less than 100 psi, holding the pressure for a period of not less than one hour. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test. Test ductile-iron pressure lines in accordance with the requirements of AWWA C600 for hydrostatic testing. Leakage on ductile-iron pipelines with mechanical-joints or push-on joints shall not exceed the amounts given in AWWA C600; allow no leakage at joints made by other methods. Test PVC plastic pressure lines in accordance with the requirements of AWWA C605 for pressure and leakage tests, using the allowable leakage given therein.

3.2.4 Field Tests for Concrete

Field testing requirements are covered in Section 03 30 00 CAST-IN-PLACE CONCRETE

-- End of Section --

SECTION 33 40 00

STORM DRAINAGE UTILITIES

02/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 198 (2010) Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION
(AREMA)

AREMA Eng Man (2010) Manual for Railway Engineering

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M (2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A48/A48M (2003; R 2008) Standard Specification for Gray Iron Castings

ASTM A536 (1984; R 2009) Standard Specification for Ductile Iron Castings

ASTM A929/A929M (2001; R 2007) Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe

ASTM B 26/B 26M (2009) Standard Specification for Aluminum-Alloy Sand Castings

ASTM C 1103 (2003; R 2009) Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines

ASTM C 139 (2010) Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes

ASTM C 14 (2007) Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe

ASTM C 1433 (2010) Standard Specification for Precast

	Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers
ASTM C 270	(2010) Standard Specification for Mortar for Unit Masonry
ASTM C 32	(2009) Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C 425	(2004; R 2009) Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 443	(2010) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C 444	(2003; R 2009) Perforated Concrete Pipe
ASTM C 478	(2009) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 506	(2011) Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
ASTM C 507	(2011) Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
ASTM C 55	(2009) Concrete Brick
ASTM C 62	(2010) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 655	(2011) Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
ASTM C 76	(2010a) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 877	(2008) External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
ASTM C 923	(2008) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C 924	(2002; R 2009) Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C231/C231M	(2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM D 1056	(2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded

Rubber

ASTM D 1171	(1999; R 2007) Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)
ASTM D 1557	(2009) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³) (2700 kN-m/m ³)
ASTM D 1751	(2004; R 2008) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(2004a; R 2008) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D 2167	(2008) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 3212	(2007) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Placing Pipe

SD-04 Samples

Pipe for Culverts and Storm Drains

SD-07 Certificates

Resin Certification

Pipeline Testing

Hydrostatic Test on Watertight Joints

Determination of Density

Frame and Cover for Gratings

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.3.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 Concrete Pipe

Manufactured in accordance with and conforming to ASTM C 76, Class V, or ASTM C 655, D-Load.

2.1.1.1 Reinforced Arch Culvert and Storm Drainpipe

Manufactured in accordance with and conforming to ASTM C 506, Class A-IV.

2.1.1.2 Reinforced Elliptical Culvert and Storm Drainpipe

Manufactured in accordance with and conforming to ASTM C 507. Horizontal elliptical pipe shall be Class HE-IV. Vertical elliptical pipe shall be Class VE-IV .

2.1.2 Perforated Piping

2.1.2.1 Concrete Pipe

Manufactured in accordance with and conforming to ASTM C 444, and applicable requirements of ASTM C 14, Class V.

2.2 DRAINAGE STRUCTURES

2.2.1 Flared End Sections

Sections shall be of a standard design fabricated from zinc coated steel sheets meeting requirements of ASTM A929/A929M.

2.2.2 Precast Reinforced Concrete Box

Manufactured in accordance with and conforming to [ASTM C 1433](#).

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 3,000 [psi](#) concrete under Section [03 30 00.00 10](#) CAST-IN-PLACE CONCRETE . The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds [1-1/2 inches](#). Air content shall be determined in accordance with [ASTM C231/C231M](#). The concrete covering over steel reinforcing shall not be less than [1 inch](#) thick for covers and not less than [1-1/2 inches](#) thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least [3 inches](#) between steel and ground. Expansion-joint filler material shall conform to [ASTM D 1751](#), or [ASTM D 1752](#), or shall be resin-impregnated fiberboard conforming to the physical requirements of [ASTM D 1752](#).

2.3.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to [ASTM C 270](#), Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar but in no case shall exceed the manufacturer's recommended amount of water per sack of cement. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

2.3.3 Precast Concrete Segmental Blocks

Precast concrete segmental block shall conform to [ASTM C 139](#), not more than [8 inches](#) thick, not less than [8 inches](#) long, and of such shape that joints can be sealed effectively and bonded with cement mortar.

2.3.4 Brick

Brick shall conform to [ASTM C 62](#), Grade SW; [ASTM C 55](#), Grade S-I or S-II; or [ASTM C 32](#), Grade MS. Mortar for jointing and plastering shall consist of one part portland cement and two parts fine sand. Lime may be added to the mortar in a quantity not more than 25 percent of the volume of cement. The joints shall be filled completely and shall be smooth and free from surplus mortar on the inside of the structure. Brick structures shall be plastered with [1/2 inch](#) of mortar over the entire outside surface of the walls. For square or rectangular structures, brick shall be laid in stretcher courses with a header course every sixth course. For round structures, brick shall be laid radially with every sixth course a stretcher course.

2.3.5 Precast Reinforced Concrete Manholes

Conform to [ASTM C 478](#). Joints between precast concrete risers and tops shall be made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph JOINTS.

2.3.6 Prefabricated Corrugated Metal Manholes

Manholes shall be of the type and design recommended by the manufacturer. Manholes shall be complete with frames and cover, or frames and gratings.

2.3.7 Frame and Cover for Gratings

Submit certification on the ability of frame and cover or gratings to carry the imposed live load. Frame and cover for gratings shall be cast gray iron, [ASTM A48/A48M](#), Class 35B; cast ductile iron, [ASTM A536](#), Grade 65-45-12; or cast aluminum, [ASTM B 26/B 26M](#), Alloy 356.OT6. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans. The word "Storm Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.3.8 Joints

2.3.8.1 Flexible Watertight Joints

- a. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe and with factory-fabricated resilient materials for clay pipe. The design of joints and the physical requirements for plastic gaskets shall conform to [AASHTO M 198](#), and rubber-type gaskets shall conform to [ASTM C 443](#). Factory-fabricated resilient joint materials shall conform to [ASTM C 425](#). Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds [54 inches](#).
- b. Test Requirements: Watertight joints shall be tested and shall meet test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS. Rubber gaskets shall comply with the oil resistant gasket requirements of [ASTM C 443](#). Certified copies of test results shall be delivered to the Contracting Officer before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished, if specifically approved.

2.3.8.2 External Sealing Bands

Requirements for external sealing bands shall conform to [ASTM C 877](#).

2.3.8.3 Flexible Watertight, Gasketed Joints

- a. Gaskets: When infiltration or exfiltration is a concern for pipe lines, the couplings may be required to have gaskets. The closed-cell expanded rubber gaskets shall be a continuous band approximately [7 inches](#) wide and approximately [3/8 inch](#) thick, meeting the requirements of [ASTM D 1056](#), Type 2 A1, and shall have a quality retention rating of not less than 70 percent when tested for weather resistance by ozone chamber exposure, Method B of [ASTM D 1171](#). Rubber O-ring gaskets shall be [13/16 inch](#) in diameter for pipe diameters of [36 inches](#) or smaller and [7/8 inch](#) in diameter for larger pipe having [1/2 inch](#) deep end

corrugation. Rubber O-ring gaskets shall be 1-3/8 inches in diameter for pipe having 1 inch deep end corrugations. O-rings shall meet the requirements of AASHTO M 198 or ASTM C 443. Flexible plastic gaskets shall conform to requirements of AASHTO M 198, Type B.

- b. Connecting Bands: Connecting bands shall be of the type, size and sheet thickness of band, and the size of angles, bolts, rods and lugs as indicated or where not indicated as specified in the applicable standards or specifications for the pipe. Exterior rivet heads in the longitudinal seam under the connecting band shall be countersunk or the rivets shall be omitted and the seam welded. Watertight joints shall be tested and shall meet the test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS.

2.3.9 Flap Gates

Flap Gates shall be medium or heavy-duty with circular opening and double-hinged. Top pivot points shall be adjustable. The seat shall be one-piece cast iron with a raised section around the perimeter of the waterway opening to provide the seating face. The seating face of the seat shall be stainless steel. The cover shall be one-piece cast iron with necessary reinforcing rib, lifting eye for manual operation, and bosses to provide a pivot point connection with the links. The seating face of the cover shall be stainless steel. Links or hinge arms shall be cast or ductile iron. Holes of pivot points shall be bronze bushed. All fasteners shall be either galvanized steel, bronze or stainless steel.

2.4 STEEL LADDER

Steel ladder shall be provided where the depth of the storm drainage structure exceeds 12 feet. These ladders shall be not less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum 3/8 inch thick and 2-1/2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A123/A123M.

2.5 DOWNSPOUT BOOTS

Boots used to connect exterior downspouts to the storm-drainage system shall be of gray cast iron conforming to ASTM A48/A48M, Class 30B or 35B. Shape and size shall be as indicated.

2.6 RESILIENT CONNECTORS

Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C 923.

2.7 HYDROSTATIC TEST ON WATERTIGHT JOINTS

2.7.1 Concrete, Clay, PVC and PE Pipe

A hydrostatic test shall be made on the watertight joint types as proposed. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Performance requirements for joints in reinforced and nonreinforced concrete pipe shall conform to AASHTO M 198 or ASTM C 443. Test requirements for joints in

clay pipe shall conform to ASTM C 425. Test requirements for joints in PVC and PE plastic pipe shall conform to ASTM D 3212.

2.8 EROSION CONTROL RIPRAP

Provide nonerodible rock not exceeding 15 inches in its greatest dimension and choked with sufficient small rocks to provide a dense mass with a minimum thickness of as indicated.

PART 3 EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 31 00 00 EARTHWORK and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 12 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheet piling and bracing, where required, shall be placed within the trench width as specified, without any overexcavation. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

3.1.2 Removal of Rock

Rock in either ledge or boulder formation shall be replaced with suitable materials to provide a compacted earth cushion having a thickness between unremoved rock and the pipe of at least 8 inches or 1/2 inch for each foot of fill over the top of the pipe, whichever is greater, but not more than three-fourths the nominal diameter of the pipe. Where bell-and-spigot pipe is used, the cushion shall be maintained under the bell as well as under the straight portion of the pipe. Rock excavation shall be as specified and defined in Section 31 00 00 EARTHWORK.

3.1.3 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor while performing shoring and sheet piling, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Government.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Concrete Pipe Requirements

When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded in granular material minimum 4 inch in depth in trenches with soil foundation. Depth of granular bedding in trenches with rock foundation shall be 1/2 inch in depth per foot of depth of fill, minimum depth of bedding shall be 8 inch up to maximum depth of 24 inches. The middle third of the granular bedding shall be loosely placed. Bell holes and depressions for joints shall be removed and formed so entire barrel of pipe is uniformly supported. The bell hole and depressions for the joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

3.3 PLACING PIPE

Submit printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated metal pipe shall be placed in the same vertical plane as the major axis of the pipe. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Deflection of installed flexible pipe shall not exceed the following limits:

TYPE OF PIPE	MAXIMUM ALLOWABLE DEFLECTION (%)
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Note post installation requirements of paragraph 'Deflection Testing' in PART 3 of this specification for all pipe products including deflection testing requirements for flexible pipe.

3.3.1 Concrete, Clay, PVC, Ribbed PVC, Ductile Iron and Cast-Iron Pipe

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.3.2 Elliptical and Elliptical Reinforced Concrete Pipe

The manufacturer's reference lines, designating the top of the pipe, shall be within 5 degrees of a vertical plane through the longitudinal axis of the pipe, during placement. Damage to or misalignment of the pipe shall be prevented in all backfilling operations.

3.3.3 Multiple Culverts

Where multiple lines of pipe are installed, adjacent sides of pipe shall be at least half the nominal pipe diameter or 3 feet apart, whichever is less.

3.3.4 Jacking Pipe Through Fills

Methods of operation and installation for jacking pipe through fills shall conform to requirements specified in Volume 1, Chapter 1, Part 4 of [AREMA Eng Man.](#)

3.4 JOINTING

3.4.1 Concrete and Clay Pipe

3.4.1.1 Cement-Mortar Bell-and-Spigot Joint

The first pipe shall be bedded to the established grade line, with the bell end placed upstream. The interior surface of the bell shall be thoroughly cleaned with a wet brush and the lower portion of the bell filled with mortar as required to bring inner surfaces of abutting pipes flush and even. The spigot end of each subsequent pipe shall be cleaned with a wet brush and uniformly matched into a bell so that sections are closely fitted. After each section is laid, the remainder of the joint shall be filled with mortar, and a bead shall be formed around the outside of the joint with sufficient additional mortar. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint shall be wrapped or bandaged with cheesecloth to hold mortar in place.

3.4.1.2 Cement-Mortar Oakum Joint for Bell-and-Spigot Pipe

A closely twisted gasket shall be made of jute or oakum of the diameter required to support the spigot end of the pipe at the proper grade and to make the joint concentric. Joint packing shall be in one piece of sufficient length to pass around the pipe and lap at top. This gasket shall be thoroughly saturated with neat cement grout. The bell of the pipe shall be thoroughly cleaned with a wet brush, and the gasket shall be laid in the bell for the lower third of the circumference and covered with mortar. The spigot of the pipe shall be thoroughly cleaned with a wet brush, inserted in the bell, and carefully driven home. A small amount of mortar shall be inserted in the annular space for the upper two-thirds of the circumference. The gasket shall be lapped at the top of the pipe and driven home in the annular space with a caulking tool. The remainder of the annular space shall be filled completely with mortar and beveled at an angle of approximately 45 degrees with the outside of the bell. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint thus made shall be wrapped with cheesecloth. Placing of this type of joint shall be kept at least five joints behind laying operations.

3.4.1.3 Cement-Mortar Diaper Joint for Bell-and-Spigot Pipe

The pipe shall be centered so that the annular space is uniform. The annular space shall be caulked with jute or oakum. Before caulking, the inside of the bell and the outside of the spigot shall be cleaned.

- a. Diaper Bands: Diaper bands shall consist of heavy cloth fabric to hold grout in place at joints and shall be cut in lengths that extend one-eighth of the circumference of pipe above the spring line on one side of the pipe and up to the spring line on the other side of the pipe. Longitudinal edges of fabric bands shall be rolled and stitched around two pieces of wire. Width of fabric bands shall be such that after fabric has been securely stitched around both edges on wires, the wires will be uniformly spaced not less than 8 inches apart. Wires

shall be cut into lengths to pass around pipe with sufficient extra length for the ends to be twisted at top of pipe to hold the band securely in place; bands shall be accurately centered around lower portion of joint.

- b. Grout: Grout shall be poured between band and pipe from the high side of band only, until grout rises to the top of band at the spring line of pipe, or as nearly so as possible, on the opposite side of pipe, to ensure a thorough sealing of joint around the portion of pipe covered by the band. Silt, slush, water, or polluted mortar grout forced up on the lower side shall be forced out by pouring, and removed.
- c. Remainder of Joint: The remaining unfilled upper portion of the joint shall be filled with mortar and a bead formed around the outside of this upper portion of the joint with a sufficient amount of additional mortar. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind actual laying of pipe. No backfilling around joints shall be done until joints have been fully inspected and approved.

3.4.1.4 Cement-Mortar Tongue-and-Groove Joint

The first pipe shall be bedded carefully to the established grade line with the groove upstream. A shallow excavation shall be made underneath the pipe at the joint and filled with mortar to provide a bed for the pipe. The grooved end of the first pipe shall be thoroughly cleaned with a wet brush, and a layer of soft mortar applied to the lower half of the groove. The tongue of the second pipe shall be cleaned with a wet brush; while in horizontal position, a layer of soft mortar shall be applied to the upper half of the tongue. The tongue end of the second pipe shall be inserted in the grooved end of the first pipe until mortar is squeezed out on interior and exterior surfaces. Sufficient mortar shall be used to fill the joint completely and to form a bead on the outside.

3.4.1.5 Cement-Mortar Diaper Joint for Tongue-and-Groove Pipe

The joint shall be of the type described for cement-mortar tongue-and-groove joint in this paragraph, except that the shallow excavation directly beneath the joint shall not be filled with mortar until after a gauze or cheesecloth band dipped in cement mortar has been wrapped around the outside of the joint. The cement-mortar bead at the joint shall be at least $\frac{1}{2}$ inch, thick and the width of the diaper band shall be at least 8 inches. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind the actual laying of the pipe. Backfilling around the joints shall not be done until the joints have been fully inspected and approved.

3.4.1.6 Plastic Sealing Compound Joints for Tongue-and-Grooved Pipe

Sealing compounds shall follow the recommendation of the particular manufacturer in regard to special installation requirements. Surfaces to receive lubricants, primers, or adhesives shall be dry and clean. Sealing compounds shall be affixed to the pipe not more than 3 hours prior to installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Sealing compounds shall be inspected before installation of the pipe, and any loose or improperly affixed sealing compound shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pulled together. If, while making the joint with mastic-type sealant, a slight protrusion of

the material is not visible along the entire inner and outer circumference of the joint when the joint is pulled up, the pipe shall be removed and the joint remade. After the joint is made, all inner protrusions shall be cut off flush with the inner surface of the pipe. If non-mastic-type sealant material is used, the "Squeeze-Out" requirement above will be waived.

3.4.1.7 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.4.1.8 External Sealing Band Joint for Noncircular Pipe

Surfaces to receive sealing bands shall be dry and clean. Bands shall be installed in accordance with manufacturer's recommendations.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of reinforced concrete, plain concrete, brick, precast reinforced concrete, precast concrete segmental blocks, prefabricated corrugated metal, or bituminous coated corrugated metal; complete with frames and covers or gratings; and with fixed galvanized steel ladders where indicated. Pipe studs and junction chambers of prefabricated corrugated metal manholes shall be fully bituminous-coated and paved when the connecting branch lines are so treated. Pipe connections to concrete manholes and inlets shall be made with flexible, watertight connectors.

3.5.2 Walls and Headwalls

Construction shall be as indicated.

3.6 STEEL LADDER INSTALLATION

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 6 feet vertically, and shall be installed to provide at least 6 inches of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.7 BACKFILLING

3.7.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of

pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation equal to the midpoint (spring line) of RCP or has reached an elevation of at least 12 inches above the top of the pipe for flexible pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 6 inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Contracting Officer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.7.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 6 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 8 inches. Use select granular material for this entire region of backfill for flexible pipe installations.

3.7.3 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.7.4 Compaction

3.7.4.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.7.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

- a. Under airfield and heliport pavements, paved roads, streets, parking

areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

- b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.
- c. Under nontraffic areas, density shall be not less than that of the surrounding material.

3.7.5 Determination of Density

Testing is the responsibility of the Contractor and performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with [ASTM D 1557](#) except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with [ASTM D 2167](#) or [ASTM D 6938](#). When [ASTM D 6938](#) is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. [ASTM D 6938](#) results in a wet unit weight of soil and [ASTM D 6938](#) shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in [ASTM D 6938](#). Test results shall be furnished the Contracting Officer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

3.8 PIPELINE TESTING

3.8.1 Leakage Tests

Lines shall be tested for leakage by low pressure air or water testing or exfiltration tests, as appropriate. [Low pressure air testing for concrete pipes shall conform to ASTM C 924](#). Testing of individual joints for leakage by low pressure air or water shall conform to [ASTM C 1103](#). Prior to exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is [2 feet](#) or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. An exfiltration test shall be made by filling the line to be tested with water so that a head of at least [2 feet](#) is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be reestablished. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by the exfiltration test shall not exceed [0.2 gallons per inch in diameter per 100](#)

feet of pipeline per hour. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished.

3.8.2 Deflection Testing

No sooner than 30 days after completion of installation and final backfill, an initial post installation inspection shall be accomplished. Clean or flush all lines prior to inspection. Perform a deflection test on entire length of installed flexible pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads. Deflection of pipe in the installed pipeline under external loads shall not exceed limits in paragraph PLACING PIPE above as percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a laser profiler or mandrel.

- a. Laser Profiler Inspection: If deflection readings in excess of the allowable deflection of average inside diameter of pipe are obtained, remove pipe which has excessive deflection, and replace with new pipe. Initial post installation inspections of the pipe interior with laser profiling equipment shall utilize low barrel distortion video equipment for pipe sizes 48 inches or less. Use a camera with lighting suitable to allow a clear picture of the entire periphery of the pipe interior. Center the camera in the pipe both vertically and horizontally and be able to pan and tilt to a 90 degree angle with the axis of the pipe rotating 360 degrees. Use equipment to move the camera through the pipe that will not obstruct the camera's view or interfere with proper documentation of the pipe's condition. The video image shall be clear, focused, and relatively free from roll static or other image distortion qualities that would prevent the reviewer from evaluating the condition of the pipe. For initial post installation inspections for pipe sizes larger than 48 inches, visual inspection shall be completed of the pipe interior.
- b. Pull-Through Device Inspection: Pass the pull-through device through each run of pipe by pulling it by hand. If deflection readings in excess of the allowable deflection of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show excess allowable deflections of the average inside diameter of pipe, remove pipe which has excessive deflection, replace with new pipe, and completely retest in same manner and under same conditions. Pull-through device: The mandrel shall be rigid, nonadjustable having a minimum of 9 fins, including pulling rings at each end, engraved with the nominal pipe size and mandrel outside diameter. The mandrel shall be 5 percent less than the certified-actual pipe diameter for Plastic Pipe, 5 percent less than the certified-actual pipe diameter for Corrugated Steel and Aluminum Alloy, 3 percent less than the certified-actual pipe diameter for Concrete-Lined Corrugated Steel and Ductile Iron Culvert provided by manufacturer. When mandrels are utilized to verify deflection of flexible pipe products, the Government will verify the mandrel OD through the use of proving rings that are manufactured with an opening that is certified to be as shown above.
- c. Deflection measuring device: Shall be approved by the Contracting Officer prior to use.
- d. Warranty period test: Pipe found to have a deflection of greater than allowable deflection in paragraph PLACING PIPE above, just prior to end

of one-year warranty period shall be replaced with new pipe and tested as specified for leakage and deflection. Inspect 100 percent of all pipe systems under the travel lanes, including curb and gutter. Random inspections of the remaining pipe system outside of the travel lanes shall represent at least 10 percent of the total pipe footage of each pipe size. Inspections shall be made, depending on the pipe size, with video camera or visual observations. In addition, for flexible pipe installations, perform deflection testing on 100 percent of all pipes under the travel lanes, including curb and gutter, with either a laser profiler or 9-fin mandrel. For flexible pipe, random deflection inspections of the pipe system outside of the travel lanes shall represent at least 10 percent of the total pipe footage of each pipe size. When mandrels are utilized to verify deflection of flexible pipe products during the final post installation inspection, the Government will verify the mandrel OD through the use of proving rings.

3.8.3 Post-Installation Inspection

One hundred percent of all reinforced concrete pipe installations shall be checked for joint separations, soil migration through the joint, cracks greater than 0.01 inches, settlement and alignment. One hundred percent of all flexible pipes (HDPE, PVC, CMP) shall be checked for rips, tears, joint separations, soil migration through the joint, cracks, localized bucking, bulges, settlement and alignment.

- a. Replace pipes having cracks greater than 0.1 inches in width or deflection greater than 5 percent deflection. An engineer shall evaluate all pipes with cracks greater than 0.01 inches but less than 0.10 inches to determine if any remediation or repair is required. RCP with crack width less than 0.10 inches and located in a non-corrosive environment (pH 5.5) are generally acceptable. Repair or replace any pipe with crack exhibiting displacement across the crack, exhibiting bulges, creases, tears, spalls, or delamination.
- b. Reports: The deflection results and final post installation inspection report shall include: a copy of all video taken, pipe location identification, equipment used for inspection, inspector name, deviation from design, grade, deviation from line, deflection and deformation of flexible pipe systems, inspector notes, condition of joints, condition of pipe wall (e.g. distress, cracking, wall damage dents, bulges, creases, tears, holes, etc.).

3.9 FIELD PAINTING

After installation, clean cast-iron frames, covers, gratings, and steps not buried in masonry or concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. Do not paint surfaces subject to abrasion.

-- End of Section --

SECTION 33 71 01

OVERHEAD TRANSMISSION AND DISTRIBUTION

07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)

ATIS ANSI 05.1 (2008) Wood Poles -- Specifications & Dimensions

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C135.14 (1979) Staples with Rolled or Slash Points for Overhead Line Construction

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C1 (2003) All Timber Products - Preservative Treatment by Pressure Processes

AWPA C4 (2003) Poles - Preservative Treatment by Pressure Processes

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M (2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 153/A 153M (2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 475 (2003; R 2009e1) Standard Specification for Zinc-Coated Steel Wire Strand

ASTM A 575 (1996; R 2007) Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades

ASTM A 576 (1990b; R 2006) Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality

ASTM B 1 (2001; R 2007) Standard Specification for Hard-Drawn Copper Wire

ASTM B 117 (2009) Standing Practice for Operating Salt Spray (Fog) Apparatus

ASTM B 2	(2008) Standard Specification for Medium-Hard-Drawn Copper Wire
ASTM B 232/B 232M	(2009) Standard Specification for Concentric-Lay-Stranded Aluminum Conductors, Coated-Steel Reinforced (ACSR)
ASTM B 3	(2001; R 2007) Standard Specification for Soft or Annealed Copper Wire
ASTM B 8	(2004) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D 1654	(2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)	
IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE 404	(2006) Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500,000 V
IEEE C135.1	(1999) Standard for Zinc-Coated Steel Bolts and Nuts for Overhead Line Construction
IEEE C135.2	(1999) Threaded Zinc-Coated Ferrous Strand-Eye Anchor Rods and Nuts for Overhead Line Construction
IEEE C135.22	(1988) Standard for Zinc-Coated Ferrous Pole-Top Insulator Pins with Lead Threads for Overhead Line Construction
IEEE C2	(2007; TIA 2007-1; TIA 2007-2; TIA 2007-3; TIA 2007-4; TIA 2007-5; Errata 2006-1; Errata 2007-2; Errata 2009-3) National Electrical Safety Code
IEEE C37.32	(2002) Standard for High-Voltage Switches, Bus Supports, and Accessories - Schedules of Preferred Ratings, Construction Guidelines and Specifications
IEEE C37.41	(2008; Errata 2009) Standard Design Tests for High-Voltage (>1000 V) Fuses, Fuse and Disconnecting Cutouts, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories Used with These Devices
IEEE C37.42	(2009) Standard Specifications for High-Voltage (> 1000 V) Expulsion-Type Distribution-Class Fuses, Fuse and

Disconnecting Cutouts, Fuse Disconnecting Switches, and Fuse Links, and Accessories Used with These Devices

IEEE C57.15 (2009) Standard Requirements, Terminology, and Test Code for Step-Voltage Regulators

IEEE C62.11 (2005; Amd 1 2008) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS (2009) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C29.2 (1992; R 1999) American National Standard for Insulators - Wet-Process Porcelain and Toughened Glass - Suspension Type

ANSI C29.3 (1986; R 2002) American National Standard for Wet Process Porcelain Insulators - Spool Type

ANSI C29.4 (1989; R 2002) Standard for Wet-Process Porcelain Insulators - Strain Type

ANSI C29.5 (1984; R 2002) Wet-Process Porcelain Insulators (Low and Medium Voltage Pin Type)

ANSI C29.7 (1996; 2007) American National Standard for Wet Process Porcelain Insulators - High-Voltage Line Post Type

ANSI/NEMA WC 71/ICEA S-96-659 (1999) Standard for Nonshielded Cables Rated 2001-5000 Volts for use in the Distribution of Electric Energy

NEMA C135.4 (1987) Zinc-Coated Ferrous Eyebolts and Nuts for Overhead Line Construction

NEMA WC 70 (2009) Power Cable Rated 2000 V or Less for the Distribution of Electrical Energy--S95-658

NEMA WC 74/ICEA S-93-639 (2006) 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011) National Electrical Code

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS 202-1 (2004) List of Materials Acceptable for Use on Systems of RUS Electrification Borrowers

RUS Bull 345-67 (1998) REA Specification for Filled Telephone Cables, PE-39

UNDERWRITERS LABORATORIES (UL)

UL 467 (2007) Grounding and Bonding Equipment

UL 486A-486B (2003; Reprint Feb 2010) Wire Connectors

UL 6 (2007) Electrical Rigid Metal Conduit-Steel

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section with additions and modifications specified herein.

1.3 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Conductors; G

Insulators; G

Steel poles; G

Wood Poles

Nameplates; G

Pole top switch; G

Cutouts; G

Surge arresters; G

Guy strand

Anchors

SD-05 Design Data

Steel poles; G

SD-06 Test Reports

Ground resistance test reports; G

SD-07 Certificates

Steel poles; G

Wood poles; G

Fiberglass crossarms; G

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, Data Package 5; G

Submit operation and maintenance data as specified herein.1.5

QUALITY ASSURANCE

1.5.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 and IEEE C2 unless more stringent requirements are specified or indicated.

1.5.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.5.3 Ground Resistance Test Reports

Submit the measured ground resistance of grounding system. When testing grounding electrodes and grounding systems, identify each grounding electrode and each grounding system for testing. Include the test method and test setup (i.e. pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

1.5.4 Fiberglass Crossarm Inspection Report

Furnish an inspection report from an independent inspection agency, approved by the Contracting Officer, stating that offered products comply with applicable AWP and RUS standards.

1.5.4.1 Field Test Plan

Provide a proposed field test plan 30 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

1.6 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected by the Contractor when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Oil filled transformers and switches shall be stored in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with ATIS ANSI O5.1. Handling of wood poles shall be in accordance with ATIS ANSI O5.1, except that pointed tools capable of producing indentations more than inch in depth shall not be used. Nails and holes are not permitted in top of poles. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Consider materials specified herein or shown on contract drawings which are identical to materials listed in RUS 202-1 as conforming to requirements. Equipment and component items, not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 120 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The

described test mark and test evaluation shall be in accordance with [ASTM D 1654](#) with a rating of not less than 7 in accordance with TABLE 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

2.2 POLES

Poles shall be of lengths and classes indicated.

2.2.1 Wood Poles

Wood poles machine trimmed by turning conforming to [ATIS ANSI O5.1](#) and [RUS Bull 345-67](#). Gain, bore and roof poles before treatment. Should additional gains be required subsequent to treatment, metal gain plates shall be provided. Pressure treat poles with pentachlorophenol, except that Douglas Fir and Western Larch poles shall not be treated with CCA in accordance with [AWPA C1](#) and [AWPA C4](#) as referenced in [RUS Bull 345-67](#). The quality of each pole shall be ensured with "WQC" (wood quality control) brand on each piece, or by an approved inspection agency report.

2.2.2 Steel Poles (Wood Pole Equivalent)

Steel poles shall be designed to withstand the loads specified in [IEEE C2](#) multiplied by the appropriate overload capacity factors, shall be hot-dip galvanized in accordance with [ASTM A 123/A 123M](#) and shall not be painted. Poles shall have tapered tubular members, either round in cross-section or polygonal, and comply with strength calculations performed by a registered professional engineer. Calculations shall be submitted in accordance with the design data portion of paragraph entitled "SUBMITTALS." Provide certification, from the manufacturer, that the technical requirements of this specification shall be met. Pole shafts shall be one piece. Poles shall be welded construction with no bolts, rivets, or other means of fastening except as specifically approved. Pole markings shall be approximately 3 to 4 feet above grade and shall include manufacturer, year of manufacture, top and bottom diameters, length, and a loading tree. Attachment requirements shall be provided as indicated, including grounding provisions. Climbing facilities are not required.

2.3 CROSSARMS AND BRACKETS

2.3.1 Fiberglass Crossarms

Crossarms shall be [fiberglass, braceless](#), distribution type. Cross-sectional area minimum dimensions shall be [4-1/4 inches](#) in height by [3-1/4 inches](#) in depth in accordance with [IEEE C2](#) for Grade B construction. Crossarms shall be [8 feet, 10 feet, and 12 feet](#) in length, except that [10 foot](#) crossarms shall be used for crossarm-mounted banked single-phase transformers or elsewhere as indicated. Crossarms shall be bored for stud and bolt holes. Factory drilling shall be provided for pole and brace mounting, for four pin or four vertical line-post insulators, and for four suspension insulators, except where otherwise indicated or required. Drilling shall provide required climbing space and wire clearances.

2.4 HARDWARE

Hardware shall be hot-dip galvanized in accordance with [ASTM A 153/A 153M](#) and [ASTM A 123/A 123M](#).

Zinc-coated hardware shall comply with IEEE C135.1, IEEE C135.2, NEMA C135.4, ANSI C135.14 IEEE C135.22. Steel hardware shall comply with ASTM A 575 and ASTM A 576. Pole-line hardware shall be hot-dip galvanized steel. Washers shall be installed under boltheads and nuts on wood surfaces and elsewhere as required. Washers used on through-bolts and double-arming bolts shall be approximately 2-1/4 inches square and 3/16 inch thick. The diameter of holes in washers shall be the correct standard size for the bolt on which a washer is used. Washers for use under heads of carriage-bolts shall be of the proper size to fit over square shanks of bolts. Eye bolts, bolt eyes, eyenuts, strain-load plates, lag screws, guy clamps, fasteners, hooks, shims, and clevises shall be used wherever required to support and to protect poles, brackets, crossarms, guy wires, and insulators.

2.5 INSULATORS

Provide wet-process porcelain insulators which are radio interference free.

- a. Line post type insulators: ANSI C29.7, Class 57-1S.
- b. Suspension insulators: ANSI C29.2 Quantity per Phase, 2, Class 52-1.
- c. Spool insulators: ANSI C29.3, Class 53-2.
- d. Guy strain insulators: ANSI C29.4, Class 54-2, except provide fiberglass type when used with underground terminal or when other interference problems exist.
- e. Pin insulators: ANSI C29.5, Class 55-3.

2.6 OVERHEAD CONDUCTORS, CONNECTORS AND SPLICES

Conductors of bare copper aluminum conductor steel reinforced (ACSR) of sizes and types indicated. Where aluminum conductors are connected to dissimilar metal, fittings conforming to UL 486A-486B shall be used.

2.6.1 Solid Copper

ASTM B 1, ASTM B 2, and ASTM B 3, hard-drawn, medium-hard-drawn, and soft-drawn, respectively. ASTM B 8, stranded.

2.6.2 Aluminum Conductor Steel Reinforced (ACSR)

ASTM B 232/B 232M, aluminum, 397 ACSR 18/1 Chickadee.

2.6.3 Connectors and Splices

Connectors and splices shall be of copper alloys for copper conductors, aluminum alloys for aluminum-composition conductors, and a type designed to minimize galvanic corrosion for copper to aluminum-composition conductors. Aluminum-composition, aluminum-composition to copper, and copper-to-copper shall comply with UL 486A-486B.

2.7 NEUTRAL-SUPPORTED SECONDARY AND SERVICE DROP CABLES

Service cables shall be aluminum, triplex or quadruplex with cross-linked polyethylene insulation on the phase conductors where indicated. Neutral shall be bare aluminum alloy and shall be the same size as the phase conductors unless otherwise indicated. Cables shall conform to NEMA WC 70 and ANSI/NEMA WC 71/ICEA S-96-659 for cross-linked polyethylene insulation.

2.8 GUY STRAND

ASTM A 475, extra high-strength. Guy strand shall be 7/16 inch in diameter with a minimum breaking strength of 18,000 pounds. Provide guy terminations designed for use with the particular strand and developing at least the ultimate breaking strength of the strand.

2.9 ROUND GUY MARKERS

Vinyl or PVC material, yellow colored, 8 feet long and shatter resistant at sub-zero temperatures.

2.9.1 Guy Attachment

Thimble eye guy attachment. Attachments shall be rated at ultimate 18,000 pounds for simple attachments. Attachments with multiple guys shall be rated at the ultimate strength for the number of guys attached.

2.10 ANCHORS AND ANCHOR RODS

Anchors shall present holding area indicated on drawings as a minimum. Anchor rods shall be triple thimble-eye, 3/4 inch diameter by 8 feet long. Anchors and anchor rods shall be hot dip galvanized.

2.10.1 Screw Anchors

Screw type swamp anchors having a manufacturer's rating of not less than 25,000 pounds in loose to medium sand/clay soil, Class 6.

2.10.2 Rock Anchors

Rock anchors having a manufacturer's rating of 36,000 pounds.

2.11 GROUNDING AND BONDING

2.11.1 Driven Ground Rods

Provide copper-clad steel ground rods conforming to UL 467 not less than 3/4 inch in diameter by 10 feet in length. Sectional type rods may be used for rods 20 feet or longer.

2.11.2 Grounding Conductors

ASTM B 3. Provide soft drawn copper wire ground conductors a minimum No. 4 AWG. Ground wire protectors shall be PVC.

2.11.3 Grounding Connections

UL 467. Exothermic weld or compression connector.

2.12 SURGE ARRESTERS

IEEE C62.11, metal oxide, polymeric-housed, surge arresters arranged for crossarm mounting. RMS voltage rating shall be 15 kV. Arresters shall be Distribution class, except for underground distribution circuits use riser class arresters.

2.13 FUSED CUTOUTS

Enclosed type fused cutouts rated 200 amperes interrupting current at 15 kV ungrounded 8.3/15 kV gnd Y, conforming to IEEE C37.42. Type K fuses conforming to IEEE C37.42 with ampere ratings equal to 150 percent of the transformer full load rating. Open link type fuse cutouts are not acceptable.

2.14 CONDUIT RISERS AND CONDUCTORS

The riser shield shall be rigid galvanized steel conduit, as indicated, and conforming to UL 6. Provide conductors and terminations as specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.15 GROUP-OPERATED LOAD INTERRUPTER SWITCHES

2.15.1 Manually Operated Type (Switch Handle Operated)

Manually operated (switch handle operated) load interrupter switches shall comply with IEEE C37.32 and shall be of the outdoor, manually-operated, three-pole, single-throw type with either tilting or rotating insulators. Switches shall be equipped with interrupters capable of interrupting currents equal to the switch's continuous current rating. Each switch shall be preassembled for the indicated configuration and mounting. Moving contacts shall be of the high-pressure, limited-area type, designed to ensure continuous surface contact. Switches shall be fused or non-fused as indicated. Switches shall be complete with necessary operating mechanisms, handles, and other items required for manual operation from the ground. Switch operating handles shall be located approximately 3 feet 6 inches above final grade. Insulation of switch operating mechanisms shall include both insulated interphase rod sections and insulated vertical shafts. Each handle shall be provided with a padlock arranged to lock the switch in both the open and the closed position.

2.16 RECLOSER

- a. The recloser shall be controlled electronically.
- b. Interrupters: Vacuum
- c. Bushings:
 1. Porcelain.
 2. 26-1/2 inch creepage, standard length.
 3. Flat pat terminals, four hole NEMA spacing.
- d. Closing solenoid: 240 VAC
- g. Wiring: Provide one control cable complete with two factory-installed receptacles (one on each end) for connection between the recloser control and the recloser.
- h. Accessories:
 1. manual open handle checking switch.
 2. One external grounding connector.

3. One pole mounting frame extension.

i. Finish: Manufacturer's standard gray. Provide touch-up paint for each color used.

2.17 VOLTAGE REGULATOR

Voltage regulators shall comply with IEEE C57.15 and shall be of the outdoor, self-cooled, 55/65 degrees C temperature rise, single-phase type. Windings and the load-tap-changing mechanism shall be mineral-oil-immersed. When operating under load, a regulator shall provide plus and minus 10 percent automatic voltage regulation in approximately 5/8 percent steps, with 16 steps above and 16 steps below rated voltage. Automatic control equipment shall provide Class 1 accuracy. Bypass surge arresters shall be suitable for a grounded system and for the associated regulator voltage. Intermediate class surge arresters shall be mounted next to each incoming line bushing on a regulator tank-mounted bracket and connected to a surge arrester ground pad-mounted on the regulator tank.

2.17.1 Ratings

Ratings at 60 Hz shall be

Maximum voltage (LG, kV).....	8
Basic Insulation Level (BIL).....	95
Current.....	438

2.17.2 Bypass and Isolation Switches

Switches shall be of the outdoor, stickhook-operated, single-pole, vertical-break type suitable for the indicated mounting. Switches shall be of a type designed to provide bypass of a single-phase regulator circuit by an integral sequence which always occurs when each switch is opened or closed. Each opening sequence shall initially bypass the single-phase regulator circuit, then open the input and output circuits, and finally interrupt the exciting current. Opening any single-phase regulator circuit shall not be possible until after the bypass circuit is closed. Ratings at 60 Hz shall be in accordance with IEEE C37.41 and as follows:

Maximum voltage (LL, kV).....	15
Nominal voltage class (LL, kV).....	12.47
BIL.....	95
Momentary asymmetrical current in the closed position (A)....	40,000
Momentary asymmetrical current in the bypass position (A)....	40,000
Continuous and interrupting current (A).....	600

2.17.3 Miscellaneous

Standard accessories and components in accordance with IEEE C57.15 shall be provided. Single-phase units shall be provided with additional components and accessories required by IEEE C57.15 for three-phase units.

2.18 NAMEPLATES

2.18.1 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable. Equipment containing liquid-dielectrics shall have the type of dielectric on the nameplate.

PART 3 EXECUTION

3.1 INSTALLATION

Provide overhead pole line installation conforming to requirements of **NESC** for Grade B construction of overhead lines in heavy loading districts and **NFPA 70** for overhead services. Provide material required to make connections into existing system and perform excavating, backfilling, and other incidental labor. Consider street, alleys, roads and drives "public." Pole configuration shall be as indicated.

3.1.1 Overhead Service

Terminate overhead service conductors into buildings at service entrance fittings or weatherhead outside building. Nearby support bracket for overhead wires shall be not less than **12 feet** above finished grade at building. Drip loops shall be formed on conductors at entrances to buildings, cabinets, or conduits.

3.1.2 Tree Trimming

Where lines pass through trees, trees shall be trimmed at least **15 feet** clear on both sides horizontally and below for medium-voltage lines, and **5 feet** clear on both sides horizontally and below for other lines. No branch shall overhang horizontal clearances. Where trees are indicated to be removed to provide a clear right-of-way, clearing is specified in Section **31 11 00** CLEARING AND GRUBBING.

3.1.3 Wood and Steel Pole Installation

Provide pole holes at least as large at the top as at the bottom and large enough to provide **4 inch** clearance between the pole and side of the hole.

3.1.3.1 Setting Depth of Pole

Pole setting depths shall be as follows:

Length of Pole (feet)	Setting in Soil (feet)	Setting in Solid Rock (feet)
20	5.0	3.0
25	5.5	3.5
30	5.5	3.5
35	6.0	4.0
40	6.0	4.0
45	6.5	4.5
50	7.0	4.5
55	7.5	5.0

Length of Pole (feet)	Setting in Soil (feet)	Setting in Solid Rock (feet)
60	8.0	5.0
65	8.5	5.5
70	9.0	5.5
75	9.5	6.0
80	10.0	6.0
85	10.5	6.5
90	11.0	6.5
95	11.5	7.0
100	12.5	7.5

3.1.3.2 Setting in Soil, Sand, and Gravel

"Setting in Soil" depths, as specified in paragraph entitled "Setting Depth of Pole," apply where the following occurs:

- a. Where pole holes are in soil, sand, or gravel or any combination of these;
- b. Where soil layer over solid rock is more than **2 feet** deep;
- c. Where hole in solid rock is not substantially vertical; or
- d. Where diameter of hole at surface of rock exceeds twice the diameter of pole at same level. At corners, dead ends and other points of extra strain, poles **40 feet** or more long shall be set **6 inches** deeper.

3.1.3.3 Setting in Solid Rock

"Setting in Solid Rock," as specified in paragraph entitled "Setting Depth of Pole," applies where poles are to be set in solid rock and where hole is substantially vertical, approximately uniform in diameter and large enough to permit use of tamping bars the full depth of hole.

3.1.3.4 Setting With Soil Over Solid Rock

Where a layer of soil **2 feet** or less in depth over solid rock exists, depth of hole shall be depth of soil in addition to depth specified under "Setting in Solid Rock" in paragraph entitled "Setting Depth of Pole," provided, however, that such depth shall not exceed depth specified under "Setting in Soil."

3.1.3.5 Setting on Sloping Ground

On sloping ground, always measure hole depth from low side of hole.

3.1.3.6 Backfill

Thoroughly tamp pole backfill for full depth of the hole and mound excess fill around the pole.

3.1.3.7 Setting Poles

Set poles so that alternate crossarm gains face in opposite directions, except at terminals and dead ends where gains of last two poles shall be on

side facing terminal or dead end. On unusually long spans, set poles so that crossarm comes on side of pole away from long span. Where pole top pins are used, they shall be on opposite side of pole from gain, with flat side against pole.

3.1.3.8 Alignment of Poles

Set poles in alignment and plumb except at corners, terminals, angles, junctions, or other points of strain, where they shall be set and raked against the strain. Set not less than 2 inches for each 10 feet of pole length above grade, nor more than 4 inches for each 10 feet of pole length after conductors are installed at required tension. When average ground run is level, consecutive poles shall not vary more than 5 feet in height. When ground is uneven, poles differing in length shall be kept to a minimum by locating poles to avoid the highest and lowest ground points. If it becomes necessary to shorten a pole, a piece shall be sawed off the top. Holes shall be dug large enough to permit the proper use of tampers to full depth of hole.

3.1.3.9 Pole Caps

Provide plastic pole caps with 1/4 inch sealing rings and four nailing tabs. Fill sealing area with either a bituminous, elastigum roof cement or an acceptable preservative paste to level of sealing ring to eliminate possibility of condensation. Place on pole top and nail each tab down with a 1 1/4 inch nail.

3.1.4 Anchors and Guys

Place anchors in line with strain. The length of the guy lead (distance from base of pole to the top of the anchor rod) shall be as indicated, if not indicated the minimum load shall be 25 feet from pole to nearest anchor.

3.1.4.1 Setting Anchors

Set anchors in place with anchor rod aligned with, and pointing directly at, guy attachment on the pole with the anchor rod projecting 6 to 9 inches out of ground to prevent burial of rod eye.

3.1.4.2 Screw Anchors

Install screw anchors by torquing with boring machine.

3.1.4.3 Rock Anchors

Install rock anchors minimum depth 12 inches in solid rock.

3.1.4.4 Guy Installation

Provide guys where indicated, with loads and strengths as indicated, and wherever conductor tensions are not balanced, such as at angles, corners and dead-ends. Where single guy will not provide the required strength, two or more guys shall be provided. Where guys are wrapped around poles, at least two guy hooks shall be provided. Provide pole shims where guy tension exceeds 6000 pounds. Guy clamps 6 inches in length with three 5/8 inch bolts, or offset-type guy clamps, or approved guy grips shall be provided at each guy terminal. Securely clamp plastic guy marker to the guy or anchor at the bottom and top of marker. Complete anchor and guy installation, dead end to dead end, and tighten guy before wire stringing

and sagging is begun on that line section. Provide strain insulators at a point on guy strand 8 feet minimum from the ground and 6 feet minimum from the surface of pole.

3.1.5 Hardware

Provide hardware with washer against wood and with nuts and lock nuts applied wrench tight. Provide locknuts on threaded hardware connections. Locknuts shall be M-F style and not palnut style.

3.1.6 Grounding

Unless otherwise indicated, grounding shall conform to IEEE C2 and NFPA 70.

3.1.6.1 Grounding Electrode Installation

Grounding electrodes shall be installed as follows:

- a. Driven rod electrodes - Unless otherwise indicated, ground rods shall be located approximately 3 feet out from base of the pole and shall be driven into the earth until the tops of the rods are approximately 1 foot below finished grade. Multiple rods shall be evenly spaced at least 10 feet apart and connected together 2 feet below grade with a minimum No. 6 bare copper conductor.
- b. Ground resistance - The maximum resistance of a driven ground rod shall not exceed 25 ohms under normally dry conditions. Whenever the required ground resistance is not met, provide additional electrodes interconnected with grounding conductors, to achieve the specified ground resistance. The additional electrodes will be 10 feet rods spaced a minimum of 10 feet apart. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, notify the Contracting Officer immediately.

3.1.6.2 Grounding Electrode Conductors

On multi-grounded circuits, as defined in IEEE C2, provide a single continuous vertical grounding electrode conductor. Neutrals, surge arresters, and equipment grounding conductors shall be bonded to this conductor. For single-grounded or ungrounded systems, provide a grounding electrode conductor for the surge arrester and equipment grounding conductors and a separate grounding electrode conductor for the secondary neutrals. Grounding electrode conductors shall be stapled to wood poles at intervals not exceeding 2 feet. On metal poles, a preformed galvanized steel strap, 5/8 inch wide by 22 gauge minimum by length, secured by a preformed locking method standard with the manufacturer, shall be used to support a grounding electrode conductor installation on the pole and spaced at intervals not exceeding 5 feet with one band not more than 3 inches from each end of the vertical grounding electrode conductor. Grounding electrode conductors shall be sized as indicated. Secondary system neutral conductors shall be connected directly to the transformer neutral bushings, then connected with a neutral bonding jumper between the transformer neutral bushing and the vertical grounding electrode conductor as indicated. Bends greater than 45 degrees in grounding electrode conductor are not permitted.

3.1.6.3 Grounding Electrode Connections

Make above grade grounding connections on pole lines by exothermic weld or by using a compression connector. Make below grade grounding connections by exothermic weld. Make exothermic welds strictly in accordance with manufacturer's written recommendations. Welds which have puffed up or which show convex surfaces indicating improper cleaning, are not acceptable. No mechanical connectors are required at exothermic weldments. Compression connectors shall be type that uses a hydraulic compression tool to provide correct pressure. Provide tools and dies recommended by compression connector manufacturer. An embossing die code or similar method shall provide visible indication that a connector has been fully compressed on ground wire.

3.1.6.4 Grounding and Grounded Connections

- a. Where no primary or common neutral exists, surge arresters and frames of equipment operating at over 750 volts shall be bonded together and connected to a dedicated primary grounding electrode.
- b. Where no primary or common neutral exists, transformer secondary neutral bushing, secondary neutral conductor, and frames of equipment operating at under 750 volts shall be bonded together and connected to a dedicated secondary grounding electrode.
- c. When a primary or common neutral exists, connect all grounding and grounded conductors to a common grounding electrode.

3.1.6.5 Protective Molding

Protect grounding conductors which are run on surface of wood poles by PVC molding extending from ground line throughout communication and transformer spaces.

3.1.7 CONDUCTOR INSTALLATION

3.1.7.1 Line Conductors

Unless otherwise indicated, conductors shall be installed in accordance with manufacturer's approved tables of sags and tensions. Conductors shall be handled with care necessary to prevent nicking, kinking, gouging, abrasions, sharp bends, cuts, flattening, or otherwise deforming or weakening conductor or any damage to insulation or impairing its conductivity. Remove damaged sections of conductor and splice conductor. Conductors shall be paid out with the free end of conductors fixed and cable reels portable, except where terrain or obstructions make this method unfeasible. Bend radius for any insulated conductor shall not be less than the applicable NEMA specification recommendation. Conductors shall not be drawn over rough or rocky ground, nor around sharp bends. When installed by machine power, conductors shall be drawn from a mounted reel through stringing sheaves in straight lines clear of obstructions. Initial sag and tension shall be checked by the Contractor, in accordance with the manufacturer's approved sag and tension charts, within an elapsed time after installation as recommended by the manufacturer.

3.1.7.2 Connectors and Splices

Conductor splices, as installed, shall exceed ultimate rated strength of conductor and shall be of type recommended by conductor manufacturer. No

splice shall be permitted within 10 feet of a support. Connectors and splices shall be mechanically and electrically secure under tension and shall be of the nonbolted compression type. The tensile strength of any splice shall be not less than the rated breaking strength of the conductor. Splice materials, sleeves, fittings, and connectors shall be noncorrosive and shall not adversely affect conductors. Aluminum-composition conductors shall be wire brushed and an oxide inhibitor applied before making a compression connection. Connectors which are factory-filled with an inhibitor are acceptable. Inhibitors and compression tools shall be of types recommended by the connector manufacturer. Primary line apparatus taps shall be by means of hot line clamps attached to compression type bail clamps (stirrups). Low-voltage connectors for copper conductors shall be of the solderless pressure type. Noninsulated connectors shall be smoothly taped to provide a waterproof insulation equivalent to the original insulation, when installed on insulated conductors. On overhead connections of aluminum and copper, the aluminum shall be installed above the copper.

3.1.7.3 Conductor-To-Insulator Attachments

Conductors shall be attached to insulators by means of clamps, shoes or tie wires, in accordance with the type of insulator. For insulators requiring conductor tie-wire attachments, tie-wire sizes shall be as specified in TABLE I.

TABLE I

TIE-WIRE REQUIREMENTS

CONDUCTOR Copper (AWG)	TIE WIRE Soft-Drawn Copper (AWG)
6	8
4 and 2	6
1 through 3/0	4
4/0 and larger	2
AAC, AAAC, or ACSR (AWG)	AAAC OR AAC (AWG)
Any size	6 or 4

3.1.7.4 Armor Rods

Armor rods shall be provided for AAC, AAAC, and ACSR conductors. Armor rods shall be installed at supports, except armor rods will not be required at primary dead-end assemblies if aluminum or aluminum-lined zinc-coated steel clamps are used. Lengths and methods of fastening armor rods shall be in accordance with the manufacturer's recommendations. For span lengths of less than 200 feet, flat aluminum armor rods may be used. Flat armor rods, not less than 0.03 by 0.25 inch shall be used on No. 1 AWG AAC and AAAC and smaller conductors and on No. 5 AWG ACSR and smaller conductors. On larger sizes, flat armor rods shall be not less than 0.05 by 0.30 inches. For span lengths of 200 feet or more, preformed round armor rods shall be used.

3.1.7.5 Ties

Provide ties on pin insulators tight against conductor and insulator and

ends turned down flat against conductor so that no wire ends project.

3.1.7.6 Low-Voltage Insulated Cables

Low-voltage cables shall be supported on clevis fittings using spool insulators. Dead-end clevis fittings and suspensions insulators shall be provided where required for adequate strength. Dead-end construction shall provide a strength exceeding the rated breaking strength of the neutral messenger. Clevis attachments shall be provided with not less than $5/8$ inch through-bolts. Secondary racks may be used when installed on wood poles and where the span length does not exceed 200 feet. Secondary racks shall be two-, three-, or four-wire, complete with spool insulators. Racks shall meet strength and deflection requirements for heavy-duty steel racks, and shall be rounded and smooth to avoid damage to conductor insulation. Each insulator shall be held in place with a $5/8$ inch button-head bolt equipped with a nonferrous cotter pin, or equivalent, at the bottom. Racks for dead-ending four No. 4/0 AWG or four larger conductors shall be attached to poles with three $5/8$ inch through-bolts. Other secondary racks shall be attached to poles with at least two $5/8$ inch through-bolts. Minimum vertical spacing between conductors shall not be less than 8 inches.

3.1.7.7 Reinstalling Conductors

Existing conductors to be reinstalled shall be resagged to existing conditions for the particular conductor type and size involved.

3.1.7.8 New Conductor Installation

String new conductors to "initial" sag table values indicated for conductor type and size of conductor and ruling span indicated.

3.1.7.9 Fittings

Dead end fittings, clamp or compression type, shall conform to written recommendations of conductor manufacturer and shall develop full ultimate strength of conductor.

3.1.7.10 Aluminum Connections

Make aluminum connections to copper or other material using only splices, connectors, lugs, or fittings designed for that specific purpose. Keep a copy of manufacturer's instructions for applying these fittings at job site for use of the inspector.

3.1.8 Pole Top Switch Installation

Install pole top switch strictly according to manufacturer's installation drawings and information.

3.1.8.1 Operating Handle

Locate approximately $3-1/2$ feet above ground on field side of pole.

3.1.9 Risers

Secure galvanized steel conduits on poles by two hole galvanized steel pipe straps spaced as indicated and within 3 feet of any outlet or termination. Ground metallic conduits.

3.2 CROSSARM MOUNTING

Crossarms shall be bolted to poles with 5/8 inch through-bolts with square washers at each end. Bolts shall extend not less than 1/8 inch nor more than 2 inches beyond nuts. On single crossarm construction, the bolt head shall be installed on the crossarm side of the pole. Double crossarms shall be securely held in position by means of 5/8 inch double-arming bolts. Each double-arming bolt shall be equipped with four nuts and four square washers. Fiberglass crossarm shall be mounted using a braceless assembly.

3.2.1 Line Arms and Buck Arms

Line arms and buck arms shall be set at right angles to lines for straight runs and for angles 45 degrees and greater; and line arms shall bisect angles of turns of less than 45 degrees. Dead-end assemblies shall be used for turns where shown. Buck arms shall be installed, as shown, at corners and junction poles. Deadend rated crossarms or shall be provided at ends of joint use or conflict sections, at dead-ends, and at angles and corners to provide adequate vertical and longitudinal strength. Double crossarms shall be provided at each line-crossing structure and where lines not attached to the same pole cross each other.

3.2.2 Equipment Arms

Equipment arms shall be set parallel or at right angles to lines as required to provide climbing space. Equipment arms shall be located below line construction to provide necessary wire and equipment clearances.

3.3 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.4 FIELD QUALITY CONTROL

3.4.1 General

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 2 days prior to conducting tests. The Contractor shall furnish materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field reports will be signed and dated by the Contractor.

3.4.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.4.3 Medium-Voltage Preassembled Cable Test

After installation, prior to connection to an existing system, and before the operating test, the medium-voltage preassembled cable system shall be given a high potential test. Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors at one terminal and connecting grounds or metallic shieldings or sheaths of the cable at the other terminal for each test. Prior to the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The method, voltage, length of time, and other characteristics of the test for initial installation shall be in accordance with [NEMA WC 74/ICEA S-93-639](#) for the particular type of cable installed, and shall not exceed the recommendations of [IEEE 404](#) for cable joints unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or other connections, the Contractor shall make necessary repairs or replace cables as directed. Repaired or replaced cables shall be retested.

3.4.4 Sag and Tension Test

The Contracting Officer shall be given prior notice of the time schedule for stringing conductors or cables serving overhead medium-voltage circuits and reserves the right to witness the procedures used for ascertaining that initial stringing sags and tensions are in compliance with requirements for the applicable loading district and cable weight.

3.4.5 Pre-Energization Services

The following services shall be performed on the equipment listed below. These services shall be performed subsequent to testing but prior to the initial energization. The equipment shall be inspected to insure that installation is in compliance with the recommendations of the manufacturer and as shown on the detail drawings. Terminations of conductors at major equipment shall be inspected to ensure the adequacy of connections. Bare and insulated conductors between such terminations shall be inspected to detect possible damage during installation. If factory tests were not performed on completed assemblies, tests shall be performed after the installation of completed assemblies. Components shall be inspected for damage caused during installation or shipment and to ensure that packaging materials have been removed. Components capable of being both manually and electrically operated shall be operated manually prior to the first electrical operation. Components capable of being calibrated, adjusted, and tested shall be calibrated, adjusted, and tested in accordance with the instructions of the equipment manufacturer. Items for which such services shall be provided, but are not limited to, are the following:

Switches.

3.4.6 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with [NETA ATS](#).

3.4.6.1 Pole Top Interrupter Switch

a. Visual and Mechanical Inspection

- (1) Compare equipment nameplate information with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition.
- (3) Verify appropriate equipment grounding.
- (4) Perform mechanical operator tests in accordance with manufacturer's instructions.
- (5) Verify correct blade alignment, blade penetration, travel stops, arc interrupter operation, and mechanical operation.

3.4.6.2 Reclosers

a. Visual and Mechanical Inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition.
- (3) Inspect alignment and grounding.
- (4) Perform mechanical operation and contact alignment tests on both the recloser and its operating mechanism in accordance with manufacturer's instructions.
- (5) Verify tightness of accessible bolted electrical connections.
- (6) Inspect for correct insulating liquid level.

b. Electrical Tests

- (1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter.
- (2) Perform a contact resistance test
- (3) Sample insulating liquid. Sample shall be tested for:
 - (a) Dielectric breakdown voltage
 - (b) Color
 - (c) Visual condition
- (4) Test protective functions.
- (5) Perform vacuum bottle integrity test (overpotential) across each vacuum bottle with the recloser in the open position in strict accordance with manufacturer's instructions.
- (6) Perform overpotential tests.

- (7) Determine time delay for each programmed reclosing interval.
- (8) Verify lockout for unsuccessful reclosing.
- (9) Determine reset time.
- (10) Verify instantaneous overcurrent lockout.

3.4.6.3 Grounding System

a. Visual and mechanical inspection

- (1) Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

- (1) Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

3.4.7 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least three times, demonstrating satisfactory operation each time.

3.4.8 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.

-- End of Section --

SECTION 33 82 00

TELECOMMUNICATIONS OUTSIDE PLANT (OSP)

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

- ASTM B 1** (2001; R 2007) Standard Specification for Hard-Drawn Copper Wire
- ASTM B 8** (2004) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- ASTM D 1557** (2009) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2700 kN-m/m³)
- ASTM D 709** (2001; R 2007) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- IEEE 100** (2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
- IEEE C2** (2007; Errata 06-1; TIA 07-1; TIA 07-2; TIA 07-3; Errata 07-2; TIA 08-4; TIA 08-5; TIA 08-6; TIA 08-7; TIA 08-8; TIA 08-9; TIA 08-10; TIA 08-11; TIA 09-12; TIA 09-13; TIA 09-14; Errata 09-3; TIA 09-15; TIA 09-16; TIA 10-17) National Electrical Safety Code

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

- ICEA S-87-640** (2006) Optical Fiber Outside Plant Communications Cable; 4th Edition
- ICEA S-98-688** (2006) Broadband Twisted Pair Telecommunication Cable, Aircore, Polyolefin Insulated, Copper Conductors Technical Requirements
- ICEA S-99-689** (2006) Broadband Twisted Pair Telecommunication Cable Filled, Polyolefin Insulated, Copper Conductors Technical Requirements

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C62.61 (1993) American National Standard for Gas
Tube Surge Arresters on Wire Line
Telephone Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011) National Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA J-STD-607 (2002a) Commercial Building Grounding
(Earthing) and Bonding Requirements for
Telecommunications

TIA-455-107 (1999a) FOTP-107 Determination of
Component Reflectance or Link/System
Return Loss using a Loss Test Set

TIA-455-78-B (2002) FOTP-78 Optical Fibres - Part
1-40: Measurement Methods and Test
Procedures - Attenuation

TIA-472D000 (2007b) Fiber Optic Communications Cable
for Outside Plant Use

TIA-492CAAA (1998; R 2002) Detail Specification for
Class IVa Dispersion-Unshifted Single-Mode
Optical Fibers

TIA-526-14 (2010b) OFSTP-14A Optical Power Loss
Measurements of Installed Multimode Fiber
Cable Plant

TIA-526-7 (2002; R 2008) OFSTP-7 Measurement of
Optical Power Loss of Installed
Single-Mode Fiber Cable Plant

TIA-568-2 (2009c; Errata 2010) Commercial Building
Telecommunications Cabling Standard - Part
2: Balanced Twisted Pair Cable Components

TIA-568-C.1 (2009) Commercial Building
Telecommunications Cabling Standard

TIA-568-C.3 (2008; Corrections 2008) Optical Fiber
Cabling Components Standard

TIA-569 (2004b; Add 1 2009) Commercial Building
Standard for Telecommunications Pathways
and Spaces

TIA-590 (1997a) Standard for Physical Location and
Protection of Below Ground Fiber Optic
Cable Plant

TIA-758 (2004a) Customer-Owned Outside Plant
Telecommunications Infrastructure Standard

TIA/EIA-455 (1998b) Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber Optic Components

TIA/EIA-455-204 (2000) Standard for Measurement of Bandwidth on Multimode Fiber

TIA/EIA-598 (2005c) Optical Fiber Cable Color Coding

TIA/EIA-606 (2002a; Errata 2007; R 2007; Adm 1 2008) Administration Standard for the Telecommunications Infrastructure

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6/NACE No.3 (2007) Commercial Blast Cleaning

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS 1755 Telecommunications Standards and Specifications for Materials, Equipment and Construction

RUS Bull 1751F-630 (1996) Design of Aerial Plant

RUS Bull 1751F-643 (2002) Underground Plant Design

RUS Bull 1751F-815 (1979) Electrical Protection of Outside Plant

RUS Bull 1753F-201 (1997) Acceptance Tests of Telecommunications Plant (PC-4)

RUS Bull 1753F-401 (1995) Splicing Copper and Fiber Optic Cables (PC-2)

RUS Bull 345-65 (1985) Shield Bonding Connectors (PE-65)

RUS Bull 345-72 (1985) Filled Splice Closures (PE-74)

RUS Bull 345-83 (1979; Rev Oct 1982) Gas Tube Surge Arrestors (PE-80)

UNDERWRITERS LABORATORIES (UL)

UL 497 (2001; Reprint Apr 2009) Protectors for Paired Conductor Communication Circuits

UL 510 (2005; Reprint Apr 2008) Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape

UL 83 (2008) Thermoplastic-Insulated Wires and Cables

1.2 RELATED REQUIREMENTS

Section 27 10 00, BUILDING TELECOMMUNICATIONS CABLING SYSTEM, , and Section 33 70 02.00 10, ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND apply to this section with additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in TIA-568-C.1, TIA-568-2, TIA-568-C.3, TIA-569, TIA/EIA-606, and IEEE 100 and herein.

1.3.1 Campus Distributor (CD)

A distributor from which the campus backbone cabling emanates. (International expression for main cross-connect - (MC).)

1.3.2 Entrance Facility (EF) (Telecommunications)

An entrance to the building for both private and public network service cables (including antennae) including the entrance point at the building wall and continuing to the entrance room or space.

1.3.3 Entrance Room (ER) (Telecommunications)

A centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.

1.3.4 Building Distributor (BD)

A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. (International expression for intermediate cross-connect - (IC).)

1.3.5 Pathway

A physical infrastructure utilized for the placement and routing of telecommunications cable.

1.4 SYSTEM DESCRIPTION

The telecommunications outside plant consists of cable, conduit, manholes, etc. required to provide signal paths from the closest point of presence to the new facility, including free standing frames or backboards, interconnecting hardware, terminating cables, lightning and surge protection modules at the entrance facility. The work consists of providing, testing and making operational cabling, interconnecting hardware and lightning and surge protection necessary to form a complete outside plant telecommunications system for continuous use. The telecommunications contractor must coordinate with the NEC concerning layout and configuration of the EF telecommunications and OSP. The telecommunications contractor may be required to coordinate work effort for access to the EF telecommunications and OSP with the NEC.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When

used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Telecommunications Outside Plant; G

Telecommunications Entrance Facility Drawings; G

In addition to Section 01 33 00 SUBMITTAL PROCEDURES, provide shop drawings in accordance with paragraph SHOP DRAWINGS.

SD-03 Product Data

Wire and cable; G

Cable splices, and connectors; G

Closures; G

Building protector assemblies; G

Protector modules; G

Submittals shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Submittals shall also include applicable federal, military, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified in paragraph REGULATORY REQUIREMENTS and as required for certificates in Section 01 33 00 SUBMITTAL PROCEDURES.

SD-06 Test Reports

Pre-installation tests; G

Acceptance tests; G

Outside Plant Test Plan; G

SD-07 Certificates

Telecommunications Contractor Qualifications; G

Key Personnel Qualifications; G

Minimum Manufacturer's Qualifications; GSD-08 Manufacturer's Instructions

Building protector assembly installation

Cable tensions; GFiber Optic Splices; G

Submit instructions prior to installation.

SD-09 Manufacturer's Field Reports

Factory Reel Test Data; G

SD-10 Operation and Maintenance Data

Telecommunications outside plant (OSP), Data Package 5; G

Commercial off-the-shelf manuals shall be provided for operation, installation, configuration, and maintenance of products provided as a part of the telecommunications outside plant (OSP). Submit operations and maintenance data in accordance with Section 01 78 23, OPERATION AND MAINTENANCE DATA and as specified herein not later than 2 months prior to the date of beneficial occupancy. In addition to requirements of Data package 5, include the requirements of paragraphs TELECOMMUNICATIONS OUTSIDE PLANT SHOP DRAWINGS and TELECOMMUNICATIONS ENTRANCE FACILITY DRAWINGS.

SD-11 Closeout Submittals

Record Documentation; G

In addition to other requirements, provide in accordance with paragraph RECORD DOCUMENTATION.

1.6 QUALITY ASSURANCE

1.6.1 Shop Drawings

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

1.6.1.1 Telecommunications Outside Plant Shop Drawings

Provide Outside Plant Design in accordance with TIA-758, RUS Bull 1751F-630 for aerial system design, and RUS Bull 1751F-643 for underground system design. Provide T0 shop drawings that show the physical and logical connections from the perspective of an entire campus, such as actual building locations, exterior pathways and campus backbone cabling on plan view drawings, major system nodes, and related connections on the logical system drawings in accordance with TIA/EIA-606. Drawings shall include wiring and schematic diagrams for fiber optic and copper cabling and splices, copper conductor gauge and pair count, fiber pair count and type, pathway duct and innerduct arrangement, associated construction materials, and any details required to demonstrate that cable system has been coordinated and will properly support the switching and transmission system identified in specification and drawings. Update existing telecommunication Outside Plant T0 drawings to include information modified, deleted or added as a result of this installation in accordance with TIA/EIA-606. The telecommunications outside plant (OSP) shop drawings shall be included in the operation and maintenance manuals.

1.6.1.2 Telecommunications Entrance Facility Drawings

The telecommunications entrance facility shop drawings shall be included in the operation and maintenance manuals.

1.6.2 Telecommunications Qualifications

Work under this section shall be performed by and the equipment shall be provided by the approved telecommunications contractor and key personnel. Qualifications shall be provided for: the telecommunications system contractor, the telecommunications system installer, the supervisor (if different from the installer), and the cable splicing and terminating personnel. A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

1.6.2.1 Telecommunications Contractor Qualifications

The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems that include outside plant and broadband cabling within the past 3 years. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems in accordance with TIA-758 within the past 3 years.

1.6.2.2 Key Personnel Qualifications

Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.

Cable splicing and terminating personnel assigned to the installation of this system or any of its components shall have training in the proper techniques and have a minimum of 3 years experience in splicing and terminating the specified cables. Modular splices shall be performed by factory certified personnel or under direct supervision of factory trained personnel for products used.

Supervisors and installers assigned to the installation of this system or any of its components shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products.

Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this solicitation. Include specific experience in installing and

testing telecommunications outside plant systems, including broadband cabling, and provide the names and locations of at least two project installations successfully completed using optical fiber and copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this solicitation. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity.

Indicate that all key persons are currently employed by the telecommunications contractor, or have a commitment to the telecommunications contractor to work on this project. All key persons shall be employed by the telecommunications contractor at the date of issuance of this solicitation, or if not, have a commitment to the telecommunications contractor to work on this project by the date that the bid was due to the Contracting Officer.

Note that only the key personnel approved by the Contracting Officer in the successful proposal shall do work on this solicitation's telecommunications system. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the telecommunications contractor's key personnel requires approval from The Contracting Officer.

1.6.2.3 Minimum [Manufacturer's Qualifications](#)

Cabling, equipment and hardware manufacturers shall have a minimum of 3 years experience in the manufacturing, assembly, and factory testing of components which comply with, [TIA-568-C.1](#), [TIA-568-2](#) and [TIA-568-C.3](#). In addition, cabling manufacturers shall have a minimum of 3 years experience in the manufacturing and factory testing of cabling which comply with [ICEA S-87-640](#), [ICEA S-98-688](#), and [ICEA S-99-689](#).

1.6.3 [Outside Plant Test Plan](#)

Prepare and provide a complete and detailed test plan for field tests of the outside plant including a complete list of test equipment for the copper conductor and optical fiber cables, components, and accessories for approval by the Contracting Officer. Include a cut-over plan with procedures and schedules for relocation of facility station numbers without interrupting service to any active location. Submit the plan at least 30 days prior to tests for Contracting Officer approval. Provide outside plant testing and performance measurement criteria in accordance with [TIA-568-C.1](#) and [RUS Bull 1753F-201](#). Include procedures for certification, validation, and testing that includes fiber optic link performance criteria.

1.6.4 Standard Products

Provide materials and equipment that are standard products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship and shall be the manufacturer's latest standard design that has been in satisfactory commercial or industrial use for at least 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market

through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Products supplied shall be specifically designed and manufactured for use with outside plant telecommunications systems. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6.4.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is provided.

1.6.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.6.5 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.6.5.1 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.7 DELIVERY, STORAGE, AND HANDLING

Ship cable on reels with a minimum overage of 10 percent. Radius of the reel drum shall not be smaller than the minimum bend radius of the cable. Wind cable on the reel so that unwinding can be done without kinking the cable. Two meters of cable at both ends of the cable shall be accessible for testing. Attach permanent label on each reel showing length, cable identification number, cable size, cable type, and date of manufacture. Provide water resistant label and the indelible writing on the labels. Apply end seals to each end of the cables to prevent moisture from entering the cable. Reels with cable shall be suitable for outside storage conditions when temperature ranges from minus 40 degrees C to plus 65 degrees C, with relative humidity from 0 to 100 percent. Equipment, other than cable, delivered and placed in storage shall be stored with protection from weather, humidity and temperature variation, dirt and dust, or other contaminants in accordance with manufacturer's requirements.

1.8 MAINTENANCE

1.8.1 Record Documentation

Provide the activity responsible for telecommunications system maintenance and administration a single complete and accurate set of record documentation for the entire telecommunications system with respect to this project.

Provide T5 drawings including documentation on cables and termination hardware in accordance with TIA/EIA-606. T5 drawings shall include schedules to show information for cut-overs and cable plant management, patch panel layouts, cross-connect information and connecting terminal layout as a minimum. T5 drawings shall be provided in hard copy format . Update existing record documentation to reflect campus distribution T0 drawings and T3 drawing schedule information modified, deleted or added as a result of this installation. Provide the following T5 drawing documentation as a minimum:

- a. Cables - A record of installed cable shall be provided in accordance with TIA/EIA-606. The cable records shall include only the required data fields in accordance with TIA/EIA-606. Include manufacture date of cable with submittal.
- b. Termination Hardware - Provide a record of installed patch panels, cross-connect points, campus distributor and terminating block arrangements and type in accordance with TIA/EIA-606. Documentation shall include only the required data fields as a minimum in accordance with TIA/EIA-606.

1.9 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Products supplied shall be specifically designed and manufactured for use with outside plant telecommunications systems.

2.2 TELECOMMUNICATIONS ENTRANCE FACILITY

2.2.1 Building Protector Assemblies

Provide self-contained 5 pin unit supplied with a field cable stub factory connected to protector socket blocks to terminate and accept protector modules for all pairs of outside cable. Building protector assembly shall have interconnecting hardware for connection to interior cabling at full capacity. Provide manufacturers instructions for building protector assembly installation. Provide copper cable interconnecting hardware as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

2.2.2 Protector Modules

Provide in accordance with [UL 497](#) three-electrode gas tube or solid state type 5 pin rated for the application. Provide gas tube protection modules in accordance with [RUS Bull 345-83](#) and shall be heavy duty, A>10kA, B>400, C>65A where A is the maximum single impulse discharge current, B is the impulse life and C is the AC discharge current in accordance with [ANSI C62.61](#). The gas modules shall shunt high voltage to ground, fail short, and be equipped with an external spark gap and heat coils in accordance with [UL 497](#). Provide the number of surge protection modules equal to the number of pairs of exterior cable of the building protector assembly.

2.2.3 Fiber Optic Terminations

Provide fiber optic cable terminations as specified in [27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM](#).

2.3 CLOSURES

2.3.1 Copper Conductor Closures

2.3.1.1 Underground Cable Closures

- a. In vault or manhole: Provide underground closure suitable to house a straight, butt, and branch splice in a protective housing into which can be poured an encapsulating compound. Closure shall be of suitable thermoplastic, thermoset, or stainless steel material supplying structural strength necessary to pass the mechanical and electrical requirements in a vault or manhole environment. Encapsulating compound shall be reenterable and shall not alter the chemical stability of the closure. Provide filled splice cases in accordance with [RUS Bull 345-72](#).

2.3.2 Fiber Optic Closures

2.3.2.1 In Vault or Manhole

Provide underground closure suitable to house splice organizer in a protective housing into which can be poured an encapsulating compound. Closure shall be of thermoplastic, thermoset, or stainless steel material supplying structural strength necessary to pass the mechanical and electrical requirements in a vault or manhole environment. Encapsulating compound shall be reenterable and shall not alter the chemical stability of the closure.

2.4 CABLE SPLICES, AND CONNECTORS

2.4.1 Copper Cable Splices

Provide multipair, in-line splices of a moisture resistant, two-wire insulation displacement connector held rigidly in place to assure maximum continuity in accordance with [RUS Bull 1753F-401](#). Cables greater than 25 pairs shall be spliced using multipair splicing connectors, which accommodate 25 pairs of conductors at a time. Provide correct connector size to accommodate the cable gauge of the supplied cable.

2.4.2 Copper Cable Splice Connector

Provide splice connectors with a polycarbonate body and cap and a tin-plated brass contact element. Connector shall accommodate 22 to 26 AWG solid wire with a maximum insulation diameter of 0.065 inch. Fill connector with sealant grease to make a moisture resistant connection, in accordance with RUS Bull 1753F-401.

2.4.3 Fiber Optic Cable Splices

Provide fiber optic cable splices and splicing materials for fusion methods at locations shown on the construction drawings. The splice insertion loss shall be 0.3 dB maximum when measured in accordance with TIA-455-78-B using an Optical Time Domain Reflectometer (OTDR). Splices shall be designed for a return loss of 40.0 db max for single mode fiber when tested in accordance with TIA-455-107. Physically protect each fiber optic splice by a splice kit specially designed for the splice.

2.4.4 Fiber Optic Splice Organizer

Provide splice organizer suitable for housing fiber optic splices in a neat and orderly fashion. Splice organizer shall allow for a minimum of 3 feet of fiber for each fiber within the cable to be neatly stored without kinks or twists. Splice organizer shall accommodate individual strain relief for each splice and allow for future maintenance or modification, without damage to the cable or splices. Provide splice organizer hardware, such as splice trays, protective glass shelves, and shield bond connectors in a splice organizer kit.

2.4.5 Shield Connectors

Provide connectors with a stable, low-impedance electrical connection between the cable shield and the bonding conductor in accordance with RUS Bull 345-65.

2.5 CONDUIT

Provide conduit as specified in Section 33 70 02.00 10, ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

2.6 PLASTIC INSULATING TAPE

UL 510.

2.7 WIRE AND CABLE

2.7.1 Copper Conductor Cable

Solid copper conductors, covered with an extruded solid insulating compound. Insulated conductors shall be twisted into pairs which are then stranded or oscillated to form a cylindrical core. For special high frequency applications, the cable core shall be separated into compartments. Cable shall be completed by the application of a suitable core wrapping material, a corrugated copper or plastic coated aluminum shield, and an overall extruded jacket. Telecommunications contractor shall verify distances between splice points prior to ordering cable in specific cut lengths. Gauge of conductor shall determine the range of numbers of pairs specified; 19 gauge (6 to 400 pairs), 22 gauge (6 to 1200 pairs), 24 gauge (6 to 2100 pairs), and 26 gauge (6 to 3000 pairs). Copper

conductor shall conform to the following:

2.7.1.1 Underground

Provide filled cable meeting the requirements of [ICEA S-99-689](#) and [RUS 1755.390](#).

2.7.1.2 Screen

Provide screen-compartmental core cable filled cable meeting the requirements of [ICEA S-99-689](#) and [RUS 1755.390](#).

2.7.2 Fiber Optic Cable

Provide single-mode, 8/125-um, 0.10 aperture 1310 nm fiber optic cable in accordance with [TIA-492CAAA](#), [TIA-472D000](#), and [ICEA S-87-640](#) including any special requirements made necessary by a specialized design. Provide optical fibers as indicated. Fiber optic cable shall be specifically designed for outside use with loose buffer construction. Provide fiber optic color code in accordance with [TIA/EIA-598](#)

2.7.2.1 Strength Members

Provide central, non-metallic strength members with sufficient tensile strength for installation and residual rated loads to meet the applicable performance requirements in accordance with [ICEA S-87-640](#). The strength member is included to serve as a cable core foundation to reduce strain on the fibers, and shall not serve as a pulling strength member.

2.7.2.2 Performance Requirements

Provide fiber optic cable with optical and mechanical performance requirements in accordance with [ICEA S-87-640](#).

2.7.3 Grounding and Bonding Conductors

Provide grounding and bonding conductors in accordance with [RUS 1755.200](#), [TIA J-STD-607](#), [IEEE C2](#), and [NFPA 70](#). Solid bare copper wire meeting the requirements of [ASTM B 1](#) for sizes No. 8 AWG and smaller and stranded bare copper wire meeting the requirements of [ASTM B 8](#), for sizes No. 6 AWG and larger. Insulated conductors shall have 600-volt, Type TW insulation meeting the requirements of [UL 83](#).

2.8 CABLE TAGS IN MANHOLES, HANDHOLES, AND VAULTS

Provide tags for each telecommunications cable or wire located in manholes, handholes, and vaults. Cable tags shall be stainless steel and labeled in accordance with [TIA/EIA-606](#). Handwritten labeling is unacceptable.

2.8.1 Stainless Steel

Provide stainless steel, cable tags $1 \frac{5}{8}$ inches in diameter $\frac{1}{16}$ inch thick minimum, and circular in shape. Tags shall be die stamped with numbers, letters, and symbols not less than 0.25 inch high and approximately 0.015 inch deep in normal block style.

2.9 BURIED WARNING AND IDENTIFICATION TAPE

Provide fiber optic media marking and protection in accordance with [TIA-590](#). Provide color, type and depth of tape as specified in paragraph BURIED

WARNING AND IDENTIFICATION TAPE in Section 31 00 00, EARTHWORK.

2.10 GROUNDING BRAID

Provide grounding braid that provides low electrical impedance connections for dependable shield bonding in accordance with RUS 1755.200. Braid shall be made from flat tin-plated copper.

2.11 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.12 FIELD FABRICATED NAMEPLATES

Provide laminated plastic nameplates in accordance with ASTM D 709 for each patch panel, protector assembly, rack, cabinet and other equipment or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

2.13 TESTS, INSPECTIONS, AND VERIFICATIONS

2.13.1 Factory Reel Test Data

Test 100 percent OTDR test of FO media at the factory in accordance with TIA-568-C.1 and TIA-568-C.3. Use TIA-526-7 for single mode fiber and TIA-526-14 Method B for multi mode fiber measurements. Calibrate OTDR to show anomalies of 0.2 dB minimum. Enhanced performance filled OSP copper cables, referred to as Broadband Outside Plant (BBOSP), shall meet the requirements of ICEA S-99-689. Enhanced performance air core OSP copper cables shall meet the requirements of ICEA S-98-688. Submit test reports, including manufacture date for each cable reel and receive approval before delivery of cable to the project site.

PART 3 EXECUTION

3.1 INSTALLATION

Install all system components and appurtenances in accordance with manufacturer's instructions IEEE C2, NFPA 70, and as indicated. Provide all necessary interconnections, services, and adjustments required for a complete and operable telecommunications system.

3.1.1 Contractor Damage

Promptly repair indicated utility lines or systems damaged during site preparation and construction. Damages to lines or systems not indicated, which are caused by Contractor operations, shall be treated as "Changes" under the terms of the Contract Clauses. When Contractor is advised in writing of the location of a nonindicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In every event, immediately notify the Contracting Officer of damage.

3.1.2 Cable Inspection and Repair

Handle cable and wire provided in the construction of this project with care. Inspect cable reels for cuts, nicks or other damage. Damaged cable shall be replaced or repaired to the satisfaction of the Contracting Officer. Reel wraps shall remain intact on the reel until the cable is ready for placement.

3.1.3 Underground Duct

Provide underground duct and connections to existing manholes, handholes, and existing ducts as specified in Section 33 70 02.00 10, ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND with any additional requirements as specified herein.

3.1.4 Reconditioning of Surfaces

Provide reconditioning of surfaces as specified in Section 33 70 02.00 10, ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

3.1.5 Penetrations

Caulk and seal cable access penetrations in walls, ceilings and other parts of the building. Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings in accordance with Section 07 84 00, FIRESTOPPING.

3.1.6 Cable Pulling

Test duct lines with a mandrel and swab out to remove foreign material before the pulling of cables. Avoid damage to cables in setting up pulling apparatus or in placing tools or hardware. Do not step on cables when entering or leaving the manhole. Do not place cables in ducts other than those shown without prior written approval of the Contracting Officer. Roll cable reels in the direction indicated by the arrows painted on the reel flanges. Set up cable reels on the same side of the manhole as the conduit section in which the cable is to be placed. Level the reel and bring into proper alignment with the conduit section so that the cable pays off from the top of the reel in a long smooth bend into the duct without twisting. Under no circumstances shall the cable be paid off from the bottom of a reel. Check the equipment set up prior to beginning the cable pulling to avoid an interruption once pulling has started. Use a cable feeder guide of suitable dimensions between cable reel and face of duct to protect cable and guide cable into the duct as it is paid off the reel. As cable is paid off the reel, lubricate and inspect cable for sheath defects. When defects are noticed, stop pulling operations and notify the Contracting Officer to determine required corrective action. Cable pulling shall also be stopped when reel binds or does not pay off freely. Rectify cause of binding before resuming pulling operations. Provide cable lubricants recommended by the cable manufacturer. Avoid bends in cables of small radii and twists that might cause damage. Do not bend cable and wire in a radius less than 10 times the outside diameter of the cable or wire.

3.1.6.1 Cable Tensions

Obtain from the cable manufacturer and provide to the Contracting Officer, the maximum allowable pulling tension. This tension shall not be exceeded.

3.1.6.2 Pulling Eyes

Equip cables 1.25 inches in diameter and larger with cable manufacturer's factory installed pulling-in eyes. Provide cables with diameter smaller than 1.25 inches with heat shrinkable type end caps or seals on cable ends when using cable pulling grips. Rings to prevent grip from slipping shall not be beaten into the cable sheath. Use a swivel of 3/4 inch links between pulling-in eyes or grips and pulling strand.

3.1.6.3 Installation of Cables in Manholes, Handholes, and Vaults

Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support cables on brackets and cable insulators at a maximum of 4 feet. In existing manholes, handholes, and vaults where new ducts are to be terminated, or where new cables are to be installed, modify the existing installation of cables, cable supports, and grounding as required with cables arranged and supported as specified for new cables. Identify each cable with corrosion-resistant embossed metal tags.

3.1.7 Cable Splicing

3.1.7.1 Copper Conductor Splices

Perform splicing in accordance with requirements of RUS Bull 1753F-401 except that direct buried splices and twisted and soldered splices are not allowed. Exception does not apply for pairs assigned for carrier application.

3.1.7.2 Fiber Optic Splices

Fiber optic splicing shall be in accordance with manufacturer's recommendation and shall exhibit an insertion loss not greater than 0.2 dB for fusion splices.

3.1.8 Surge Protection

All cables and conductors, except fiber optic cable, which serve as communication lines through off-premise lines, shall have surge protection installed at each end which meet the requirements of RUS Bull 1751F-815.

3.1.9 Grounding

Provide grounding and bonding in accordance with RUS 1755.200, TIA J-STD-607, IEEE C2, and NFPA 70. Ground exposed noncurrent carrying metallic parts of telephone equipment, cable sheaths, cable splices, and terminals.

3.1.9.1 Telecommunications Master Ground Bar (TMGB)

The TMGB is the hub of the basic telecommunications grounding system providing a common point of connection for ground from outside cable, CD, and equipment. Establish a TMGB for connection point for cable stub shields to connector blocks and CD protector assemblies.

3.1.9.2 Incoming Cable Shields

Shields shall not be bonded across the splice to the cable stubs. Ground shields of incoming cables in the EF Telecommunications to the TMGB.

3.1.9.3 Campus Distributor Grounding

- a. Protection assemblies: Mount CD protector assemblies directly on the telecommunications backboard. Connect assemblies mounted on each vertical frame with No. 6 AWG copper conductor to provide a low resistance path to TMGB.
- b. TMGB connection: Connect TMGB to TGB with copper conductor with a total resistance of less than 0.01 ohms.

3.1.10 Cut-Over

All necessary transfers and cut-overs, shall be accomplished by the telecommunications contractor.

3.2 LABELING

3.2.1 Labels

Provide labeling for new cabling and termination hardware located within the facility in accordance with TIA/EIA-606. Handwritten labeling is unacceptable. Stenciled lettering for cable and termination hardware shall be provided using thermal ink transfer process.

3.2.2 Cable Tag Installation

Install cable tags for each telecommunications cable or wire located in manholes, handholes, and vaults including each splice. Tag new wire and cable provided under this contract and existing wire and cable which are indicated to have splices and terminations provided by this contract. The labeling of telecommunications cable tag identifiers shall be in accordance with TIA/EIA-606. Do not provide handwritten letters. Install cable tags so that they are clearly visible without disturbing any cabling or wiring in the manholes, handholes, and vaults.

3.2.3 Termination Hardware

Label patch panels, distribution panels, connector blocks and protection modules using color coded labels with identifiers in accordance with TIA/EIA-606.

3.3 FIELD APPLIED PAINTING

Provide ferrous metallic enclosure finishes in accordance with the following procedures. Ensure that surfaces are dry and clean when the coating is applied. Coat joints and crevices. Prior to assembly, paint surfaces which will be concealed or inaccessible after assembly. Apply primer and finish coat in accordance with the manufacturer's recommendations. Provide ferrous metallic enclosure finishes as specified in Section 09 90 00, PAINTS AND COATINGS.

3.3.1 Cleaning

Clean surfaces in accordance with SSPC SP 6/NACE No.3.

3.3.2 Priming

Prime with a two component polyamide epoxy primer which has a bisphenol-A

base, a minimum of 60 percent solids by volume, and an ability to build up a minimum dry film thickness on a vertical surface of 5.0 mils. Apply in two coats to a total dry film thickness of 5 to 8 mils.

3.3.3 Finish Coat

Finish with a two component urethane consisting of saturated polyester polyol resin mixed with aliphatic isocyanate which has a minimum of 50 percent solids by volume. Apply to a minimum dry film thickness of 2 to 3 mils. Color shall be the manufacturer's standard.

3.4 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.5 FIELD QUALITY CONTROL

Provide the Contracting Officer 10 working days notice prior to each test. Provide labor, equipment, and incidentals required for testing. Correct defective material and workmanship disclosed as the results of the tests. Furnish a signed copy of the test results to the Contracting Officer within 3 working days after the tests for each segment of construction are completed. Perform testing as construction progresses and do not wait until all construction is complete before starting field tests.

3.5.1 Pre-Installation Tests

Perform the following tests on cable at the job site before it is removed from the cable reel. For cables with factory installed pulling eyes, these tests shall be performed at the factory and certified test results shall accompany the cable.

3.5.1.1 Cable Capacitance

Perform capacitance tests on at least 10 percent of the pairs within a cable to determine if cable capacitance is within the limits specified.

3.5.1.2 Loop Resistance

Perform DC-loop resistance on at least 10 percent of the pairs within a cable to determine if DC-loop resistance is within the manufacturer's calculated resistance.

3.5.1.3 Pre-Installation Test Results

Provide results of pre-installation tests to the Contracting Officer at least 5 working days before installation is to start. Results shall indicate reel number of the cable, manufacturer, size of cable, pairs tested, and recorded readings. When pre-installation tests indicate that cable does not meet specifications, remove cable from the job site.

3.5.2 Acceptance Tests

Perform acceptance testing in accordance with RUS Bull 1753F-201 and as further specified in this section. Provide personnel, equipment, instrumentation, and supplies necessary to perform required testing. Notification of any planned testing shall be given to the Contracting

Officer at least 14 days prior to any test unless specified otherwise. Testing shall not proceed until after the Contractor has received written Contracting Officer's approval of the test plans as specified. Test plans shall define the tests required to ensure that the system meets technical, operational, and performance specifications. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested. Provide test reports in booklet form showing all field tests performed, upon completion and testing of the installed system. Measurements shall be tabulated on a pair by pair or strand by strand basis.

3.5.2.1 Copper Conductor Cable

Perform the following acceptance tests in accordance with [TIA-758](#):

- a. Wire map (pin to pin continuity)
- b. Continuity to remote end
- c. Crossed pairs
- d. Reversed pairs
- e. Split pairs
- f. Shorts between two or more conductors

3.5.2.2 Fiber Optic Cable

Test fiber optic cable in accordance with [TIA/EIA-455](#) and as further specified in this section. Two optical tests shall be performed on all optical fibers: Optical Time Domain Reflectometry (OTDR) Test, and Attenuation Test. In addition, a Bandwidth Test shall be performed on all multimode optical fibers. These tests shall be performed on the completed end-to-end spans which include the near-end pre-connectorized single fiber cable assembly, outside plant as specified, and the far-end pre-connectorized single fiber cable assembly.

- a. OTDR Test: The OTDR test shall be used to determine the adequacy of the cable installations by showing any irregularities, such as discontinuities, micro-bendings or improper splices for the cable span under test. Hard copy fiber signature records shall be obtained from the OTDR for each fiber in each span and shall be included in the test results. The OTDR test shall be measured in both directions. A reference length of fiber, [66 feet](#) minimum, used as the delay line shall be placed before the new end connector and after the far end patch panel connectors for inspection of connector signature. Conduct OTDR test and provide calculation or interpretation of results in accordance with [TIA-526-7](#) for single-mode fiber and [TIA-526-14](#) for multimode fiber. Splice losses shall not exceed 0.3 db.
- b. Attenuation Test: End-to-end attenuation measurements shall be made on all fibers, in both directions, using a 1310, 1550 nanometer light source at one end and the optical power meter on the other end to verify that the cable system attenuation requirements are met in accordance with [TIA-526-7](#) for single-mode fiber optic cables. The measurement method shall be in accordance

with TIA-455-78-B. Attenuation losses shall not exceed 0.5 db/km at 1310 nm and 1550 nm for single-mode fiber. Attenuation losses shall not exceed 5.0 db/km at 850 nm and 1.5 db/km at 1300 nm for multimode fiber.

- c. Bandwidth Test: The end-to-end bandwidth of all multimode fiber span links shall be measured by the frequency domain method. The bandwidth shall be measured in both directions on all fibers. The bandwidth measurements shall be in accordance with TIA/EIA-455-204.

3.5.3 Soil Density Tests

- a. Determine soil-density relationships for compaction of backfill material in accordance with ASTM D 1557, Method D.

-- End of Section --

SECTION 34 73 13

MOORING AND GROUNDING POINTS FOR AIRCRAFT
04/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4/D1.4M (2011) Structural Welding Code - Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

ASTM A436 (1984; R 2006) Standard Specification for Austenitic Gray Iron Castings

ASTM A615/A615M (2009b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM B371/B371M (2008) Standard Specification for Copper-Zinc-Silicon Alloy Rod

ASTM B8 (2011) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 407 (2007; Errata 07-1; TIA 08-1; TIA 08-2; TIA 09-3) Standard for Aircraft Fuel Servicing

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 300 (1990) Specifications for Membrane-Forming Compounds for Curing Concrete

UNDERWRITERS LABORATORIES (UL)

UL 467 (2007) Grounding and Bonding Equipment

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

As-Built Drawings; G

Drawings as specified.

SD-06 Test Reports

Concrete; G

Complete concrete mix design including all cement, aggregate, and concrete tests and compliance certificates.

Tests

An independent testing agency's certified reports of inspections and tests, including analysis and interpretation of test results. Each report shall be properly identified. Describe Test methods and standards used.

SD-07 Certificates

Mooring Devices

Certificate of compliance stating that the mooring devices meet the specified requirements.

Grounding Rods

Certificate of compliance stating that the grounding rods meet the specified requirements.

Grounding Connectors

Certificate of compliance stating that the grounding connectors meet the specified requirements.

Copper Conductors

Certificate of compliance stating that the copper conductors meet the specified requirements.

Reinforcing Steel

Certificate of compliance stating that the reinforcing steel meets the specified requirements.

1.3 AS-BUILT DRAWINGS

Submit AS-Built Drawings that provide current factual information, including deviations from and amendments to the drawings and changes in the work, concealed and visible.

PART 2 PRODUCTS

2.1 METALS

Do not use combination of materials that forms an electrolytic couple, which accelerates corrosion in the presence of moisture, unless moisture is

permanently excluded from the junction of such metals.

2.2 MOORING DEVICES

Mooring devices shall be cast in ductile iron 80-55-06 conforming to [ASTM A436](#). The device shall be as shown in the contract drawings. Submit certificates of compliance on the devices.

2.3 GROUNDING RODS

Grounding rods shall conform to [UL 467](#) and shall be made of copper-clad steel. The rods shall be not less than [3/4 inch](#) in diameter and not less than [10 feet](#) long. The copper cladding shall conform to the applicable requirements of [ASTM B371/B371M](#), Copper Alloy UNS No's. c 69400, c 69430, c 69440 or c 69450. The copper cladding shall be not less than [0.010 inches](#) thick at any point and shall comply with adherence requirements and the banding requirements of [UL 467](#). Submit certificates of compliance on the grounding rods. Rods shall be provided with a closed eye or shepherd's hook bend having an inside diameter of not less than [1-1/4 inches](#). The rods shall be pointed unless used for flexible pavement. For flexible pavement, the rods shall have [3/4 inch](#) American standard rolled threads for attachment of a bottom anchor and shall be equipped with a screw-type bottom having a wing diameter of not less than [6 inches](#).

2.4 COPPER CONDUCTORS

Copper conductors shall be bare number 4 AWG copper wire conforming to [ASTM B8](#). Submit certificates of compliance on the copper conductors.

2.5 GROUNDING CONNECTORS

Grounding connectors shall comply with [UL 467](#) for the required application. Submit certificates of compliance on the grounding connectors.

2.6 CONCRETE

Concrete shall be in accordance with Section [32 13 11](#) CONCRETE PAVEMENT FOR AIRFIELDS AND OTHER HEAVY-DUTY PAVEMENTS. The concrete shall be air entrained and have a minimum compressive strength of [6000 psi](#). The concrete shall have the following properties: Nominal maximum aggregate size of [1 inch](#), air content of 6 percent, and a maximum slump of [4 inches](#) for drilled piers and [2 inches](#) for all other applications. Submit certificates of compliance of the concrete mix.

2.7 REINFORCING STEEL

Reinforcing steel shall conform to [ASTM A615/A615M](#) Grade 40 or 60 for #4 tie bars and Grade 60 for #6 vertical bars. Steel shall be welded into cages in accordance with [AWS D1.4/D1.4M](#) and inserted securely in the piers, in position and alignment, as shown, prior to concrete placement. Submit certificates of compliance of the reinforcing steel.

PART 3 EXECUTION

3.1 MOORING POINTS IN NEW RIGID PAVEMENTS OR CONCRETE PADS

Install the mooring device within plus or minus [2 inches](#) of the location shown on the contract drawings. The top of the mooring device shall be set within [1/4 inch](#) of the plan pavement surface elevation, but not higher than

the pavement surface. Install the mooring device prior to placement of the concrete pavement. Place concrete and reinforcement in accordance with Section 03 20 00.00 10 CONCRETE REINFORCING and 03 30 00.00 10 CAST-IN-PLACE CONCRETE. Hand finishing of the concrete around the mooring devices shall be kept to a minimum.

3.2 MOORING POINTS IN EXISTING RIGID PAVEMENTS

Install the mooring points in 12 plus or minus 1/2 inch diameter holes cored through the pavement. The core holes shall be drilled within plus or minus 1-1/2 inches of the location shown in the contract drawings. The mooring device and attached grounding rod shall be installed within plus or minus 1/2 inch of the center of the core hole. The top of the mooring device shall be installed within 1/4 inch of the surrounding pavement surfaces, but not higher.

3.2.1 Coring Requirements

Core the holes using rotary, non-percussion drilling techniques. The sides of the core hole shall be perpendicular to the pavement surface. Once the pavement is cored, the base course shall be excavated as shown in the drawings. The sides of the core hole shall be cleaned of laitance and roughened by sand blasting. Place the concrete around the mooring device in two or more lifts. The first lift shall be placed to within 5 inches of the pavement surface and thoroughly consolidated by spud vibrators. The second lift shall be placed and also consolidated by internal vibration. The surface of the concrete shall be finished and textured to match the adjacent pavement surface and elevation. White pigmented curing compound meeting the requirements of COE CRD-C 300 shall be uniformly applied at a coverage of not more than 200 square feet per gallon.

3.2.2 Cleanup

Control all operations to minimize the amount of dust, dirt, debris and laitance in the work area. Clean all dirt, dust, debris, or laitance from coring or concreting operations, from the pavement surfaces prior to final acceptance.

3.3 MOORING POINTS INSTALLED IN DRILLED PIERS

Coordinate excavation of piers so that reinforcing steel and concrete placement is a continuous operation performed the same day that the excavation is completed. Excavations shall not be left open overnight. Place concrete within 3 hours after approval of the completed pier excavation. Pier drilling equipment shall have the minimum torque capacity and downward force capacity for the contract site conditions.

3.3.1 Government Inspection

The Contracting Officer will inspect each drilled pier excavation. Concrete shall not be placed until the excavation has been approved. Furnish the Contracting Officer all necessary equipment required for proper inspection of drilled pier excavations.

3.3.2 Installation Procedures

Excavate piers to the depths and dimensions shown. Piers shall be core drilled through pavements. Bottoms of piers shall be cleaned of loose or soft material and leveled. Excavated material shall be disposed of in

accordance with Section 31 00 00 EARTHWORK. Perform the following:

- a. The surrounding base courses, subgrade, and soil shall be adequately and securely protected against cave-ins, displacement of the surrounding earth, and retention of ground water by means of temporary steel casings. Casings shall have outside diameters not less than the indicated shaft sizes and shall be a minimum of 1/4-inch thick. Withdraw steel casings as the concrete is being placed, maintaining sufficient head of concrete within the casing to prevent extraneous material from falling in from the sides and mixing with the concrete. Casings may be jerked upward a maximum of 4 inches to break the bottom seal; but, thereafter, shall be removed with a smooth, continuous motion.
- b. The inside of steel casings shall be thoroughly cleaned and oiled before reuse.
- c. Water that flows into the excavations shall be continuously removed and all water shall be removed from the excavation bottom, to the extent possible, prior to concrete placement. The maximum permissible depth of water shall be 2 inches. In the event of a severe water condition that makes it impossible or impractical to dewater the excavation, concrete shall be placed using underwater tremie after water movement has stabilized.
- d. Continuously place concrete, ensuring against segregation and dislodging of excavation sidewalls; concrete shall completely fill the shaft. Concrete shall be placed by pumping or drop chutes in dry holes and by tremie or pumping in wet holes. The discharge shall be kept a minimum of 1 foot below the fresh concrete surface during placement. Concrete placement shall not be interrupted in any pier for more than 30 minutes. The upper 5 feet of the concrete pier shall be vibrated.
- e. Correct any pier out of center or plumb beyond the specified tolerance, as necessary for compliance; bear any cost of correction. Cross sections of shafts shall not be less than design dimensions. Piers shall be installed with top location deviating a maximum of 2 inches from centerline locations.
- f. Install the mooring device within plus or minus 1 inch of the center of the drilled pier. The top of the mooring device shall be within 1/4 inch of the top of the pier, but not higher.
- g. Replace, at no additional cost to the Government, piers found out of tolerance.
- h. Provide protection around top of the excavation to prevent debris from being dislodged into the excavation and concrete.

3.4 GROUNDING POINTS

Locate the grounding points as shown on the contract drawings to within plus or minus 2 inches.

3.4.1 Pavement Recess

The top of the grounding rod shall be set at or not more than 1/4 inch below the pavement surface grade. A recess 2-3/4 inches wide, and not more than 6 inches long, with a smooth rounded edge shall be provided in the

pavement around the grounding point anchor eye to permit the entrance of lines into the eye and to allow for attachment of the grounding cable. The depth of the recess shall be no deeper than the bottom of the opening of the grounding point eye.

3.4.2 Installation

3.4.2.1 Existing Rigid Pavement

Install grounding rods in holes cored through the rigid pavement using rotary, non-percussion drilling techniques. The core holes shall have a minimum diameter of 6 inches. The grounding rod shall be installed by pushing or driving the rod through the pavement base courses and subgrade. The installation technique chosen shall not damage the grounding rod or the pavement. Installation shall be completed by placing concrete around the grounding rod in two lifts with each lift consolidated with spud vibrators.

3.4.2.2 New Rigid Pavement

Install the grounding rod by pushing or driving the rod through the pavement base courses and subgrade prior to concrete placement. The installation technique chosen shall not damage the grounding rod. Hand finishing around the rod shall be kept to a minimum.

3.4.3 Interconnection

Grounding rods within aircraft hangars shall be electrically interconnected to the hangar electrical grounding system with not less than a number 4 AWG bare copper conductor. Grounding rods installed at fueling hydrant outlets shall be electrically interconnected with the fuel piping with not less than a number 4 AWG bare copper conductor.

3.5 TESTS

Measure resistance to ground tests as specified in NFPA 407. Submit test results to the Contracting Officer. Report to the Contracting Officer, immediately, any ground rods that have more than 10,000 ohms of resistance.

-- End of Section --

APPENDIX BB
Engineering & Construction Bulletin (ECB) 2011-1



**US Army Corps
of Engineers®**

ENGINEERING AND CONSTRUCTION BULLETIN

No. 2011-1

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Subject: High Performance Energy and Sustainability Policy

Applicability: Directive and Guidance

References:

- a. Engineering and Construction Bulletin (ECB) 2010-14, 28 Jun 2010, Subject: Improving Building Performance through Enhanced Requirements for Energy Performance and Selected LEED Credits
- b. Memorandum of Understanding (MOU), 06 Mar 06, *Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings*
- c. Memorandum, DUSD (I&E), 25 Oct 10, subject: Department of Defense Sustainable Buildings Policy
- d. Memorandum, ASA (IE&E), 27 Oct 10, subject: Sustainable Design and Development Update (Environmental and Energy Performance)
- e. U.S. Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) NC rating tool v2.2 and 2009/v3

1. The purpose of this Engineering and Construction Bulletin (ECB) is to implement new policies and procedures into the Military Construction, Army (MCA) program. This ECB is effective when issued and, together with ECB 2010-14 (Reference a), defines the Energy and Sustainability performance requirements for projects in the various phases of the Planning, Programming, Budgeting, and Execution process. ECB 2010-14 was intended to start the process by taking advantage of the good bid environment to fund additional energy enhancements for projects that were already authorized and appropriated. After the FY13 Program, ECB 2010-14 will no longer be applicable.

2. National energy security and sustainability concerns continue to drive construction programs to build higher performance buildings than ever before. Building more energy efficient and sustainable facilities is a mission objective of the US Army. We must continue to implement improved energy standards and sustainability objectives that are cost effective over the life of our facilities, installations, and infrastructure to meet energy security and independence goals.

3. Project Delivery Teams (PDT) are authorized and encouraged to aggressively enhance the energy and sustainability performance of our projects. Project features referenced by Attachment A that accomplish this objective whether programmed or incorporated by change during design or construction are to be considered technical requirements and not User Requested Changes. The PDT should be aware of how these features affect the scope of projects

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that have a congressionally approved DD1391, as well as how they affect the PDR/3086 process for projects under design.

4. PDTs are to perform a Life Cycle Cost Analysis (LCCA) on energy-related design decisions of major systems and features that will exceed 1% of the Programmed Amount (PA) in cost. This Life Cycle Cost Analysis shall be documented as part of design analysis and/or basis of design files and kept available for review.

5. This ECB is intended to enhance conformance with the *Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings* (Reference b) which continues to be in effect. See also *High Performance and Sustainable Buildings Guidance* issued by Office of Management and Budget in December 2008 for further information.

6. All MCA projects will comply with the Department of Defense Sustainable Buildings Policy (Reference c) and the Department of the Army Sustainable Design and Development Policy Update (Reference d) pursuant to the following implementation plan by program year:

a. **Guidance for All Program Years:** Studies by the Department of Energy in conjunction with our own Construction Engineering Research Laboratory have shown the energy and sustainability enhancements listed in Attachment A to be consistently cost effective for multiple facility types and climatic regions. Therefore, project teams are to incorporate as many of these enhancements as practicable at the discretion of the PDT as a mandatory change without further approval necessary, provided the following conditions are met. The PDT is responsible for selecting a comprehensive suite of enhancements that work in concert to achieve a low energy consumption facility as a whole and with respect to the facility type and climatic region of the site.

(1) No energy enhancement can result in the project exceeding the total of any unit attribute (such as Square Feet, Linear Feet, etc.) of any line item within the Primary Facility portion of an approved DD Form 1391.

(2) For projects in Planning: Energy enhancements that affect the scope of a DD Form 1391 should be addressed in the Project Definition Report (PDR) and coordinated with HQUSACE and HQDA.

(3) For projects in Design: If the Current Working Estimate (CWE) with energy enhancements added exceeds the authorized Programmed Amount (PA), per existing guidance, the PDT must identify bid options. These options shall not include the required Energy Enhancements listed in Attachment A.

(4) For projects in Construction: Energy and sustainability enhancements referenced in Attachment A may be incorporated into the project by the PDT using funds available. If additional funding is required, the PDT shall submit the requested change to Headquarters with a supporting LCCA. If the change is authorized, update the Design Analysis to include the Life Cycle Cost Analysis (LCCA) to document the change.

(5) Energy and sustainability enhancements not referenced in Attachment A are to be considered User Requested Changes and follow the approval process already established.

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If the installed feature exceeds 1% of the Programmed Amount (PA) request should be supported by a LCCA documented in the design analysis and/or basis of design. The LCCA shall show the enhancements will either reduce source Green House Gas (GHG) emissions or pay for themselves within the life cycle of the facility or both.

b. FY11 and Prior Year Programs: ECB 2010-14 (Reference a) continues to apply. For clarification, note that the use of the Bid Option to achieve 50% better energy savings as described in ECB 2010-14 is not automatically included by use of the RFP wizard, but needs to be included manually in the CLIN table added to each new RFP. This option shall be listed after all base options. If the Current Working Estimate (CWE) exceeds the Program Amount (PA) the approval must be obtained from HQDA prior to advertising. Likewise, HQDA approval must still be obtained to Award in excess of PA per existing guidance. HQDA will continue to have the final decision regarding Below or Above Threshold Reprogrammings. When performing Site Selection and Master Planning activities, teams are encouraged to review the requirements of the SDD policy (Reference d) as well as local Renewable Energy availability data from the Department of Energy's National Renewable Energy Laboratory (NREL) at <http://www.nrel.gov/>. Use this information to generate future development plans with respect to energy and sustainability.

c. FY12 Program: ECB 2010-14 (Reference a) continues to apply to the FY12 MCA program; specifically, applicable projects are to be designed to achieve energy performance 40% better than as prescribed in ASHRAE 90.1-2007. Further, an Option to achieve 50% better shall be included in the CLIN table added to each new RFP. Headquarters has worked with DA to adjust the allowable square footage shown on the current DD Form 1391s to accommodate some energy and sustainability strategies such as thicker exterior walls. These adjustments in allowable square footage will not change current PA or early gross square-footage based CWE. If the final approved DD Form 1391s reflect this change the PDT is expected to incorporate these energy enhancements; e.g. include the additional wall thickness and insulation as a design requirement. The additional square footage authorized shall not be used for any other purpose than to increase energy and sustainability performance.

d. FY13 Program: Design projects to fully comply with the SDD policy (Reference d) and include energy enhancements from Attachment A, as appropriate to the project site and facility type. The PA and square footage will be adjusted by DA after the 3086 review to incorporate energy enhancements in Attachment A to fully comply with the SDD policy. Installations have opportunities to gain better financial efficiency and other benefits by consolidating the renewable energy requirements of multiple buildings into a larger-scale "central plant" type projects. Therefore, the SDD policy (Reference d) contains language in Paragraph 5.b that allows an exemption to installing renewable energy systems on each building per ASHRAE 189.1 in favor of aggregating the requirements installation-wide or program-wide. Centralized Renewable Energy plants used to meet consolidated renewable requirements of ASHRAE 189.1 are not required to be built concurrently in FY13, but may be planned to be executed in FY15 to allow for the additional master planning and design required. Additional energy enhancements, such as renewable energy systems, that can be easily separable from the base design may be included as contract options or alternates.

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PDTs, the Centers of Standardization, HQUSACE will work together to determine the best acquisition strategy to maximize energy innovation. The use of Waiver requests to the Standard Designs is encouraged if necessary to facilitate innovation.

e. **FY 14 program:** The renewable energy components of the SDD policy (Reference d) will begin to be addressed by aggregating the requirements of multiple facilities into larger scale renewable energy projects to the extent practical and that funding allows. Installations are encouraged to seek partnerships with the private sector, including using power purchase agreements (PPA), enhanced-use leases (EUL), energy savings performance contracts (ESPC), and utilities energy service contracts (UESCs) as vehicles to optimize renewable energy sources and leverage Federal, State, and local utility incentives. USACE will continue to pursue low energy models and will issue additional guidance.

f. **FY 15 Program and beyond:** Starting with the FY 15 Program, all projects will be planned and programmed to achieve the renewable energy component of ASHRAE 189.1 (per Paragraph 5(b) of Reference d) either within each project's scope or by a consolidated renewable energy solution for an aggregate of multiple project requirements.

7. Sustainability Certification:

a. All MCA projects meeting the Minimum Program Requirements (MPR) for the Leadership in Energy and Environmental Design (Reference e) program shall be planned, designed, and built to be certified at the SILVER level or higher from the Green Building Certification Institute (GBCI)

(1) Projects previously registered under LEED 2.2 may continue to pursue the version 2.2 points and seek USGBC certification under LEED 2.2 scoring at the discretion of the PDT, subject to GBCI approval.

(2) Any project not registered under 2.2 shall register and seek certification with GBCI under LEED NC/MR version 2009/3.0 or later.

(3) At its discretion, the PDT may pursue achieving Gold level certification and is authorized to seek certification at the highest attainable level of certification within available funding provided that doing so continues to reduce the total cost of ownership over the life cycle of the facility.

(4) In accordance with the Department of Defense Sustainable Buildings Policy (Reference c) at least 40% of the minimum points required for Silver level certification shall be earned in any combination of these credit categories:

- (a) SS 7.1 Heat Island Effect, Non-Roof
- (b) SS 7.2 Heat Island Effect, Roof
- (c) SS 8 Light Pollution Reduction
- (d) WE 1.1 Water Efficient Landscaping - Reduce Potable Water Use by 50%

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- (e) WE 1.2 Water Efficient Landscaping - No Potable Use or No Irrigation
- (f) WE 2 Innovative Wastewater Technologies
- (g) WE 3 Water Use Reduction
- (h) EA 1 Optimize Energy Performance
- (i) EA 2 On-Site Renewable Energy
- (j) EA 3 Enhanced Commissioning
- (k) EA 5 Measurement & Verification
- (l) EA 6 Green Power
- (m) IEQ 1 Outside Air Delivery Monitoring
- (n) IEQ 8.1 Daylight & Views - Daylight 75% of Spaces
- (o) ID 1.1-1.5 Innovative Design, if achieved for energy and/or water savings
- (p) RP 1.1-1.4 Regional Priorities, if achieved for energy and/or water savings

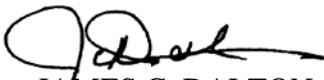
(5) In addition to the prerequisites, the following LEED-NC/NR credits shall be included in all MCA projects where applicable:

- (a) SS 6.1 Stormwater Design, Quantity Control
- (b) SS 6.2 Stormwater Design, Quality Control
- (c) WE 1 Water Efficient Landscaping: No potable water used for irrigation.
- (d) WE 3 Water Use Reduction: earn at least two points under this credit
- (e) EA 1 Optimize Energy: earn at least 15 points under this credit
- (f) EA 3 Enhanced Commissioning
- (g) EA 5 Measurement and Verification
- (h) MR 2 Construction Waste Management
- (i) MR 4 Recycled Content
- (j) IEQ 3.1 Construction IAQ Management Plans
- (k) IEQ 3.2 Construction IAQ Management Plans
- (l) IEQ 7.1 Thermal Comfort Design

b. Army Family Housing projects may be certified at the LEED for Homes SILVER level or higher from the GBCI or Energy Star Qualified New Homes, or will be designed to achieve energy consumption levels 45% below the baseline set by International Energy Conservation Code (IECC) 2009.

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- c. The definitions and guidance on the LEED minimum program requirements are provided in a document, titled Supplemental Guidance, available on the USGBC website (<http://www.usgbc.org/DisplayPage.aspx?CMSPageID=2102>)
- d. Projects not falling within the scope of the LEED program will be designed and built to incorporate the maximum LEED components or equivalent sustainable design features available as allowed by project scope. If such a project is of a significant size, has high visibility or public interest, the use of alternative standards and certification systems available to the project is encouraged, such as Green Globes or Host Nation programs.
8. A request for an exemption through HQ USACE may be made for any specific requirement included herein or by reference that the PDT determines would adversely affect mission performance, security requirements, health, safety, or welfare. The exemption shall only apply to the specific requirements in conflict. Any approved exemptions to this policy shall be documented with reference to the specific requirement in conflict and included in the project documentation.
9. Reporting and documentation of Energy and SDD performance: New energy enhancements above our current standard design or criteria included in a solicitation, or incorporated through the modification process, must be reported to HQUSACE. A list of these enhancements, and any associated costs and Life Cycle Cost Analyses available will be kept to further our knowledge about the costs associated with these enhancements, and to answer inquiries about the Army's progress towards the Energy mandates and requirements that will come from HQDA, OSD, and Congress. The District (through the MSC) will submit to their Regional Integration Team (RIT) a list of new energy enhancements with the estimated costs shown on a new tab of an updated Current Working Estimate (CWE) worksheet and include a brief descriptive justification with pertinent design details. All projects shall report the following information, at a minimum:
- a. LEED credits earned, with percentage in Water and Energy
 - b. Gross percentage of anticipated energy savings versus baseline
 - c. Gross percentage of anticipated water savings versus baseline
10. The Headquarters USACE point of contact is Eric Mucklow, at 202-761-0522 or eric.mucklow@usace.army.mil. The Army Program Manager is Gary Skusek, 202-761-5749.



ENCL JAMES C. DALTON, P.E., SES
Chief, Engineering and Construction Division
Directorate of Civil Works



LLOYD C. CALDWELL, P.E., SES
Chief, Programs Management Division
Directorate of Military Programs

ATTACHEMENT A

VIALE ENERGY AND SUSTAINABILITY ENHANCEMENTS

The following enhancements may be considered viable for a wide range of building types and climactic regions. From these, a comprehensive suite of enhancements may be selected that work in concert to achieve a low energy consumption facility as a whole and with respect to the facility type and climactic region of the site. These enhancements are to be implemented by the PDT as practicable with respect to the project's scope, schedule, and existing conditions.

The list below contains only brief descriptions representing strategies and design criteria that enhance the energy performance or sustainability of facilities. It is assumed members of the design team will be familiar with these concepts. More in-depth guidance regarding specific criteria and implementation information can be found by consulting the *Energy and Water Conservation Design Guide (for Sustainment, Restoration and Modernization (SRM) and MILCON Projects)* on the Whole Building Design Guide site at http://www.wbdg.org/references/pa_dod_energy.php

1. Optimize building orientation (East-West Axis with Passive Solar shading geometry)
2. Tight construction with Infiltration less than .15 cfm per square foot of exterior envelope area at 75 PA
3. Added insulation to high performance 'Passivhaus' levels (See the Building Envelope section of the *Energy and Water Conservation Design Guide* referred to above for minimum R/U values per climatic zone)
4. Design detailing to avoid thermal bridges that allow heat to bypass insulation
5. Windows: Triple-pane, Energy Star, with low-E coatings appropriate to climatic zone.
6. Lighting: lower lighting consumption to average 0.75W/ft² or less. To achieve this performance, consider the following:
 - a. Low maintenance, low wattage-per-lumen technologies, e.g. SSL/LED fixtures
 - b. Occupancy, Vacancy, and Daylighting sensors for active ambient light control
 - c. Increase vertical glazing by 50% over standard designs
 - d. Increase Skylight to Floor Area (SFA) fraction to 3% over corridors, admin areas and office areas
 - e. Use digital multi-zone lighting controls with individually addressable fixtures
7. 'Cool Roof' finishes where cooling load exceeds heating (e.g. Climate Zones 1-5)
8. Top Tier Energy Star or FEMP rated appliances and equipment
9. Demand/user controlled High Efficiency HVAC equipment per ASHRAE 189.1
10. Optimize HVAC zones with respect to user schedules and occupancy
11. Include Energy Recovery Ventilation (ERV) systems with >75% efficiency

12. Dedicated Outside Air System (DOAS) for ventilation with heat recovery for assembly and heat/fume generating activities
13. Indirect Evaporative Pre-Cooling (IEPC or IDEC) for Dry Climates (Climate Zones xB)
14. HVAC equipment efficiency ratings (e.g. COP) that exceed ASHRAE 189.1 (C) requirements
15. High Efficiency condensing boilers with >90% efficiency and/or incorporate Ground-Source Heat Pump technology
16. NEMA MG1 Premium Efficiency/ Electronically Commutated Motors (ECM) motors
17. Variable Air Volume (VAV) or hydronic distribution; consider:
 - a. radiant heating systems, especially in maintenance bays, and
 - b. “Radiant” cooling systems in ceilings
18. Measurement and Verification (M&V) systems
19. On-site Renewable Energy elements:
 - a. Transpired Solar Collectors in Climate Zones 2A to 8.
 - b. SSL/LED parking and street lighting; site-specific light distribution patterns
 - c. Prepackaged pole-mounted solar site lighting solutions
 - d. Include 30% demand solar water heating in areas where the average sun exposure is equal or greater than 4.0 kWh/m² per day according to the National Renewable Energy Lab (<http://www.nrel.gov/gis/solar.html>) in accordance with the SDD policy (Reference d.)
20. Maximum flow rates for plumbing fixtures per ASHRAE 189.1
 - a. Dual-flush toilets
 - b. Waterless Urinals: urinals that use either no water or no potable water (e.g. may use harvested rainwater or reclaimed greywater)
21. Stormwater management: Meet local codes and Low Impact Development (LID) best practices (e.g. pervious pavement, rainwater harvesting, swales, bioretention ponds)

See the Whole Building Design Guide (<http://www.wbdg.org/>) and the USACE Centers of Standardization website at <https://eportal.usace.army.mil/sites/COS/Pages/Default.aspx> for more information about these technologies. As projects progress, PDT members may find peers who have shared their success stories and share your own on the Energy Hall of Fame website at <https://www.us.army.mil/suite/page/639754> (AKO login required.)

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Hazardous Material Storage Information

APPENDIX DD
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ARMY AVIATION FACILITIES

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ARMY AVIATION FACILITIES

1. GENERAL.

a. General and Specific Criteria. The specific criteria contained in this appendix are applicable to the design of Army aviation facilities. The general criteria contained in the preceding chapters also apply, except as modified by this appendix. Therefore, this appendix must be used with the chapters contained in this document.

b. Aviation Facilities. Army airfields and heliports are examples of a large aviation facility. Helipads and short fields are examples of small aviation facilities. Aviation Facilities are supported by a network of four distinct functional land use areas. The four land use areas consist of the:

- 1) landing and takeoff area
- 2) aircraft ground movement and parking area
- 3) aircraft maintenance area
- 4) aviation operations support areas.

c. The landing and takeoff area is a required land use area. However, the rest of the land use areas are not necessarily required to make the aviation facility complete and usable (operational). A general description of each land use area is provided later in this Appendix.

c. Planning and Technical Criteria, UFC 3-260-01 (reference K-1), Support Facility Annexes (SFAs), and the Master Planning Instructions (MPI) (reference K-32), will be consulted whenever planning Army aviation facilities. The tri-service criteria contained in UFC 3-260-01 should be used when planning Power Projection Platforms for Crisis Response because aircraft of all military services may be using Army facilities. (See MPI Chapter 6 for instructions regarding the mobilization component.) SFA 95 should be used when planning Tactical Unmanned Aerial Vehicle (TUAV) facilities.

d. Aero Clubs. Criteria for aero clubs are provided in Appendix D.

e. Land Area. Aviation facilities need substantial airspace and land area for safe and efficient operation and to accommodate future growth or changes in mission support (Also see MPI Chapter 3). Facilities in direct support of aircraft operations and maintenance should have sufficient land area for expansion because of the changing equipment and training needs in support of Force Modernization from the Legacy Force to the Objective Force.

f. Functional Proponent. The functional installation proponent responsible for developing the scope and requirements for Army aviation facilities is usually assigned to the Aviation Division, Directorate of Plans, Training and Mobilization (DPTM) of the installation staff or the Operations Section (G/S-3) of the senior aviation organization. At locations where there is no DPTM or G/S-3 office, facility planners must coordinate with the commander of the aviation unit(s) to be supported. The DPTM, as primary functional proponent, is responsible for determining mission support requirements for aviation facilities, operations, safety and air traffic.

g. Facility Planning System (FPS).

(1) The FPS provides military planners with the means to compute facility space allowances for 37 category codes for TOE units, 21 category codes for TDA organizations and 27 category codes under mobilization criteria. These category codes represent the most frequently occurring unit-driven facilities. Computations are based upon the Table of Organization and Equipment (TOE) or the Table of Distribution and Allowances (TDA) for

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each organization examined. Facility allowances are calculated in accordance with current Army planning criteria as provided in the Army Criteria Tracking System (ACTS). In addition to computing facility space allowances, FPS provides military planners with other capabilities, e.g., to obtain a personnel and equipment list for an organization, or to search personnel or equipment lists for MOSs, LINs, or keywords, or to search TOE/TDA titles for keywords.

(2) Systems Interface. The FPS is no longer available under the PAX menu. FPS is available through the INTERNET at <http://rkeng.com/>. The primary source data used by the FPS are the TOE documents (from TRADOC), the TDA documents (from DA), and category code criteria (from ACTS). The FPS is designed to function as a stand-alone system. A link to the Support Facility Annex (SFA) application alerts FPS users to the presence of SFA reports applicable to the TOEs entered for FPS analysis. Allowances calculated by the FPS are used to support ACTS, RPLANS and HQRPLANS. Proponency transitioned to the Assistant Chief of Staff for Installation Management on 1 October 1996. In some cases, SFAs are also available from the USACE proponent for those systems not included in FPS. A listing of additional SFAs is available from the Project Manager, Engineering Services, HQUSACE (CRST), 441 G St, NW, Washington, DC 20314-1000; 202-761-8817; or email: gordon.g.velasco@usace.army.mil, pending re-establishing electronic linkages to revised SFAs under the Army System-of-System Management/Unit Set Fielding initiative.

(4) ACSIM Points of Contact for HQRPLANS, RPLANS, ACTS, and FPS, :

Program Integration Office

Randy Klug, Acting Chief 703 692-9219
Randy.Klug@hqda.army.mil

Program Integration Team

Stu Grayson, Program Integrator 703 428-6012
GraysonSM@hqda.army.mil

h. Support Facility Annexes (SFA). The SFA identify impacts associated with the fielding of new aircraft and aircraft support equipment. These impacts usually affect about 70 percent of the facilities identified in this appendix. SFAs may be obtained as described in paragraph 1.g(2) above.

2. FUNCTIONS OF AN AVIATION FACILITY.

a. General. The aviation facility should be organized to permit operational efficiency and to provide safe conditions for takeoff/landing operations and ground movement of aircraft. The boundaries of the operational, safety, and environmental (noise) clearance areas should be depicted in accordance with references K-1 through K-2 to ensure that subsequent facility sites will not be in violation of these clearance areas which could render the facility inoperable. Master planning of the land use areas must also ensure that expansion of operational capabilities are maintained while encroachment from activities on and off post are minimized.

b. Description. The description of the functional activities within each aviation facility and the allowance of facility types within each area follow a sequential analysis process. This sequence should be followed closely because horizontal and vertical operational safety clearances must be applied to each area prior to addressing the next. As an example, a well-designed hangar is functionally excellent but was improperly sited and constructed too close to an active runway. The facility is now in violation of basic safety clearance criteria. A waiver may be requested for this example; however, waivers are temporary in nature and may not be granted when they jeopardize the certification of the airfield.

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c. Airside and Landside Facilities. The descriptions provided below are intended to highlight the major areas associated with the aviation airside and landside facilities. The airside facilities are necessary to ensure safe aircraft operations and control in flight and on the ground. The landside facilities are necessary to support general aviation support activities. The areas are not intended to be all-inclusive.

(a) Airside Facilities

- (1) Landing and Takeoff Area.
- (2) Aircraft ground movement and parking areas.

(d) Landside Facilities.

- (3) Aircraft maintenance areas.
- (4) Aviation Operations support areas.

(2) Required facilities within these areas, by construction category code types, are dependent upon the aviation mission(s) and organization(s) to be supported. The scopes of these facilities are dependent upon the fielding of equipment or materiel (type, size, and amount) that belong to that organization.

(3) Each facility area includes ancillary equipment and infrastructure support requirements that are usually provided along with that area such as navigational aids and lighting.

d. Aviation Module Development Methodology. The methodology, rationales, and considerations used to develop the space modules for this appendix are provided in Section 7 - Aviation Module Development Methodology. Section 7 provides a general perspective in determining the functions that were considered and included in the lump space for the modules. The methodology may also be applied in cases where no criteria exist to support changes in materiel fielding or special requirements.

3. LANDING AND TAKEOFF AREA.

a. General. The landing and takeoff area is comprised of the landing/takeoff surface (either a runway, short field, training assault landing zones, helicopter landing lane, helipad, or hoverpoint (Category Code 111)). Ancillary support necessary to maintain safe operations may include navigational aids (NAVAIDS) (Category Codes 133 and 134), airfield lighting (category code 136) air traffic control (ATC), communications, lighting, utilities, and physical security. These types of facilities are normally required for Army Airfields (AAF) and Army Heliports (AHP) and are optional for helipads and hoverpoints. This area also includes numerous vertical, horizontal and airspace mandatory safety clearances and environmental zones. Airspace criteria is defined in UFC 3-260-01(Reference K-1).

(1) The Aviation Division, Directorate of Plans, Training and Mobilization (DPTM) of the installation staff has general responsibility for determining the adequacy of the facilities comprised in this area.

(2) AAF supports both fixed-wing and rotary-wing operations. AHP support only rotary-wing operations. When support to both types of operations is required, an AAF will be provided. An AHP will suffice only if rotary-wing aircraft support is required. AAF and AHP combinations may be required to enhance operational safety and efficiency at a facility with large numbers of air traffic operations. Facilities supporting initial flight training will normally augment AAF and AHP with training assault strips due to the air traffic density and increased

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need for safety in a training environment. An AAF nor a AHP will be provided specifically for Unmanned Aerial Vehicle operations.

b. Flight Control Tower (Category Code 133-10).

(1) One control tower will be provided for each airfield or heliport qualified in accordance with AR 95-2 (reference K-3 -).

(a) Standards for control towers can be obtained from ATZQ-ATC-F B.

(b) The recommended control tower design to be used is the Fort Huachuca Control Tower, File Number 223-25-360, SPK Specification 5422, dated 15 April 1980 (reference K 5) available from the Sacramento District Engineer Office but modified to meet the requirements contained in TB 95-1 (reference K- 4).

(2) The siting and height of the tower cab will be such as to permit a clear view of the entire runway and taxiway system. Control towers may be combined with airfield operations buildings or fire and rescue stations, or both.

(3) At facilities where direct weather support is provided by a U.S. Air Force (USAF) Air Weather Service (AWS) detachment, a separate floor of the control tower may be modified or added to house a representative weather observation station (RWOS) with 37 m² [400 ft²] gross area. An observation platform or catwalk may be provided around the exterior of the RWOS floor.

c. Airfield Operations Buildings (Category Code 141-10).

(1) Functional Areas. An airfield operations building will be provided to house the flight operational and administrative functions of the airfield headquarters. Descriptions of the functions and corresponding space allowed in this type of facility are contained in Attachment 3 of UFC 3-260-01 (Reference K-1) and from ATZQ-ATC-FB.).

(2) Location of the Facility. The airfield operations facility may be provided in a separate building; combined with the flight control tower and/or a fire and rescue station; or in some cases, located in administrative spaces of a hangar.

(3) Space Requirements.

(a) Actual space requirements for each facility will be based on a local survey of needs. The office floor area per building occupant will be based on the number of personnel assigned office space and personnel authorizations, and the criteria contained in Attachment 3 of UFC 3-260-01 (Reference K-1) and from ATZQ-ATC-FB.). Special purpose rooms, such as briefing, communications, conference, plotting, and transient waiting will be justified separately by operational requirements. Personnel requiring locker space, but not assigned office space, will not be included as building occupants when computing office space.

(b) Special facility requirements, such as AWS and the flight surgeon, when provided as direct support at an airfield, will be included as indicated in Attachment 3 of UFC 3-260-01 (Reference K-1) without regard to the number of personnel assigned to the special unit.

(c) For planning purposes only, Table K-1 provides the approximate sizes of airfield operations and headquarters buildings without AWS detachment and flight surgeon spaces.

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TABLE K-1 AIRFIELD OPERATIONS AND HEADQUARTERS BUILDINGS		
NUMBER OF ASSIGNED AIRCRAFT	GROSS AREA ¹	
	square meters	(square feet)
25 or less	204.5	(2,200)
26 - 50	279	(3,000)
A division and up to 25 additional miscellaneous aircraft.	492	(5,300)
Note ²	1022 to 1858	(11,000 to 20,000)
<p>¹ Mechanical, electrical and electronic equipment room space as required will be added to the gross areas shown when determining a single gross area figure for each facility.</p> <p>² At airfields with approximately 60 personnel and which provide interim facilities for USAF air operations during airlifts, serve other USAF and Army aviation missions, and houses a medical evacuation team. The actual gross area will be based on a detailed survey of requirements.</p>		

d. Airfield Fire and Rescue Stations (Category Code 141-11).

(1) General. Army airfield facilities and flight operations will be supported by fire and rescue equipment. The gross areas indicated below will not be exceeded unless the facility has an additional fire protection mission or requirement for special rescue equipment to be stationed in the vicinity of the airfield, and it is economically sound to develop a consolidated or expanded facility.

(2) Space Allowances. One station capable of accommodating equipment apparatus and personnel authorized under the standards set forth in AR 420-90 (reference K-6) will be provided. One-company, two-stall stations will have 280 m² [3,000 ft²] gross area, including mechanical equipment room space. Two-company, three-stall stations will have 430 m² [4,600 ft²] gross area, including mechanical, electrical and electronic equipment room spaces. Standby facilities, when authorized, will be provided at auxiliary locations.

(3) Siting.

(a) Siting of Fire and Rescue Stations. The siting of fire and rescue stations must permit ready access of equipment onto the aircraft operational areas and the road system serving airfield facilities. A site centrally located, close to the midpoint of the runway and near the airfield operations area and air traffic control tower is preferred.

(b) Siting of Rescue and Ambulance Helicopters. With the increasing use of helicopters for emergency rescue and air ambulance service, consideration should be given to providing an alert helicopter parking space on the ground near the fire and rescue station. This space may be located as part of the fire and rescue station or in a designated area on an adjacent aircraft parking apron.

(4) Parking. Privately-owned-vehicle (POV) parking spaces for exclusive use by assigned station personnel will be provided adjacent to each station.

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e. Representative Weather Observation Station (RWOS). (Category Code 141-15.)

(1) A RWOS may be required where a USAF AWS detachment is assigned to an airfield for making continued weather observations that are critical to the takeoff and landing operations of aircraft.

(2) The location and requirements for a RWOS will vary at each airfield depending on the results of a survey conducted by the USAF AWS. The location may be a jointly used control tower, rooms in the tower, a separate building, or rooms in an existing building that provide sufficient space for the functions and equipment.

f. Aircraft Lighting Equipment Vault (Category Code 136-40). A single vault, not to exceed 44.5 m² (480 ft²) gross area, will be provided for fixed-wing runway or separate heliport lighting equipment. A combination vault not to exceed 70 m² (750 ft²) gross area will be provided where both fixed-wing runway and heliport lighting is provided. The area may be increased when a standby generator for the airfield lighting system is authorized.

g. Navigation Building, Air (Category Code 133-20). A facility which houses designated types of equipment systems for the exchange of information between airfields and aircraft. Also included are air traffic control facilities which provide approach control services to aircraft arriving, departing, and transitioning the airspace controlled by the airfield or heliport. Unmanned structures containing regulators, relays, emergency generators, service feeder switches, and secondary control panels for lighting at airfields or heliports are also included. Space allowances for Air Navigation buildings are shown in Table K-2.

TABLE K-2 SPACE ALLOWANCES FOR AIR NAVIGATION BUILDINGS			
BUILDING TYPE	BUILDING DESCRIPTION	GROSS AREA	
		square meters	[square feet]
0	Equipment room only	14.4	[156]
1	Equipment room plus one (1) generator	32.1	[344]
2	Equipment room plus two (2) generators	42.3	[452]
3	Equipment room plus three (3) generators	52	[560]

h. Radar Buildings (Category Code 133-40). Normally, space for radar equipment is provided in flight control towers. However, when a different location is required, 21 m² [225 ft²] net area will be provided within another building or 25 m² [270 ft²] gross area will be provided in a separate radar building.

i. Aviation Unit Operations Buildings (Category Code 141-12). Aviation units require administration and training support facilities in addition to maintenance shops. This space is provided in the hangar basic shop space allowance. Normally, a separate aviation unit operations building will not be provided for miscellaneous aircraft. In such cases, the administration space requirements should be accommodated in the hangar space.

j. Aircraft Runway Holding Apron (Warm-up Pads) (Category Code 113-50). A paved surface which provides an aircraft holding area that is accessible from a taxiway. Normally, it is located adjacent to the connecting taxiway between the runway and parallel taxiway located at the ends of runways. It is provided for pre-takeoff engine and instrument checks. From an operational point of view, an apron includes the prepared surface, stabilized shoulders, lighting and lateral clear zones. For inventory purposes, only the prepared surface is included. Aircraft (engine run up) holding aprons are authorized for each runway. The area for the holding apron will be sized to accommodate those assigned and transient aircraft which normally use the runway and should not

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exceed 3135m² [3,750 yd²] each, without submitting special justification. Holding aprons are usually programmed with, and as a part of, the parallel taxiway system. Figure K-1 provides a sketch indicating aircraft runway holding aprons to runway relationships.



Figure K-1

4. AIRCRAFT GROUND MOVEMENT AND PARKING AREAS.

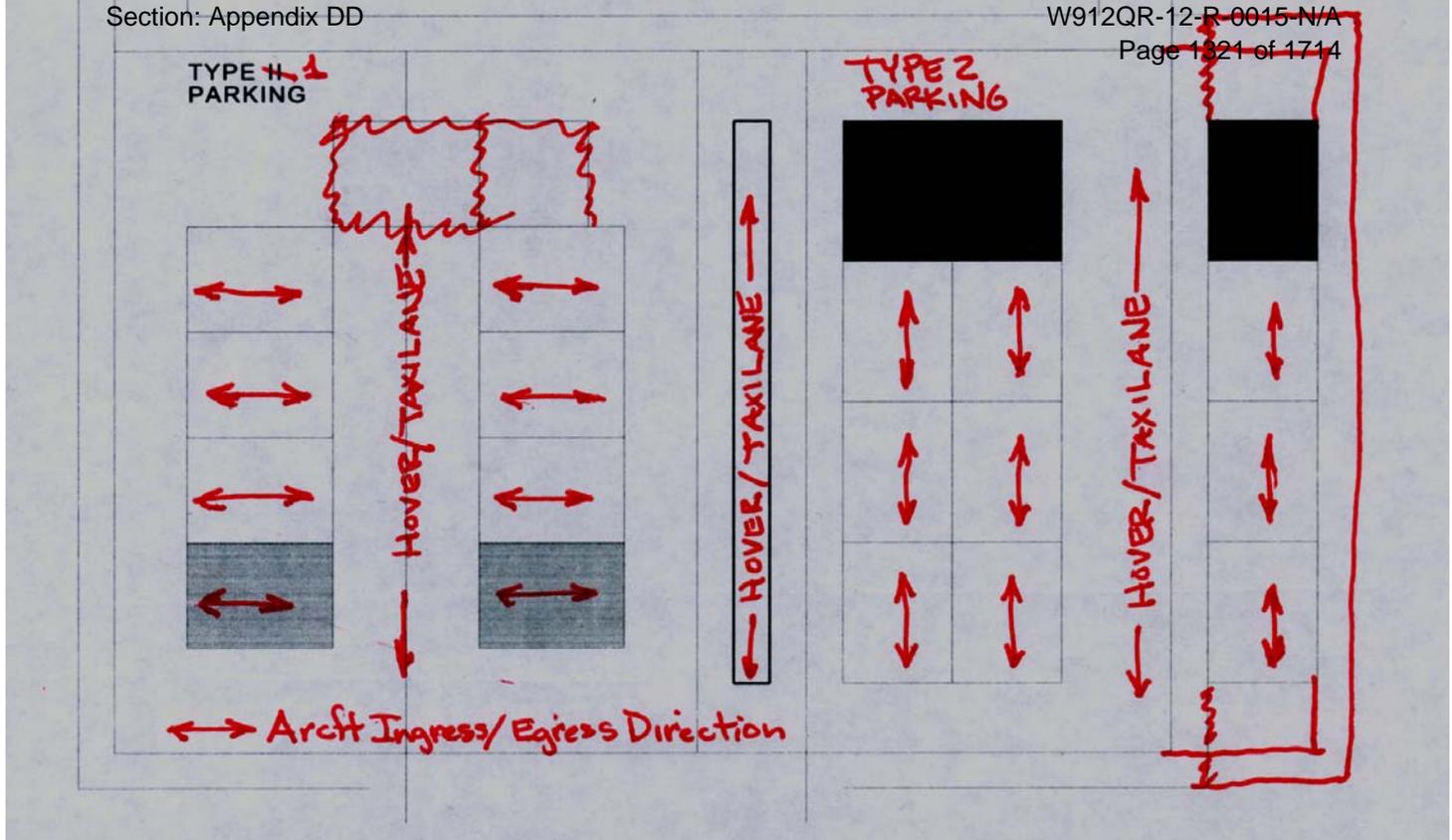
a. General. The aircraft parking area is normally a unit support function and is divided into two major types of parking aprons, fixed and rotary. A modular approach should be utilized for determining the scope of this area which is comprised of parking pads, and hover/taxilanes. The parking areas should be designed and constructed as a continuous mass parking area of concrete composition with each pad and lane identified by painted markings.

This parking area must be separated from the nearest fixed or mobile object based on wingtip clearance, as discussed in Chapter 6 of UFC 3-260-01 (Reference K-1). The size of the aircraft parking apron will be based on the type of aircraft, parking module size and parking arrangement, as discussed in Chapter 6 of UFC 3-260-01 (Reference K-1).

b. Fixed-wing Aircraft Parking Modules. Parking modules for fixed-wing aircraft are normally based on the C-12 J (Huron) with a wing span of 17 m [55 ft] and a length of 18.25 m [60 ft]. However, mission requirements may require different aircraft dimensions. Criteria for module clearances and taxilanes are found in Chapter 6 of UFC 3-260-01 (Reference K-1).

c. Rotary-wing Aircraft Parking Modules. Individual parking modules for rotary-wing aircraft are based on the type of aircraft and type of parking arrangement. The module size for a Type 1 parking arrangement for all rotary-wing aircraft except the CH-47 is 30 m [100 ft] long by 25 m [80 ft] wide. The module size for a Type 2 parking arrangement for all rotary-wing aircraft except skid aircraft is 50 m [160 ft] long by 30 m [100 ft] wide. The module size for a Type 1 parking arrangement of CH-47 aircraft is 30 m [100 ft] wide by 46 m [150 ft] long. The module size for a Type 2 parking arrangement of skid aircraft is 30 m [100 ft] wide by 25 m [80 ft] long.

Figure K-2



d. Parking Arrangement. Rotary-wing aircraft are parked in one of two configurations, referred to as Type 1 or Type 2. In the Type 1 configuration, rotary wing aircraft are parked in a single lane, which is perpendicular to the taxilane. When parked in this configuration, the parking arrangement resembles that of fixed-wing aircraft. This parking arrangement is preferred for wheeled aircraft. In the Type 2 configuration, rotary-wing aircraft are parked in a double lane, which is parallel to the taxilane. This parking arrangement is preferred for skid-gear aircraft. (Figure K-2 provides sketches indicating aircraft parking configurations (Not to scale).

e. Hover/ Taxilanes. Taxilane widths for fixed-wing aircraft will be based on the wing span of the aircraft. Interior taxilane widths for fixed-wing aircraft will be the wing spans of the aircraft plus 6 m (20 feet) for aircraft with wing spans up to 33.5 (110 feet) and 9.1 m (30 feet) for aircraft with wing spans of 33.5 m (110 feet) or more. Through or peripheral taxilanes widths for fixed-wing aircraft will be the wing span of the aircraft plus 9 m (30 feet) for aircraft with wing spans up to 33.5 (110 feet) and a minimum of 15.2 m (50 feet) for aircraft with wing spans of 33.5 m (110 feet) or more. Interior Hover/ taxilane widths for rotary-wing aircraft will be 40 m (120 feet) for all aircraft. Peripheral Hover/ taxilane widths will be 36 m (85 feet) for all aircraft. All the parameters of aircraft design and the associated safety clearances determine the width of the Hover/ taxilanes. The length or depth of the hover/ taxilanes is dependent on the depth of the parking apron relative to the landing surface. Additionally, a hover/ taxilane should be provided on the exterior sides of the parking apron for unobstructed movement of aircraft, whenever feasible.

f. Mooring and Grounding Points for Mass Parking Areas and Hardstands.

(1) General. Provisions will be made to moor aircraft at Army airfields and heliports through the use of tie-down anchors installed for this purpose in parking areas and hardstands.

(2) Fixed-Wing Facilities. Mooring points for fixed-wing aircraft will be installed in mass parking apron areas. Mooring points should be located as recommended by the aircraft manufacturer or as required by the facility.

(3) Rotary-Wing Facilities. Moored parking spaces will be provided for 100 percent of the authorized aircraft. The combined total of apron parking space and hangar parking space should provide sufficient parking for wind protection for all the facilities authorized aircraft and typical transient aircraft. Additional parking spaces with mooring points may be added as necessary to ensure wind protection for all aircraft. The location of these

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additional mooring points can be on pavements other than parking aprons. Each rotary-wing aircraft parking space will have six mooring points spaced in a rectangular configuration. Additional discussion on mooring points is found in Attachment 12 in UFC 3-260-01 (Reference K-1).

(4) Both Fixed and Rotary-Wing Facilities. Where it is anticipated that both fixed- and rotary-wing aircraft will use a mass parking apron area, the spacing and configuration of mooring and grounding points for rotary-wing facilities is discussed in Attachment 12 of UFC 3-260-01.

(5) Detail Requirements. Detail information on mooring and grounding point materials castings, requirements, etc is found in Attachment 12 of UFC 3-260-01.

5. AIRCRAFT MAINTENANCE AREAS.

a. General.

(1) The aircraft maintenance area is required when aircraft maintenance is to be performed regularly at an aviation facility. The same modular concept utilized in the preceding paragraphs should be applied to this area. The maintenance concept for aircraft is divided into three levels as follows:

- (a) Aviation Unit Maintenance (AVUM).
- (b) Aviation Intermediate Maintenance (AVIM).
- (c) Depot Maintenance.

(2) For the purposes of this appendix, only AVUM and AVIM requirements are described. However, modifications specific to depot level activities can be accomplished by referencing the methodology described in Section 7 - Aviation Module Development Methodology.

(3) The aircraft maintenance area includes, but is not limited to; aircraft maintenance hangars, special purpose hangars, hangar access aprons, weapon system support shops, aircraft system testing and repair shops, aircraft parts storage, corrosion control facilities and special purpose maintenance pads. The aircraft maintenance area includes utilities, roadways, fencing and security facilities.

(4) Functional requirements and associated space allowances are based on the unit or units to be supported within the hangar. There is a significant difference in the type, orientation, and quantity of space required between AVUM and AVIM functions. Consolidated hangars (more than one unit within a single hangar structure) should be limited to units with like type maintenance capabilities. Where a single unit has both AVUM and AVIM capability, close coordination with the using agency throughout the planning, design, and construction phases is required. A method of determining the space allowances for a hangar is furnished below for the major hangar components described in the Space Requirements Analysis. This method includes computation algorithms and instructions for each step.

b. Hangar Bay Modules. The maintenance level to be performed is determined by the inherent maintenance capability of the organization or activity, overall aircraft dimensions to be supported, landing gear configuration or type, and number of main rotor blades or wing span. Hangar floor space will be determined by multiplying the authorized number of aircraft maintenance spaces times the aircraft space module for each type of aircraft and then adding the required aircraft and fire access space and a 1.5 m [5 ft] wide perimeter safety corridor to circumvent the area.

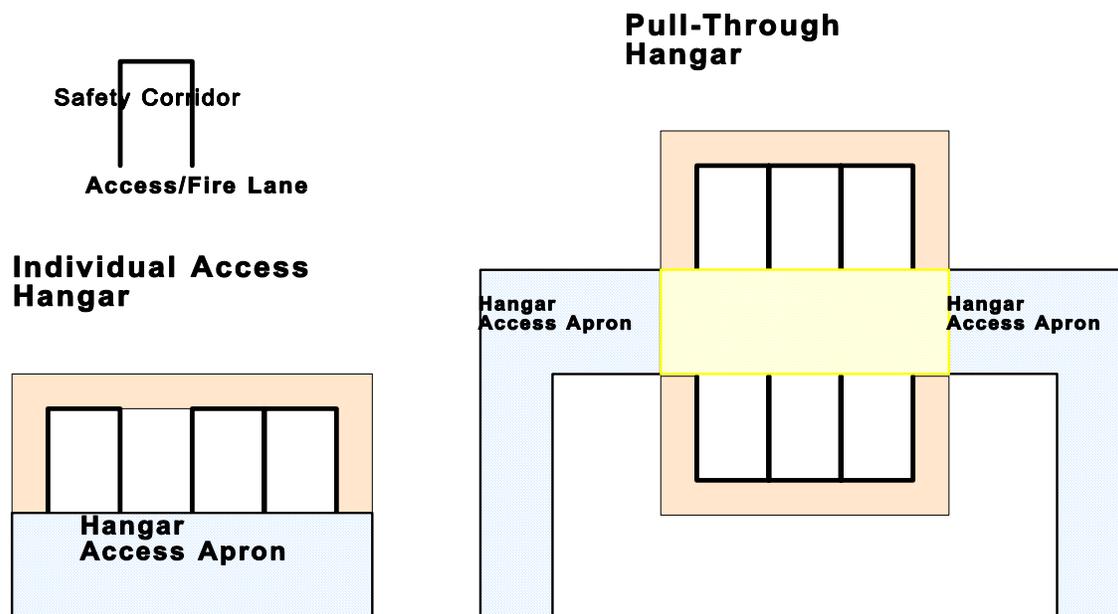
- (1) Access Lanes.

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(a) Aircraft and fire access lanes should be 20 m [65 ft] wide for multi-blade rotary-wing or fixed-wing aircraft hangars, and 10 m [30 ft] wide for UH-1 (two-blade) type aircraft hangars.

(b) Access lanes will be provided when hangars are the pull-through type design or when aircraft maintenance spaces (bays) do not have direct access to hangar doors. Hangars with direct outside access for all bays are preferred so that access lanes are not required. Figure K-3 provides sketches that indicates aircraft parking and circulation patterns for hover/taxilanes .



(c) Aircraft Module Computations and Assumptions. Table K-3 displays module dimensions that were derived for multiple module applications (modules placed side by side). This allows for the joint use of safety and operational buffer areas by adjacent modules. When single modules are provided (no adjacent module), an additional 3 m (10 ft) will be added to the width of the module. The module sizes provided in this appendix and UFC 3-260-01 (reference K-1) support basic airframes. Special mission type aircraft configurations may affect the module dimensions in which cases the SFA will be the governing criteria.

c. Hangar Shop Space.

(1) Hangar shop space is the space other than hangar floor space. The basic shop space includes areas such as aircraft parts storage, aircraft weapons repair and storage, flammable storage, maintenance administration, unit flight operations, technical shops, unit TOE storage, and utilities. Additional or special shop space may be required, such as special equipment repair and storage (such as, weapons and target acquisition equipment repair, medical supplies for MEDEVAC units, or special kit maintenance, repair of storage); or the additional requirements of a medium helicopter company, or a combination of all three.

(2) The same factors which determined the hangar bay module also affect hangar shop space allowances along with the number of engines and mission equipment packages (for example, medical, armament, and extended fuel tanks) associated with the aircraft to be supported.

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(3) The hangar bay module also provides a limited contingency for inclement weather storage (see Section 7 - Aviation Module Development Methodology). For example, the rotary-wing module which supports multi-bladed aircraft (UH-60A) is based on the main rotor blade 90 degrees to the centerline. By turning the main rotor blade 45 degrees to the centerline, approximately 40 to 50 percent of the assigned aircraft can be provided with temporary covered storage. In the case of a two-bladed aircraft, the space provided for auxiliary lift or component removal can be used in the same manner with an estimated storage capability of 50 to 65 percent of the assigned aircraft. These estimates assume that sufficient time will be available to manually maneuver aircraft into positions allowing for maximum coverage under the roof.

d. Storage.

(1) Supply and logistics space allowances are generally categorized along maintenance levels. The associated supply storage space (Category Codes 442-10, -11, and -12) should be provided within the hangar structure or immediately adjacent to the hangar commensurate with the maintenance level to be performed. For example, Category Code 442-12 is associated with AVUM maintenance and should be provided for each organization or activity with an inherent AVUM capability. Category Codes 442-10 and -11 are associated with AVIM maintenance and should be provided for an AVIM activity. When two or more activities are provided within the same hangar, each activity is authorized the corresponding supply and logistic space. Safety and environmental clearances normally associated with aviation facilities necessitate their siting a substantial distance away from normal bulk supply areas of a facility (for example, light industrial areas). The repair parts and supply contained in these facilities are required for day-to-day maintenance performance and should be collocated with the facility in which that maintenance is to be performed.

(2) Additional consideration on where to provide storage space for support equipment, such as maintenance platforms or stands, mobile cranes, shop vans and ground power units, may have a significant bearing on the external layout of hangars and pavement design requirements. This equipment will be collocated, in lieu of the unit motor pool. Adequate space to accommodate these requirements will be provided while ensuring that safety clearances are not violated.

(3) Aircraft Space Modules. Space allowances for aircraft space modules are shown in Table K-3.

TABLE K-3 SPACE ALLOWANCES FOR AIRCRAFT SPACE MODULES*						
TYPES OF AIRCRAFT	DIMENSIONS				MODULE AREA	
	length		width		m ²	[ft ²]
	meters	[feet]	meters	[feet]		
UH-1,** AH-1, OH-58 (2 blades)	23.5	[77]	9.1	[30]	215	[2,310]
UH-1 (4 blades)	23.5	[77]	16.5	[54]	386	[4,158]
UH-60 (4 blades)	25.6	[84]	19.5	[64]	499	[5,376]

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TABLE K-3 SPACE ALLOWANCES FOR AIRCRAFT SPACE MODULES*						
TYPES OF AIRCRAFT	DIMENSIONS				MODULE AREA	
	length		width			
	meters	[feet]	meters	[feet]	m ²	[ft ²]
AH-64 (4 blades)	23.5	[77]	18.3	[60]	429	[4,620]
OH-58 (4 blades)	23.5	[77]	13.7	[45]	322	[3,465]
CH-47 (6 blades - tandem)	33.5	[110]	21.3	[70]	715	[7,700]
C-12 Fixed Wing *	19.5	[64]	0 19.8	[65]	386	(4,160)

* Aircraft space modules shown in the table have been derived by adding approximately 6m [20 ft] to the aircraft width and length dimensions, thus providing a 3m [10 ft] wide buffer/work space around each aircraft.
 ** Equate aircraft such as U-6, U-8 and U-21 to C-12; equate C-23 to C-12; equate AH-15 to UH-1 (4 Blades).

e. AVUM and AVIM Hangars (Category Codes 211-10 and -11).

(1) General.

(a) The criteria provided in the following subparagraphs are applicable to most normal types of hangar facility designs. However, Army Table of Distribution and Allowances (TDA) organizations also provide aircraft maintenance support in addition to Table of Organization and Equipment (TOE) organizations at many locations. This support is normally provided by the Directorate of Logistics (DOL) at Army facilities. When this requirement exists, coordination with the DOL should be accomplished to determine which aspects of the following criteria apply.

(b) Hangars supporting a single organization with less than 50 aircraft should be designed to utilize an individual access design configuration. The vast majority of AVUM hangars fall into this category. Individual access hangars preclude the need for two hangar access aprons and the access space described in this appendix. This type of design also reduces the amount of linear feet of overhead lifting cranes required to adequately cover the hangar maintenance bay areas.

(c) For those hangars supporting more than 50 aircraft, a pull-through design configuration should be provided. This usually occurs with AVIM hangars. When two or more units are consolidated into a single hangar facility, a pull-through configuration may be necessary.

(2) Aviation Unit Maintenance (AVUM) Hangars.

(a) Definition. AVUM is defined as activities staffed and equipped to perform high frequency "on aircraft" maintenance tasks required to retain or return aircraft to a serviceable condition.

(b) General. AVUM hangars will be designed to support the daily routine of operational and safety inspections and will provide space for arms repair and storage, parts storage, records maintenance, storage of

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flammable materials, technical library, and unit (AVUM) maintenance shops. In addition, space will be provided to support administrative, training, and unit operational functions.

(c) Allowances.

1/ AVUM hangars are authorized aircraft maintenance spaces (modules) for 20 percent of each type of aircraft authorized in a unit. This 20 percent is based on a factor of 25 percent of the unit aircraft undergoing unit maintenance and 80 percent of these requiring hangar space. Army aviation facilities work sheets are shown as Figures K-4 through K-10.

2/ The basic shop space authorized for a unit in an AVUM hangar is 697 m² [7,500 ft²] gross area, within additional 348 m² [3,750 ft²] gross area allowed for special shop space. The total gross area is 1,045 m² [11,250 ft²], not including mechanical, electrical and electronic equipment room space which must be added.

FIGURE K-4 STATIONING ARMY AVIATION FACILITIES WORK SHEET NO. 1	
Step 1 - Aircraft Stationing INSTRUCTIONS: Determine the actual and projected aircraft stationing quantities by type.	
Aircraft (ACFT) Types	Quantity of Aircraft per Type
1. UH-1, AH-1, OH-58A-C	_____
2. OH-58D (4 blades)	_____
3. AH-64 (4 blades)	_____
4. UH-60 (4 blades)	_____
5. CH-47A-D (3 blades tandem)	_____
6. CH-54 (6 blades)	_____
7. C-12, U-21, U-8 (all)	_____
8. OV-1	_____
9. Other	_____
TOTAL	_____

FIGURE K-5 HANGAR MODULES ARMY AVIATION FACILITIES WORK SHEET NO. 2
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<p>Step 2 - Hangar Floor Space Modules INSTRUCTIONS: The required hangar floor space is predicated by the maintenance capability of the unit. AVUM - 20 percent of the number of assigned aircraft projected by type. AVIM - 10 percent of the number of supported aircraft by type. AVUM/AVIM - 15 percent of the number of supported aircraft by type. When aircraft require 100 percent covered storage due to physical security and equipment sensitivity protection, they will not be included in the percentage factor computation. Modular requirements will be added to the quantity requirement by type of aircraft to determine the total quantity required.</p>				
Module Net Area				Number Required
ACFT Type	Maximum Dimensions	Net Area		
	Length X Width	square meters	[square feet]	
1.	23.5 m [77 ft] X 9.1 m [30 ft]	242	[2,310]	_____
2.	23.5 m [77 ft] X 13.7 m [45 ft]	322	[3,465]	_____
3.	23.5 m [77 ft] X 18.3 m [60 ft]	429	[4,620]	_____
4.	25.6 m [84 ft] X 19.5 m [64 ft]	499	[5,376]	_____
5.	33.5 m [110 ft] X 21.3 m [70 ft]	715	[7,700]	_____
6.	33.5 m [110 ft] X 24.4 m [80 ft]	817	[8,800]	_____
7.	19.5 m [64 ft] X 19.8 m [65 ft]	386	[4,160]	_____
8.	19.5 m [64 ft] X 17.7 m [58 ft]	345	[3,712]	_____
9.	_____ m [____ ft] X _____ m [____ ft]	_____	[_____]	_____

<p align="center">FIGURE K-6 AIRCRAFT FLOOR SPACE ARMY AVIATION FACILITIES WORK SHEET NO. 3</p>				
<p>Step 3 - Area "A" Net Space (Module Times Required Number Equals Net Floor Space) INSTRUCTIONS: (Area A) Multiply the quantities in Step 2 (Figure K-5) by the Module Net Area below to determine the "Net ACFT Floor Space."</p>				
ACFT Type	Module Net Area		Number Required	Net ACFT Floor Space
	square meters	[square feet]		
1.	242	[2,310]	X _____ =	_____
2.	322	[3,465]	X _____ =	_____
3.	429	[4,620]	X _____ =	_____
4.	499	[5,376]	X _____ =	_____

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FIGURE K-6 AIRCRAFT FLOOR SPACE ARMY AVIATION FACILITIES WORK SHEET NO. 3				
Step 3 - Area "A" Net Space (Module Times Required Number Equals Net Floor Space) INSTRUCTIONS: (Area A) Multiply the quantities in Step 2 (Figure K-5) by the Module Net Area below to determine the "Net ACFT Floor Space."				
ACFT Type	Module Net Area		Number Required	Net ACFT Floor Space
	square meters	[square feet]		
5.	715	[7,700]	X _____ =	_____
6.	817	[8,800]	X _____ =	_____
7.	386	[4,160]	X _____ =	_____
8.	345	[3,712]	X _____ =	_____
9.	_____	[_____]	X _____ =	_____

FIGURE K-7 ACCESS/FIRE LANE SPACE - ARMY AVIATION FACILITIES WORK SHEET NO. 4	
Step 4 - Area "B" Access and Fire Lane - Optional by Design INSTRUCTIONS: (Area B) Access and fire lanes are optional by design. If the hangar is a pull-through design, an access lane will be provided. The access lane is a central corridor with maintenance modules (bays) on either side. This lane will be 20 m [65 ft] wide, except when the hangar supports two-bladed helicopters only or if alternate means of ingress and egress are provided for multi-bladed (three or more) helicopters and fixed-wing aircraft. A 10 m [30 ft] wide dimension will be used in this latter case.	
20 m [65 ft] wide X [_____ m [ft] long + 3 m [10 ft] buffer] = _____ m ² [ft ²]	

FIGURE K-8 HANGAR SPACE W/O SHOPS ARMY AVIATION FACILITIES WORK SHEET NO. 5	
Step 5 - X times Y Hangar Space Without Shops INSTRUCTIONS: The X dimension equals the total width of the aircraft maintenance modules (including the access and fire lane option) plus a 3 m [10 ft] safety corridor (1.5 m [5 ft] on either side). The Y dimension equals the total length (depth) of the aircraft maintenance modules plus a 3 m [10 ft] safety corridor (1.5 m [5 ft] on either side). For computation simplicity, several (X) and (Y) dimensions may be used in order to determine the total floor space requirement.	
X1 _____ meters [feet] times Y1 _____ meters [feet] = _____ m ² [ft ²]	
X2 _____ meters [feet] times Y2 _____ meters [feet] = _____ m ² [ft ²]	
X3 _____ meters [feet] times Y3 _____ meters [feet] = _____ m ² [ft ²]	

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FIGURE K-8 HANGAR SPACE W/O SHOPS ARMY AVIATION FACILITIES WORK SHEET NO. 5
X4 _____ meters [feet] times Y4 _____ meters [feet] = _____ m ² [ft ²]
X times Y TOTAL = _____ m ² [ft ²]

FIGURE K-9 SHOPS FLOOR SPACE ARMY AVIATION FACILITIES WORK SHEETS NO. 6
<p>Step 6 - Area "C" Shop Space INSTRUCTIONS: (Area C) Shop floor space is predicated on the maintenance capability of the unit. Whenever two units with separate maintenance capabilities are utilizing the same hangar, the total shop floor space will be the combined total (for example, two CSAC with AVUM equals 697 m² [7,500 ft²] each or a hangar of 1393 m² [15,000 ft²]). The basis for authorization is as follows: AVUM - 697 m² [7,500 ft²] basic NOT MORE THAN 1045 m² [11,250 ft²] with justification (weapons systems repair storage, medical supplies, special avionics). AVIM - 1393 m² [15,000 ft²] basic NOT MORE THAN 2090 m² [22,500 ft²] with justification as with the AVUM additional space. No maintenance capability organic - 325 m² [3,500 ft²] basic NOT MORE THAN 488 m² [5,250 ft²] with justification as with the additional space. Justification for allocations greater than stated above will be submitted to HQUSACE, ATTN: CECW-EW, Washington, D.C. 20314-1000.</p>
Type Capability _____ = Total square meters [feet] _____ m ² [ft ²]

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FIGURE K-10 TOTAL HANGAR NET SPACE ARMY AVIATION FACILITIES WORK SHEET NO. 7
<p>Step 7 - Hangar Net Area Summary</p> <p>INSTRUCTIONS: The total requirement is determined by combining steps 5 and 6 (Figures 8 and 9). If step 5 can't be determined, the total from step 3 (Figure 6) can be used as an estimated value. This total does not include the square meters [feet] for areas such as break rooms, locker rooms, and toilet facilities, other than maintenance and operations administrative functions (such as classrooms, conference rooms) or support equipment (such as environmental controls, transformers).</p>
<p>Total Step 5 (Figure 8) _____ square meters _____ [square feet]</p> <p>Total Step 6 (Figure 9) _____ square meters _____ [square feet]</p> <p>TOTAL _____ m² _____ [ft²]</p>

(3) Aviation Intermediate Maintenance (AVIM) Hangars.

(1) Definition. AVIM is defined as units that provide mobile, responsive "one-stop" maintenance and repair of equipment for return to the user.

(2) General. AVIM hangars will be designed to include technical shops to conduct repair and replacement of assemblies and components; for the storage and issue of parts; to provide technical assistance to user units; and for administration and training functions of the unit.

(3) Allowances.

1/ AVIM hangars are authorized aircraft maintenance spaces (modules) for 10 percent of each type of aircraft authorized to be supported.

2/ The basic shop space in an AVIM hangar is 1,394 m² [15,000 ft²] gross area, with an additional 697 m² [7,500 ft²] gross area allowed, if required, for special shop space. The total gross area is 2,090 m² [22,500 ft²], not including mechanical, electrical and electronic equipment room space which must be added.

f. Other Types of Hangars (Category Code 211-90).

(1) Security and storage hangars are limited use hangars. They do not normally require all of the features provided in AVUM and AVIM hangars since any maintenance performed is extremely limited. Therefore, security and storage hangars will not be designed with high-bay ceilings or overhead moving cranes, unless specifically justified and approved. All requests for approval will be forwarded to HQUSACE (CECW-EW) for coordination.

(2) Security hangars are authorized up to 325 m² [3,500 ft²] gross area of shop space.

g. Avionics Maintenance Shops (Category Code 217-40).

(1) A facility for the repair of electronic gear used in aircraft and in aviation facilities. This category code should be used only at depot level. At other levels of aircraft maintenance use 21110 or 21117.

(2) A minimum of 56 m² [600 ft²] gross area will be provided in a hangar or in a separate building adjoining an aircraft maintenance apron for an avionics maintenance shop. The facility will be provided with humidity control and suitably equipped to support the repair and storage of electronic gear of aircraft and aviation facilities. Test areas may be shielded to reduce radio frequency interference. Space allowances for avionics maintenance shops

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are shown in Table K-4.

TABLE K-4 SPACE ALLOWANCES FOR AVIONICS MAINTENANCE SHOPS		
NUMBER OF AIRCRAFT	GROSS AREA ¹	
	square meters	[square feet]
1 to 30	56 ²	[603]
31 to 50	Up to 111 ³	[Up to 1,200]
51 to 100	Up to 228 ⁴	[Up to 2,450]
101 to 150	Up to 321 ⁵	[Up to 3,450]
151 to 450	Up to 432 ⁶	[Up to 4,650]
451 and above	Note ⁷	Note ⁷

¹ Mechanical, electrical and electronic equipment room space as required will be added to the gross areas shown when determining a single gross area figure for each facility.

² Space generally located in a hangar shop.

³ Space based on 2.8 m² [30 ft²] for each additional aircraft above 30.

⁴ Space based on 2.3 m² [25 ft²] for each additional aircraft above 50.

⁵ Space based on 1.9 m² [20 ft²] for each additional aircraft above 100.

⁶ Space based on 0.37 m² [4 ft²] for each additional aircraft above 150.

⁷ Space will be justified and based on specific requirements.

(3) Aggregate space provided for electronics repair will be taken into account in programming separate and new avionics maintenance facilities at airfields and heliports in order to eliminate duplication of existing facilities. However, consideration will be given to economy and efficiency gained where these functions are performed in one central facility. These are space generally utilized in flight control towers, aircraft maintenance hangars, and for radio parts storage in aircraft unit parts storage buildings, as well as other available facilities.

h. Aircraft Washing Apron (Category Code 113-70).

(1) A rigid pavement area for aircraft washing and cleaning. It normally includes electrical and water service, drainage, and waste water collection equipment. From an operational point of view, an apron includes the prepared surface, stabilized shoulders, lighting and lateral clear zones. For inventory purposes, only the prepared surface is included. Standard washing apron sizes are provided in Figure K-11.

(2) Washing aprons should be sited immediately adjacent to hangars to minimize the cost associated with providing compressed air, electrical (110 VAC), and water (one inch service) accessibility which are provided in the hangars. Environmental considerations in accordance with environmental requirements must be provided for detergent and oil particulate waste by-products. AR 200-1 (reference K- 7) and AR 200-2 (reference K- 8) requirements will govern as the minimum acceptability standards.

FIGURE K-11 ACFT WASH APRON SPACE ARMY AVIATION FACILITIES WORK SHEET NO. 8
Step 8 - Area "D" Wash Aprons INSTRUCTIONS: Wash aprons will be provided for each hangar by

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FIGURE K-11 ACFT WASH APRON SPACE ARMY AVIATION FACILITIES WORK SHEET NO. 8		
<p>maintenance capability and largest aircraft type supported. One wash apron will be provided for each unit with AVUM or AVIM capability. AVIM units may require two different types of wash aprons or a gross total of these aprons when supported aircraft have a significant disparity in size (for example, UH-60 and CH 47). Additionally, adverse weather and environmental considerations may require more than one apron (for example, high salt or sand environments). Units with no organic maintenance capability, but have a 100 percent covered storage requirement, will also be provided with one wash apron per storage hangar. The basis for the wash apron size is the aircraft dimensions with a buffer area. Small-size aircraft buffer areas will be 1.5 m [5 ft] per aircraft to be serviced, wing tip-to-wing tip, and 1.5 m [5 ft] from the nose and tail of the aircraft to the end of the pavement. 1.5 m [5 ft] will also be provided from the hangar wall-to-wing tip when the wash apron is immediately adjacent to a hangar. Medium and Large-size aircraft will be provided with 3 m [10 ft] buffers. Table doesn't match UFC 3-260-01, Table 6.4.</p>		
Aircraft Size	Length Times Width Equals the Required Area	Example Aircraft
Small	26 m [85 ft] X 16 m [52 ft] = 416 m ² [4,420 ft ² or 492 yd ²]	two OH-58
Medium	42 m [138 ft] X 23 m [74 ft] = 966 m ² [10,212 ft ² or 1,135 yd ²]	two UH-60
Large	45.5 m [150 ft] X 36.5 m [120 ft] = 1660.5 m ² [18,000 ft ² or 2,000 yd ²]	two CH-47

i. Hangar Access Apron (Category Code 113-40). Hangar access aprons provide a stabilized circulation path between the hangar and the parking area of an aviation facility. The width dimensions of the apron are dependent upon the actual hangar configuration and size to be supported (see subparagraph 5.a., above). The depth of the hangar access apron is dependent on the type of Aircraft and class of runway. For example, individual access hangars for Class B fixed-wing aircraft will normally have access aprons as long as the total hangar door length and 40 m [125 ft] deep. **Pull-through hangars for Class B fixed-wing aircraft are normally provided with two hangar access aprons 20 m [65 ft] long (width of access/fire lanes) and 40 m [125 ft] deep. Verify statement is correct as not in UFC 3-260-01??** The hangar, at Army facilities, must be located beyond the clearance distance from the apron edge to fixed or mobile obstacles. This type of apron is normally a concrete surface to preclude pavement degradation associated with fuel contact on bituminous pavement. The space criteria work sheet for aircraft hangar access aprons is at Figure K-12.

FIGURE K-12 HANGAR ACCESS APRONS ARMY AVIATION FACILITIES WORK SHEET NO. 9
<p>Step 9 - Area "E" Hangar Access Apron INSTRUCTIONS: Hangar access aprons will be predicated on the hangar design. The minimum length of apron is based on type of aircraft and class of runway. This area will normally be portland cement for individual bay access.</p>

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FIGURE K-12 HANGAR ACCESS APRONS
ARMY AVIATION FACILITIES WORK SHEET NO. 9

Length times width equals required area, therefore:

Individual Access Hangar

<i>Fixed-Wing Class A Runway:</i>	Access Apron ___ meter [feet] long X 30 m [100 ft] depth = ___ m ² [___ft ²]
<i>Fixed-Wing Class B Runway:</i>	Access Apron ___ meter [feet] long X 40 m [125 ft] depth = ___ m ² [___ft ²]
<i>Rotary-Wing Aircraft, Except H-53 Helicopters:</i>	Access Apron ___ meter [feet] long X 23 m [75 ft] depth = ___ m ² [___ft ²]
<i>H-53 Helicopters:</i>	Access Apron ___ meter [feet] long X 30 m [100 ft] depth = ___ m ² [___ft ²]

Pull Through Hangar **(Verify the correctness of the remaining computations as not in UFC 3-260-01).**

<i>Fixed-Wing Class A Runway:</i>	Access Apron <u>23</u> meter [75 feet] long X 20 m [65 ft] depth = <u>460</u> m ² [<u>4875</u> ft ²]
	Access Taxiway = ___ m ² [___ft ²]
<i>Fixed-Wing Class B Runway:</i>	Access Apron <u>27</u> meter [75 feet] long X 20 m [65 ft] depth = <u>460</u> m ² [<u>4875</u> ft ²]
	Access Taxiway = ___ m ² [___ft ²]

6 AVIATION OPERATIONS SUPPORT AREAS.

a. General. The aviation operations support areas are comprised of major distribution, transfer, physical security, bulk storage, and transportation facilities necessary for support to one or more of the three functional areas previously identified. If flight simulation training devices are required, this is the area where they should be located.

b. Bulk Fuel Storage (Group Category Code 41 or 411?). Bulk fuel storage requirements are determined by the fuel capacity, fuel consumption rate, and the DA Flying Hour Program for aircraft systems. The method of calculation requires coordination with either the Directorate of Logistics or the Aviation Division, DPTM of the installation staff, since the DA Flying Hour Program is determined by the available training funds which change periodically based on the PPBES process. Detailed information on aircraft systems currently in production or under development may be obtained from various aircraft SFA. Additional data on most systems already fielded may also be obtained from SFA when a comparison against these aircraft is published (for example, the UH-60A SFA also includes UH-1H data since the UH-60A replaces many UH-1H aircraft).

c. Flight Simulator Buildings (Category Codes 171-10 and 171-12). May be authorized in accordance with the DA approved basis of issue plan and should conform to the following standard type facilities and scopes as shown in Table K-5.

(1) Table K-5 should be used as a guide only when determining the sizes for flight simulator buildings. These sizes may be adjusted as needed to meet actual project and equipment requirements.

(2) When two or more flight simulator facilities are being planned, consideration should be given to locating them on the same or adjacent sites. The allowances shown in Table K-5 provide space to accommodate flight planning, administrative and instructor spaces, and classrooms in each facility type. These types of spaces could be joint usage with collocated facilities; therefore, the total space should be reduced accordingly. An assessment of actual training loads (student and instructor training time in the simulators and classrooms, and the number of students to be trained), and the size of the staffs needed to operate and maintain the simulators should be considered.

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(3) Specific projects should be coordinated with the Aviation Division, DPTM at Army facilities during the planning, programming, and design stages to determine the type of simulator, administrative and classroom space requirements, and siting parameters.

(4) Current designs maintained by the Program Manager, Training Devices (PM TRADE) should be used for initial flight simulator designs. HVAC loading should be based on computations normally associated with computer hardware installations. Until standard designs for flight simulators under the DA Facilities Standardization Program are developed, geographical design agencies should coordinate specific design requirements with PM TRADE, Naval Training Center, ATTN: NTSC FE, Orlando, FL 32813. Additional information has been published in SFA (Various Aircraft Systems), available on the PAX computer system under the Facilities Planning System or the Trainer Facility Report from PM TRADE.

TABLE K-5 SPACE ALLOWANCES FOR FLIGHT SIMULATOR BUILDINGS		
TYPES OF AIRCRAFT SIMULATOR	GROSS AREA ¹	
	square meters	[square feet]
UH-1 FS (2B24) ²	669	[7,200]
CH-47 FS (2B31) ²	1607	[17,30]
AH-1 FS (2B33) ²	2127	[22,900]
UH-60 FS (2B38) ²	2081	[22,400]
AH-64 FWS (2B40)	2072	[22,300]
UH-1/UH-60 (2B24/38)	1951	[21,000]
CH-47/AH-1 (2B31/33)	2648	[28,500]
CH-47/UH-60 (2B31/38)	2806	[30,200]
AH-1/UH-60 (2B33/38)	3512	[37,800]
CH-47/AH-1/UH-60 (2B31/33/38)	4543	[48,900]
FS = FLT SIMS; FWS = FLT & WPN SIM ¹ Mechanical, electrical and electronic equipment room space as required will be added to the gross areas shown when determining a single gross area figure for each facility. ² Definitive drawings for these facilities may be obtained thru HQDA (DAEN-ECE-A).		

d. Personnel Loading Apron (Category Code 113- 80). This type of apron will be provided to support transient and Very Important Persons (VIP) aircraft operations and normally sited immediately adjacent or in proximity to the airfield operations building. It may also be used to size and support medical evacuation (MEDEVAC) operations. In the latter case, proximity to the MEDEVAC unit hangar or the quickest ground vehicular access to the flight line, or both, will be the determining factor for siting and the number of loading aprons to be provided on an aviation facility.

e. Aircraft Special-Purpose Apron (Category Code 113-82). Special purpose aprons may be authorized for providing safe areas for arming and/or disarming aircraft weapons; loading and unloading ammunition; special

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handling and/or decontamination facilities for CBR warfare items; and for special security areas. Special-purpose aprons required to conduct defueling operations will be provided at Army aviation facilities. Design will be predicated on the largest aircraft and adequate space for fire support equipment and defueling vehicle and apparatus. Grounding points will be provided. The scope of the apron area and the type of the supporting facilities for these special-purpose aprons will be individually justified on the basis of the mission requirements. Safety clearances, appropriate to the requirements of the apron will be observed. Airfield maps and plans will identify the purpose of the apron and show the required safety clearance distances. Explosive clearances are discussed in UFC 3-260-01 -Attachment 10 (Reference K-1).

f. Aircraft Compass Swing Base (Category Code 116-10). One compass calibration pad may be provided at Army airfields or heliports where fifteen or more aircraft are permanently assigned, and at Army depots where aircraft maintenance missions are assigned (AR 750-1). The compass calibration pad is a paved area which should be located in an electronically quiet zone of the airfield. Compass calibration pads are typically circular and are sized to accommodate one of the assigned or mission aircraft.

7. AVIATION MODULE DEVELOPMENT METHODOLOGY.

a. Fixed-Wing Aircraft Parking Module. This module is based on the C-12 J aircraft. The module length is 18.25m (60 ft.) and 17m (55 ft.) The baseline aircraft dimension is 13.4 m [44 ft] long by 16.8 m [55 ft] wide. The module length is derived by rounding off the aircraft length to 14 m [45 ft] and adding 4.25 m [15 ft]. This will provide a circulation path for refueling or support vehicles, 2268 kg or 4536 kg [2 1/2 or 5-ton] chassis, to park at 90 degrees to the aircraft centerline, and provides a safety clearance between the aircraft centered in the parking module and aircraft taxiing in the hover or taxilanes. This separation between modules provide separation as noted in Chapter 6 of UFC 3-260-01 (Reference K-1) from wing tip to wing tip from the next adjacent parked aircraft clearance and an alternate refueling position with safety clearances. The separation distance provides an area for work stands, tool boxes, and components removed during the performance of maintenance outdoors without interference with adjacent or operational aircraft.

b. Rotary-Wing Aircraft Parking Modules. Rotary-wing parking modules are based on the landing gear configuration and prop wash characteristics of the aircraft.

(1) Landing Gear Configurations. Skid configured aircraft must hover for movement. Wheel configured aircraft taxi like fixed-wing aircraft. The safest method of movement in and around fixed or movable objects is accomplished by positive ground contact. Therefore, wheel configured aircraft taxi on the ground like fixed-wing aircraft and parking modules are established accordingly.

(2) Prop Wash. Prop wash dynamics affect clearance requirements during power-on operations. The prop wash dynamics include several factors, such as engine power, blade diameter, and the number of blades. In general, these factors can be categorized into three basic configurations. The remaining configurations by the type of aircraft can be accommodated within the basic configurations. The basic configurations are:

- (a) Two-bladed rotors, single main rotor head (for example, UH-1H type aircraft).
- (b) Multi-bladed rotors, single main rotor main rotor head.
- (c) Multi-bladed rotors, multi-rotor heads.

c. Aircraft Hangar Bay Modules.

(1) Rotary-Wing Hangar Bay Modules. Rotary-wing aircraft hangar module dimensions will be derived for multiple module application (for example, modules placed side by side). This will allow for sharing of safety and operational clearance areas with adjacent modules. The rationale for this approach is that only highly specialized requirements or situations would justify the construction of an entire hangar to support a single aircraft. However,

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should this situation arise, 3 m [10 ft] will be subtracted from the multiple module width since no adjacent safety clearance will be required. In all cases other than the UH-1 module, the aircraft width is actually the main rotor diameter. This methodology was chosen since current Army aircraft are not designed to fold blades in other than airlift transport situations. Therefore, repetitive folding of main rotor blades to accomplish routine maintenance increases maintenance down time and risk to incidental damage not normally required or accommodated by the system design.

(a) UH-1 Aircraft (UH-1H Baseline Aircraft, Includes AH-1S and OH-58 A-C Aircraft). The UH-1H aircraft is 17.4 m [57 ft] long by 3 m [10 ft] wide. The module is derived by adding 6 m [20 ft] to the actual length of the aircraft. The module width is derived by adding 6 m [20 ft] to the width of the aircraft. This provides a buffer area around the aircraft for wrecker vehicle, 2268 kg or 4536 kg [2-1/2 or 5-ton] chassis, secondary support requirements during landing gear maintenance. The buffer area also provides space for jack stands, tool boxes, work stands, and components removed to perform maintenance activities.

(b) OH-58D Aircraft (OH-58D Baseline Aircraft (formerly described as YOH-58). The OH-58D aircraft is 12.5 m [41 ft] long by 10.7 m [35 ft] wide. The module length is the same as the UH-1 module length for two reasons. The first reason is discussed in the subparagraph for AH-64 aircraft. The second reason is in anticipation of the development of a new family of scout helicopters which preliminary indications are that the aircraft dimensions will be somewhere between the OH-58D and UH-60A. The module width is derived by adding 3 m [10 ft] to the width of the aircraft. As with the UH-60 and AH-64, the OH-58D incorporates a four-blade design and the space underneath the blades is assumed to be sufficient. Maximum flexibility of the module can be obtained by placing two OH-58D aircraft tail-to-tail. Two OH-58D modules can support three UH-1H aircraft as well.

(c) AH-64 Aircraft (AH-64A Baseline Aircraft). The AH-64A aircraft is 18 m [59 ft] long by 14.6 m [48 ft] wide. The UH-1 module length of 23.5 m [77 ft] has been adopted for modular planning and to simplify any modifications to existing hangars (the AH-64A replaces most of the AH-1S fleet). The module width is derived by rounding off the width of the aircraft to 15 m [50 ft] and adding 3 m [10 ft]. This approach has also been adopted to maximize the UH-1 module width. Since the AH-64A was also designed with work stands as an integral part of the airframe, safety clearance could be achieved in the same manner as with the UH-60 module. This approach provides the maximum flexibility by providing space for either one AH-64 or two AH-1S aircraft. Two adjacent AH-64 modules can support either two AH-64A, one AH-64A and two UH-1H, or two OH-58D and one UH-1H aircraft simultaneously.

(d) UH-60 Aircraft (UH-60A Baseline Aircraft). The UH-60A aircraft is 19.5 m [64 ft] long by 16.5 m [54 ft] wide (rotor blades 90 degrees to the aircraft centerline). The module length is derived by adding 6 m [20 ft] to the length of the aircraft. The module width is derived by adding 3 m [10 ft] to the width of the aircraft. This provides the same buffer area as described above for the UH-1 module, except that work stands are an integral part of the UH-60A airframe. The area underneath the multi-blades is sufficient for component removal and the 3 m [10 ft] addition to the width of the module merely provides sufficient clearance between the blades of the adjacent modules. The blades may be rotated 45 degrees to the centerline of the aircraft to allow sufficient clearance for the wrecker support operations.

(e) CH-47 Aircraft (CH-47C-D Baseline Aircraft). The CH-47C-D aircraft is 30.2 m [99 ft] long by 18.3 m [60 ft] wide. The module length is derived by rounding off the length of the aircraft to 30 m [100 ft] and adding 3 m [10 ft]. The module width is derived by adding 3 m [10 ft] to the width of the aircraft. The space provided underneath the blades is considered to be sufficient as in the case of the UH-60 aircraft module. The cabin top of the CH-47C-D provides some work stand area and the 18.3 m [60 ft] rotor system diameter has sufficient height clearance except for the forward rotor immediately in front of the nose which can be rotated out of the way.

(f) CH-54 Aircraft (CH-54B Baseline Aircraft). The CH-54A-B aircraft is 27.1 m [89 ft] long by 21.9 m [72 ft] wide. Since the CH-54A-B is only found in Reserve Component (RC) organizations, no attempt has been made to adopt modular considerations with the CH-47 module. The modular length is derived by rounding off the

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length of the aircraft to 27 m [90 ft] and adding 6 m [20 ft]. The module width is derived by rounding off the width of the aircraft to 21 m [70 ft] and adding 3 m [10 ft]. The rotor system height is more than adequate to allow for the performance of maintenance.

(g) RAH-66 Aircraft (formerly Light Helicopter LH). The RAH-66 is a developmental aircraft. Current dimensional data indicates that the RAH-66 can be accommodated by using the OH-58D module. However, since the RAH-66 is currently configured as a 5-bladed aircraft, there may be a need to either modify the OH-58D module or use the UH-60 module depending on the maintenance procedures which are being developed. The need to modify or upgrade will be validated as the system develops. Until the aforementioned procedures and criteria are developed, the OH-58D module should be used for planning purposes.

(2) Fixed-Wing Hangar Bay Modules. The same basic approach will be used for fixed-wing aircraft as indicated above, except that the wing span of the aircraft will be substituted for the main rotor blade diameter.

(a) C-12 Aircraft (C-12A-C Baseline Aircraft). The C-12A-C aircraft is 13.4 m [44 ft] long by 16.8 m [55 ft] wide. The module length is derived by rounding off the length of the aircraft to 13.5 m [45 ft] and adding 6 m [20 ft] for buffer areas. The module width is derived by adding 3 m [10 ft] to the width of the aircraft. This will provide maintenance and equipment space as provided in the rotary-wing hangar modules. Maximum space within the module may be obtained by placing the aircraft at a 45-degree angle when necessary.

(b) OV-1 Aircraft (RV1-D Baseline Aircraft). The RV/OV-1C-aircraft is 12.5 m [41 ft] long by 14.6 m [48 ft] wide. The module length is derived by rounding off the length of the aircraft to 13 m [44 ft] and adding 6 m [20 ft] in order to maximize the modular development of the C-12 module. The module width is derived by adding 3 m [10 ft] to the width of the aircraft. Space considerations for this module are the same as for the C-12 module.

(c) Hybrid Aircraft. The only hybrid aircraft under consideration by the Army is the V-22 Osprey (tilt-rotor). Dimensional data and characteristics of the V-22 indicate major revisions to current aircraft space allowances. DRAFT modular data have been developed and are currently under going criteria validation and verification approval process at the Army Staff level. This information will be provided upon approval. Pending a decision by the Army, the only application of the DRAFT criteria developed for the V-22 would be at those facilities intended to support USN, USMC, or USAF aircraft of this type (for example, hospital MEDEVAC helipads). Information may be obtained from HQUSACE (CEMP-ET).

d. Hangar Access and Fire Lanes. Hangars are generally designed in two basic configurations: Pull-Through and Individual Access.

(1) When a hangar design utilizes a pull-through configuration, aircraft modules will be located on either side of a center corridor. This corridor is considered to be an access and fire lane. The corridor width is dependent on safety clearances as well as aircraft dimensions (blade static). Utilization of this corridor for individual access hangar designs is not normally considered.

(2) For UH-1 category aircraft, a corridor width of 10 m [30 ft] is adequate. The corridor length is dependent on the number of aircraft modules to be provided within the hangar. The 9.1-m [30-ft] wide corridor should be provided only when there is no current or future plan to support multi-blade aircraft.

(3) For OH-58D, AH-64A, UH-60A, CH-47C-D, and fixed-wing aircraft, the corridor should be 20 m [65 ft] wide.

e. Safety Corridor, Hangar Bay Area. Personnel who pass-through the maintenance floor area within a hangar require corridors which do not interfere with on-going maintenance or subject personnel not involved in actual maintenance functions to potential safety hazards. Therefore, a 1.5-m [5-ft] wide safety corridor will be provided around the perimeter of the maintenance floor (all aircraft hangar modules). If a hangar access and fire lane is provided, this corridor will be provided to the outside perimeter of the maintenance floor only.

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f. Hangar Shop Space.

(1) General.

(a) The methodology utilized in determining shop space within maintenance hangars for administrative, supply, repair, and storage functions is based on the organic maintenance capability of an organization. Hangar shops are categorized by the level of maintenance.

(b) Additional space (special shop space) may be provided for functions which are peculiar to the mission of the organization and not normally associated with an equivalent maintenance capability (for example, weapons and armament, improved avionics, CEWI equipment, medical evacuation, and special navigation systems maintenance, supply and storage functions). Basic shop space includes maintenance and operations administration, common supply and equipment storage, technical shops, and flammable storage functions.

(c) Space allocation for mechanical equipment (HVAC), electrical and electronic equipment, classrooms, briefing rooms, lockers, toilet facilities, or other similar requirements are not included.

(2) Aviation Unit Maintenance (AVUM). AVUM is defined as on-aircraft maintenance and limited to component removal. The maximum basic shop space allowance is 700 m² [7,500 ft²] gross area. The maximum special shop space allowance is an additional 350 m² [3,750 ft²] gross area. A maximum allowance merely indicates what will be acceptable during facility programming and design without special justification.

(3) Aviation Intermediate Maintenance (AVIM). AVIM is defined as major component removal and repair (DS/GS) maintenance. The maximum basic shop space allowance is 1,400 m² [15,000 ft²] gross area. The maximum special shop space allowance is an additional 700 m² [7,500 ft²] gross area. The limitation or definition of maximum allowable space applies to AVIM as it does to AVUM.

(4) Organizations With No Organic Maintenance Capability. If no organic maintenance capability exists, aircraft will normally be maintained by another related organization. Hangar requirements or allocations will be supported by detailed justifications.

g. Aircraft Wash Aprons. A minimum of one wash apron should be provided for each maintenance hangar. Ground handling of aircraft in this area is required. Maintenance procedures for engine flushing require environmental controls to be placed on the waste water distribution of the wash apron. In addition, utility connections for electricity and compressed air are required. Therefore, the siting of wash aprons adjacent to hangars provides a common source for utilities. There are three sizes of wash aprons as follows:

(1) Light to Medium Helicopters (UH-60 Baseline). The wash apron width will be derived by adding 3 m [10 ft] to twice the width of the aircraft. This will provide a minimum clearance of 1.5 m [5 ft] between rotor blades (rotor tip to rotor tip) on the centerline of the aircraft. The wash apron length will be derived by adding 6m [20 ft] to the length of the aircraft. This will ensure that a clearance o 3.0 m [10 ft] to the front and rear of the aircraft is provided and that runoff from all parts of the airframe could be adequately collected. The maximum capacity is two UH-60A aircraft simultaneously or organizations equipped with smaller aircraft. *This is not in accordance with UFC 3-260-01 Table 6.4.*

(2) Heavy Helicopters (CH-47 Baseline). The wash apron width will be derived by adding 6 m [20 ft] to twice the width of the aircraft. This will provide a rotor separation minimum clearance of 3 m [10 ft]. The wash apron length will be derived by adding 3 m [10 ft] to the length of the aircraft as in the case with the UH-60 wash apron. The maximum capacity is two CH-47C-D aircraft simultaneously or one CH-54A-B aircraft. *This is not in accordance with UFC 3-260-01 Table 6.4.*

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(3) Fixed-Wing Aircraft (C-12 Baseline). Due to the size of fixed-wing aircraft, a single fixed-wing wash apron size will be provided. The wash apron width will be derived by adding 6 m [20 ft] to twice the width of the aircraft. This will provide a minimum of 3 m [10 ft] separation from wing tip to wing tip. The wash apron length will be derived by adding 3 m [10 ft] to the length of the aircraft for the same considerations as utilized in the rotary-wing wash aprons. Maximum capacities for this type of wash apron are two C-12 series, two RV/OV-1 series, or one UV-18A at an oblique angle. *This is not in accordance with UFC 3-260-01 Table 6.4.*

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8. REFERENCES.

- K-1 UFC 3-260-01TM 5-803-7, Airfield and Heliport Planning and Design
- K-2 TM 5-834-2, Geometric Design for: Airfields, Heliports, and Helipads
- K-32 Master Planning Instructions (MPI) issued by HQUSACE (CEMP-E), latest edition
- K-43 AR 95- 2, Air Traffic Control, Air Space, Airfield Flight Facilities and Navigational Aids
- K-54 TB 95-1, US Army Air Traffic Control and NavAid Facility Standards, 15 Sep 1979
- K-65 Fort Huachuca Control Tower, File Number 223-25-360, SPK Specification 5422, dated 15 April 1980, available from the Sacramento District Engineer Office
- K-76 AR 420-90, Fire Prevention and Protection, 1 Feb 1985
- K-87 AR 200-1, Environmental Protection and Enhancement, 15 June 1982
- K-98 AR 200-2, Environmental Effects of Army Actions, 1 September 1981
- K-109 DoD Standard 6055.9-STD, DoD Ammunition and Explosives Safety Standards, July 1984, authorized by DoD Directive 6055.9, November 25, 1983
- K-1110 AR 385-64, Ammunition and Explosives Safety Standards, 15 March 1982

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TECHNICAL MANUAL

CLEANING AND CORROSION CONTROL

VOLUME I
CORROSION PROGRAM AND
CORROSION THEORY

This publication supersedes NAVAIR 01-1A-509/TM 1-1500-344-23, dated 1 May 2001
and NAVAIR 16-1-540/TM 1-1500-343-23/TO 1-1-689, dated 1 Sep 2000.

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CHAPTER 1 INTRODUCTION

This volume was prepared under the technical cognizance of the
Materials Engineering Division, NAVAIR North Island, San Diego, California.

1-1. OVERVIEW. Prevention and repair of corrosion damage to aircraft and avionic systems continues to be an ever increasing cost and safety burden for military aircraft. Equipment is routinely exposed to changes in temperature and pressure, varying humidity levels, dust, dirt, ultraviolet light, aircraft fluids, and environments that promote corrosion. Increasing environmental and safety restrictions, which limit traditional corrosion control materials, are also a significant factor in the safe and economic operation of aircraft and avionics.

1-1.1. The Cleaning and Corrosion Control manual was established jointly by the Navy, Air Force, and Army as a combined effort to consolidate and coordinate corrosion control best practices for aircraft and avionics.

1-1.2. This volumized set of corrosion manuals combines and replaces the former Aircraft Weapons Systems Cleaning and Corrosion Control (NAVAIR 01-1A-509/TM 1-1500-344-23) and Avionics Cleaning and Corrosion Prevention/Control (NAVAIR 16-1-540/TO 1-1-689/TM 1-1500-343-23) manuals.

1-2. PURPOSE. The purpose of this manual is to provide information on materials and procedures to

prevent, control, and repair corrosion damage to aircraft and avionics on land or at sea.

1-3. SCOPE. The material in this manual contains basic corrosion prevention and corrective maintenance information to be used at Organizational, Intermediate, and Depot levels.

1-4. ARRANGEMENT OF MANUAL.

1-4.1. OVERVIEW OF ALL VOLUMES. The NAVAIR 01-1A-509/TM 1-1500-343-23/TO 1-1-689 series of manuals is arranged as shown in Table 1-1.

1-4.1.1. A complete set of manuals to perform aircraft cleaning and corrosion control functions consists of Volumes I, II, and IV (replaces NAVAIR 01-1A-509/TM 1-1500-344-23).

1-4.1.2. A complete set of manuals to perform avionics and electronics cleaning and corrosion control functions consists of Volumes I, III, and IV (Navy and Army) or Volumes I, III, and V (Air Force) (replaces NAVAIR 16-1-540/TM 1-1500-343-23/TO 1-1-689).

Table 1-1. Outline of Manual - All Volumes

VOLUME	TITLE	BRIEF DESCRIPTION
I	Corrosion Program and Corrosion Theory	This volume provides overall program information and explains what corrosion is, why it occurs, the forms it can take, and how to recognize it.
II	Aircraft	This volume provides cleaning and corrosion control procedures for aircraft.
III	Avionics and Electronics	This volume provides cleaning and corrosion control procedures for avionics and electronics.
IV	Consumable Materials and Equipment for Aircraft and Avionics	This volume lists approved materials and equipment for cleaning and corrosion control, and provides ordering information.
V	Consumable Materials and Equipment for Avionics	This volume was prepared at the request of the Air Force. It lists approved materials and equipment for cleaning and corrosion control, and provides ordering information, for avionics only.

Table 1-2. Outline of Volume I

CHAPTER	TITLE	BRIEF DESCRIPTION
1	Introduction	This chapter explains the purpose, appropriate usage, and the responsibility for changes to this manual. Also, this section presents the scope and outline of this volume of the manual, and an overview of the entire volumized manual.
2	Corrosion Programs	This chapter outlines the corrosion control and preventive maintenance program requirements, and provides general safety information.
3	Corrosion Theory	This chapter explains what corrosion is, why it occurs, the various forms it can take, and how to recognize it.
	Glossary	The glossary defines terms commonly used by personnel performing aircraft and avionics cleaning and corrosion control.

1-4.2. ARRANGEMENT OF VOLUME I. Volume I consists of three chapters and a glossary, arranged as shown in Table 1-2.

1-5. RELATED PUBLICATIONS. A listing of related publications is provided in Chapter 1 of each volume of this manual, as applicable.

1-6. USAGE AND CONFLICTS.

1-6.1. Supervisory and maintenance personnel shall use this manual as a guide for all corrosion control and maintenance efforts. Contractors who maintain and repair corrosion for military aircraft and avionics shall also comply with the requirements of this manual.

1-6.2. This manual shall be used in conjunction with and in support of the appropriate Army Technical Manuals (TMs), Technical Bulletins (TBs), Department of the Army Pamphlets (DA PAMs), Navy Maintenance Instruction Manuals (MIMs), Navy Structural Repair Manuals (SRMs), Maintenance Requirement Cards (MRCs), or Air Force Technical Orders (TOs).

1-6.2.1. In the case of a conflict between this manual and other Navy manuals, this manual shall take precedence; however, maintenance activities shall contact the appropriate Cognizant Field Activity (CFA)/ Fleet Support Team (FST) for immediate resolution of the conflict.

1-6.2.2. The Army and Air Force specific systems/components manuals shall take precedence over this manual.

1-6.3. WORDING. The following definitions are adhered to in preparing this manual.

1-6.3.1. Shall is used when a procedure is mandatory.

1-6.3.2. Should is used when a procedure is recommended but not mandatory.

1-6.3.3. Will indicates future action but does not indicate a mandatory procedure.

1-6.3.4. May is used only when a procedure is optional.

1-6.4. SYMBOLS (WARNINGS, CAUTIONS and NOTES). The following definitions apply to WARNINGS, CAUTIONS and NOTES found throughout the manual.

1-6.4.1. WARNING. An operation or maintenance procedure, practice, condition, or statement, which if not strictly observed, could result in injury to or death of personnel, or long term health hazards to personnel.

1-6.4.2. CAUTION. An operating or maintenance procedure, practice, condition, or statement, which if not strictly observed, could result in damage/destruction of equipment or loss of mission effectiveness.

1-6.4.3. NOTE. An operating procedure, practice, or condition which is essential to emphasize.

1-6.5. SERVICE DESIGNATIONS. Since this is a tri-service manual, not all sections apply to all services. Information within the text that does not apply to all three services is designated after the paragraph number as follows: (N) NAVY ONLY, (A) ARMY ONLY, or (AF) AIR FORCE ONLY. Large sections that are service specific are included as appendices in the appropriate volume.

1-7. REPORTING ERRORS AND IMPROVEMENT RECOMMENDATIONS.

1-7.1. GENERAL. All activities using this manual are invited to submit recommended changes, additions, or deletions.

1-7.2. SPECIFIC REPORTING REQUIREMENTS. Recommended changes, additions, or deletions shall be reported as follows:

1-7.2.1. Navy personnel should submit recommended changes to the appropriate technical services facility using the reporting system outlined in OPNAVINST 4790.2.

1-7.2.2. Air Force personnel should refer to TO 00-5-1 to report changes.

1-7.2.3. Army personnel should submit completed DA 2028/2028-2 forms to Commander, U.S. Army Aviation and Missile Command, ATTN: AMSAM-MMC-MA-NP, Redstone Arsenal, AL 35898-5220. Changes may also be submitted electronically via the Army website, <https://amcom2028.redstone.army.mil>, or via email to: 2028@redstpme/army.mil.

1-8. MANUAL CHANGE PROCEDURES.

1-8.1. RESPONSIBILITY. This manual is a tri-service document, coordinated by the Materials Engineering Division, Naval Air Depot North Island, Code 4.9.7, San Diego, CA. The following activities are responsible for maintaining this document: the Naval Air Systems Command, the Air Force Corrosion Program Office, and the U.S. Army Aviation and Missile Command. As necessary, representatives from these activities shall meet to review proposed engineering and logistical changes to this manual. Changes are approved by all services, except for service-specific information.

1-8.2. PROCEDURES. The Navy is the lead service for publication of this manual; therefore, the following Navy publication change procedures apply:

1-8.2.1. Revisions. Volumes will be updated periodically by the issuance of a revision, which is a complete replacement of all pages with all change information incorporated.

1-8.2.2. Routine Changes. Between revisions, routine changes may be issued in the form of corrected pages

to a portion of the existing manual. They consist of replacement change pages for that section of the manual affected by the change.

1-8.2.3. Rapid Action Changes. Changes may be issued as a formal Rapid Action Change (RAC) or an Interim Rapid Action Change (IRAC). IRACs are issued as naval messages to expedite the release of urgent and essential operational and maintenance change information. Army and Air Force program managers are responsible for retransmittal of IRACs to the appropriate service addressees.

1-9. REQUISITIONING AND AUTOMATIC DISTRIBUTION.

1-9.1. Procedures to be used by Naval activities and other Department of Defense activities requiring NAVAIR technical manuals are defined in NAVAIR 00-25-100.

1-9.2. To automatically receive future changes and revisions to NAVAIR technical manuals, an activity must be established on the Automatic Distribution Requirements List (ADRL) maintained by the Naval Air Technical Data and Engineering Service Command (NATEC). To become established on the ADRL, notify your activity central technical publications librarian. If your activity does not have a library, you may establish your automatic distribution requirements by contacting the Commanding Officer, NATEC, Naval Air Station North Island, P.O. Box 357031, Bldg. 90 Distribution, San Diego, CA 92135-7031. Annual reconfirmation of these requirements is necessary to remain on automatic distribution. Use your NATEC assigned account number whenever referring to automatic distribution requirements.

1-9.3. If additional or replacement copies of this manual are required with no attendant changes in the ADRL, they may be ordered by submitting requisitions to the Commanding Officer, Naval Supply Systems Command, Naval Logistics Library, 5801 Tabor Avenue, Philadelphia, PA 19120-5099.

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CHAPTER 2 PREVENTIVE MAINTENANCE PROGRAM

2-1. OVERVIEW. Investigations during the past ten years have identified corrosion as a major factor in electronics failure in the field. As much as 30% to 40% of military avionic failures are due to the corrosion process. This is despite steady improvements in reliability of avionic systems fielded to date and outlines the need for an effective preventive maintenance program.

2-2. CORROSION PREVENTION PHILOSOPHY. Corrosion and environmental conditions are natural phenomena that adversely affect equipment in field service. Although never totally eliminated, the problems these factors cause can be minimized so that they are less severe and better controlled. This can be achieved by understanding equipment failure mechanisms and development/utilization of corrosion control technology.

2-2.1. As a general rule, maintenance personnel should assume corrosion is ongoing, regardless of visible physical evidence. The aim of corrosion prevention is to enable systems to perform satisfactorily for a specified time period. In other words, maintenance efforts should allow equipment to approach its maximum lifetime.

2-2.2. The general workflow diagram, in Figure 2-1, defines procedures followed to implement a corrosion preventive maintenance program. This process is designed to indicate the sequence of events needed to implement and maintain an effective corrosion prevention and control program.

2-3. PREVENTIVE MAINTENANCE. The two most important factors in preventing corrosion, and the only ones which can be controlled by field personnel, are the removal of the electrolyte and the application of protective coatings. Since the extent of corrosion depends on the length of time electrolytes are in contact with metals, aircraft corrosion can be minimized by frequent washing. If noncorrosive cleaners are used, the more frequently a surface is cleaned in a corrosive environment the less the possibility of corrosive attack. In addition, by maintaining chemical treatments and paint finishes in good condition, corrosion can be minimized. The degradation of non-metallic materials can be minimized by avoiding the use of unauthorized maintenance chemicals and procedures. In addition, when repair or replacement of non-metallic materials is required, only approved materials shall be used. Dedication to proper preventive maintenance practices maximizes equipment reliability.

2-4. AIRCRAFT PREVENTIVE MAINTENANCE PROGRAM.

2-4.1. The prevention and control of corrosion on aircraft and related equipment is a command responsibility. Each command must place special emphasis on the importance of the corrosion control program and lend its full support to ensure that corrosion prevention and control receives sufficient priority to be accomplished along with other required maintenance.

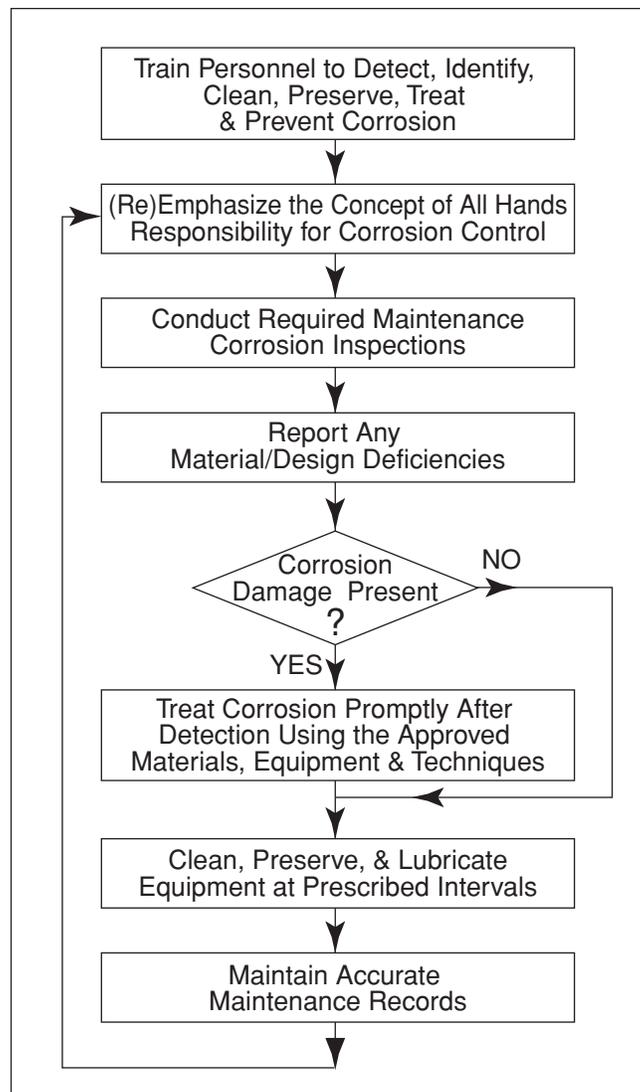


Figure 2-1. Corrosion Prevention Program General Workflow Diagram

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2-4.2. Aluminum and magnesium alloys found in aviation equipment will normally begin to corrode if salt deposits, other corrosive soils, or electrolytes are allowed to remain. In order to prevent corrosion, a constant cycle of cleaning, inspection, operational preservation, and lubrication must be followed. Prompt detection and removal of corrosion will limit the extent of damage to aircraft components. An effective preventive maintenance program requires cleaning, lubrication and preservation, as well as corrosion removal, paint removal, surface treatment, sealing, and painting. A disciplined preventive maintenance program includes:

- a. Regularly scheduled aircraft washing as specified by parent service organization directives;
- b. Using clean water with low chloride content for aircraft washing and rinsing (chloride content should be less than 400 parts per million, approximately the same limit as that for potable water);
- c. Regularly scheduled cleaning or wipe down of all exposed unpainted surfaces, such as landing gear struts and actuating rods of hydraulic cylinders as specified by parent service organization directives, with a compatible fluid or lubricant;
- d. Keeping low-point drains open;
- e. Inspection, removal, and reapplication of corrosion preventative compounds (CPCs) on a scheduled basis;
- f. Earliest detection and repair of damaged protective coatings; and
- g. Using padded panel racks to store panels/parts for aircraft and equipment during maintenance and using protective measures to prevent abrasions/scratches resulting from placement of parts, tools, or tool boxes on wings, fuselage or other aircraft surfaces.

2-5. AVIONICS PREVENTIVE MAINTENANCE PROGRAM.

2-5.1. PROGRAM REQUIREMENTS. Successful avionic cleaning and corrosion prevention/control efforts depend on a coordinated, comprehensive preventive maintenance program. Everyone involved in maintenance, repair, and operation of avionic systems must be concerned with corrosion, cleaning, inspection, prevention, and treatment. Specifically, avionic corrosion prevention/control is everyone's responsibility. Each command must place special emphasis on the corrosion

control program and lend their full support. This ensures the program receives sufficient priority to be accomplished along with other required maintenance. The goal of a preventive maintenance program is to halt corrosion before significant decline in equipment performance occurs. As such, it is important to recognize the difference between prevention of corrosion and repair of damage caused by corrosion. A preventive maintenance program at the Organizational/Unit and Intermediate Maintenance Activities should:

- a. Reduce the maintenance time spent repairing corrosion damage.
- b. Improve avionic system reliability, durability, and service life.
- c. Make the military avionics community aware of the extent of the problem.
- d. Report any deficiencies with materials and processes associated with corrosion control.

2-5.2. APPLICABLE GUIDELINES. All activities responsible for the maintenance of military aircraft and avionic systems shall establish a corrosion prevention/control program. The type of program depends on the conditions or environments to which the aircraft/avionic systems are exposed. Those aircraft and avionic systems exposed to salt-air and tropical environments require the most stringent corrosion prevention and control programs.

2-5.3. MAINTENANCE FUNCTIONS. Experience has shown that all activities have a corrosion problem. This is regardless of whether the equipment is an installed avionic system, ground support equipment, or missile system. Accordingly, corrosion control efforts by all hands is mandatory. This must be a day-to-day requirement to prevent corrosion before it starts. Figure 2-2 depicts the basic maintenance functions.

2-6. CORROSION CONTROL PROGRAM. All activities responsible for aircraft maintenance shall establish corrosion control programs as required by the parent service organization. This program shall be structured as required by OPNAVINST 4790.2 (Navy), TO 00-20-1 (Air Force), or AR 750-59 (Army) and ensure that personnel receive hazardous material/waste handlers training. The type of program depends upon the environment to which the aircraft may be exposed. At sea, where conditions are normally the most severe, aircraft are exposed to salt spray, ship stack gases, and

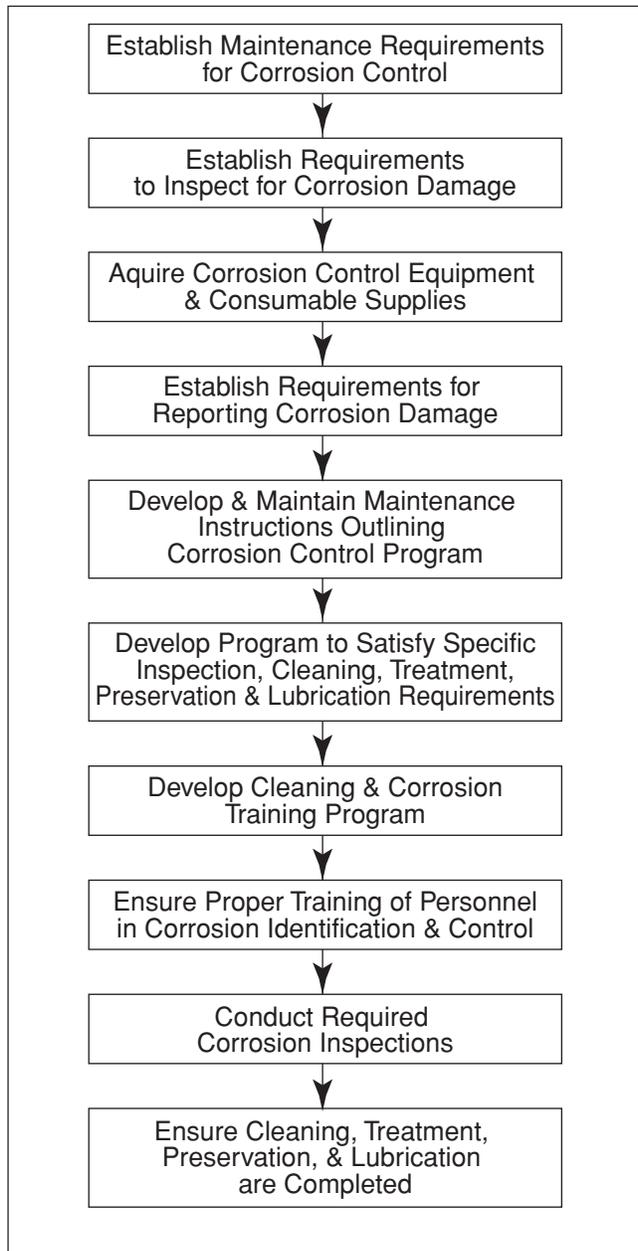


Figure 2-2. Basic Maintenance Functions

aircraft engine exhausts. Land-based aircraft may be exposed to industrial gases, salts, rain, mud, and, near salt water, mists containing sea salts. A comprehensive corrosion control program shall consist of either a Corrosion Control Work Center or a Corrosion Control Team with personnel trained in the prevention, early detection, reporting, and repair of corrosion damage. Such a program requires a dedicated effort by all maintenance personnel to prevent corrosion before it starts. These efforts will improve the operational readiness of equipment and minimize costly repairs.

2-6.1. TRAINING. Personnel performing maintenance on aircraft shall be trained in basic corrosion control skills as established by the parent service organization. Personnel shall be fully aware of the reasons for the corrosion control program. Without such training and understanding, further damage or additional problems may result.

2-6.2. TRAINING AND QUALIFICATION REQUIREMENTS. Personnel responsible for corrosion control maintenance and treatment shall receive the following training.

a. Supervisors and corrosion control personnel shall attend basic corrosion control courses established by the parent service organization.

b. Cleaning and repair personnel shall be trained in inspection, identification, cleaning, treatment, preservation, lubrication, hazardous material handling/hazardous waste disposal, and proper documentation reporting.

c. Supervisors shall ensure maximum use of in-service and on-the-job-training.

2-6.3. MAINTENANCE. An effective corrosion control program shall include thorough cleaning, inspection, preservation, and lubrication, at specified intervals, in accordance with Volumes II and III of this manual. Check for corrosion damage and integrity of protective finishes during all scheduled and unscheduled maintenance. Early detection and repair of corrosion will limit further damage. When corrosion is discovered, treat corrosion as prescribed in Volumes II and III as soon as possible and use only approved materials, equipment, and techniques. Only affected areas shall be repaired. All maintenance personnel shall report corrosion promptly, in accordance with directives established by the parent service organization.

2-7. CORROSION-RELATED FAILURE DATA FEEDBACK.

2-7.1. Since corrosion prevention and control for aircraft and avionics is a continuing concern, it is vitally important that corrosion problems are properly reported. Problems can be corrected and improvements made to prevent reoccurrence in future equipment design. Identification of the specific causes and extent of corrosion problems is essential. Improved equipment performance and maintenance assistance (personnel, equipment, materials, and procedures) are dependent on this data.

NAVAIR 01-1A-509-1
 TM 1-1500-344-23-1
 TO 1-1-689-1

2-7.2. MAINTENANCE AND READINESS DATA COLLECTION. All activities using this manual are required to use the current maintenance data collection system(s) of the parent service organization. This will enable a record of corrosion-related failures to be submitted to the appropriate technical services facility for analysis. Reporting personnel shall identify/report corrosion discrepancies in accordance with OPNAVINST 4709.2 (Navy), TO 00-20-2 (Air Force), or DA PAM 738-750/DA PAM 738-751 (Army).

2-8. SAFETY. Safety is everyone's business and concern.

2-8.1. RESPONSIBILITY OF SUPERVISORS.

2-8.1.1. Work center supervisors shall receive the following training in accordance with parent service directives:

- a. The recognition and elimination of hazards;
- b. Occupational safety and health;
- c. The safety of the individual;
- d. Accident investigation and reporting; and
- e. The inspection and maintenance of personal protective equipment (PPE).

2-8.1.2. Supervisors shall ensure that all corrosion control personnel are informed of:

- a. Current safety procedures;
- b. Characteristics of materials to which they will be exposed; and
- c. Required protective clothing to ensure safety of personnel.

2-8.1.3 In addition, supervisors shall ensure that an adequate supply of safety equipment is in a ready-for-issue condition, and that the personnel under their control are given, and use, appropriate protective equipment to prevent accidents, injuries, and occupational illness.

2-8.2. RESPONSIBILITY OF PERSONNEL. Maintenance personnel shall use appropriate equipment while exposed to hazardous conditions, and shall report to the supervisor any protective equipment that is bro-

ken, damaged, defective, or inadequate. No one shall use protective equipment that is not in a satisfactory and serviceable condition. Personnel shall comply with occupational safety and health requirements, including medical examinations, respirator training and fit testing, and use of protection for eyes, ears, head, skin, and feet.

2-8.3. MATERIALS HANDLING. Many of the materials and procedures outlined in this manual are potentially hazardous to personnel and potentially damaging to aircraft, especially with improper use. When using any chemicals, such as paint removers, detergents, conversion coatings, and solvents, follow the correct procedures with appropriate protective gear to prevent personnel injury and aircraft damage. Read the appropriate warnings and cautions in this manual prior to use of any hazardous materials. Misuse of certain materials can damage parts or cause corrosion which may lead to catastrophic failure. Refer to DoD 6050.5-LR, Hazardous Materials Information System, or the appropriate parent service organization documents for the handling, storage, and disposal of hazardous materials. Refer to local directives and policies pertaining to hazardous waste management. When in doubt, contact the local safety office, industrial hygienist, bioenvironmental engineer, or regional medical center.

2-9. MATERIALS.

2-9.1. Consumable materials and equipment listed in Volumes IV and V shall be used for corrosion control. These materials and equipment have been approved only after extensive testing to prove their ability to perform properly and effectively without damaging any of the metallic or nonmetallic materials used in aircraft.

2-9.2. Only those materials listed in this manual shall be used for cleaning or corrosion control of aircraft components. When several methods or materials are listed, the preferred one is listed first, with alternates following. Materials listed in other manuals shall be used only when required procedures are not covered by this manual. When approved materials are not available, substitutions shall only be made by the appropriate Aircraft Controlling Custodians (ACC) or System Program Manager (SPM).

2-9.3. Materials or processes considered to be an improvement over existing ones, after local laboratory analysis and evaluation, shall be forwarded to the Aircraft Controlling Custodians (ACC) or System Program Manager (SPM) for submission to the parent service organization for further evaluation.

APPENDIX FF
Storage Container Dimensions and Quantities

Storage Container Dimensions and Quantities

Container ID	Dimensions	Total Quantity
ISU 90s	8'9" X 7'	24 Total
FOX BOX	8'5" X 27'	7 Total
SEA LAND	10' X 40'	4 Total
Arms Storage	8' X 19'11"	2 Total
SPAMS	7'10" X 18'9"	4 Total

APPENDIX GG
Security Requirements

CAM Regulation 190-1

**DEPARTMENT OF THE ARMY
FORT CAMPBELL INSTALLATION
39 Normandy Boulevard
Fort Campbell, Kentucky 42223-5617
1 July 2008**

**Physical Security
Fort Campbell's Physical Security Program**

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CHAPTER 1: General

1-1. Summary

This regulation—

Establishes the Fort Campbell Physical Security Program. This program is part of the Installation Force Protection Program. Provides supplemental guidance to DA physical-security publications. Must be used with AR 190-5, AR 190-11, AR 190-13, AR 190-16, AR 190-51, AR 525-13, DA Pamphlet 190-51, DA Pamphlet 710-2-1, CAM Reg 190-5, CAM Reg 525-13, CAM Reg 700-2, CAM PAM 1-201, and DOD Reg UFC 4-010-01 / (02)

1-2. Applicability

This regulation applies to any element or component of the Department of Defense, whether assigned, attached, or supported by Headquarters, 101st Airborne Division (Air Assault) and Fort Campbell, Kentucky. This regulation does not authorize methods of operation or requirements outlined or specified by higher command to be changed in any manner. In the case where this regulation may conflict with a higher command's requirement or regulation, the more stringent standard of the two will apply. Questions concerning the applicability and interpretation of contents should be referred to the Physical Security Office, Directorate of Emergency Services.

1-3. Supplementation

Supplementation of this regulation is prohibited without approval of Director, Emergency Services. Commanders will not deviate or supplement this regulation.

1-4. Suggested Improvements

Users are invited to send comments and suggested improvements, through established command channels, on DA Form 2028 (Recommended Changes to Publications and Blank Forms) to Director, Emergency Services, Attn: Chief, Physical Security.

1-5. Distribution

Intranet.

Chapter 2: Security of Arms, Ammunition, and Explosives (AA&E)

Section I

Commanders and Custodians of AA&E

2.1.1. Arms room Standing Operating Procedures (SOP)

Commanders are responsible to provide written guidance/special instructions for the protection and accountability of Arms, Ammunition, & Explosives (AA&E)/Sensitive Items (SI) that are stored in AA&E facilities. The unit AA&E SOP at a minimum must address the following:

- a. Must be approved and signed by the current Commander.
- b. Duty responsibilities for:
 - (1) Armorers. (Primary and Alternate).
 - (2) Unit Arms Room Officers.
 - (3) Arms Room Key & Lock custodians (Armorers are prohibited from this duty).
 - (4) Inventory Officers (Monthly PBO).
- c. Individual responsibility for AA&E during operational and field training conditions.
- d. Security of AA&E stored or mounted on vehicles and aircraft.
- e. Instructions for timely submission of Serious Incident Reports (SIR) refer to AR 190-45 and CG Policy Letter# 16.
- f. Reporting procedures for all losses (actual or suspected) or recoveries of AA&E/sensitive items (PMO must be notified within 2 hours).
- g. Security of AA&E/SI for medically evacuated personnel during training.
- h. Specific procedures for posting an armed guard (with firearm and like ammunition) in the event of IDS alarm failure and Higher Force Protection Conditions (FPCON). Personnel are required to be briefed and sign a statement on the use of deadly force IAW AR 190-14.
- i. Use and completion of required forms, ie., FC Form 2171, alarm test memo, DA Form 3749, MAL, etc.

2.1.2. Duties and Responsibilities

a. Commanders.

All unit commanders will establish effective written procedures defining security responsibilities for receipt, utilization, and accountability of all government AA&E and Sensitive Items property within the unit under the following conditions:

- (1) Implementation of established written procedures, records, and compliance with regulations.
- (2) Establish controls within each subordinate unit/activity for periodic inspection and correction of deficiencies noted.
- (3) Conduct assessments/inventories to ensure accountability of property and adherence to required procedures.
- (4) Establish a training program for those personnel responsible for the accountability and security of AA&E and Sensitive Items.

b. Arms Room Officers.

(1) Commanders will appoint in writing an Arms Room Officer (E-6 and above) for each arms room under their command. Arms Room Officers will not be listed on the unaccompanied access roster and do not require a DA Form 7281 (Command Oriented AA&E Security Screening and Evaluation Record)

(2) Appointed arms room officer must conduct inspections/assessments of the arms room operational procedures pertaining to the security and accountability of AA&E to ensure that regulatory requirements are met or exceeded. At a minimum inspections will be conducted quarterly and written report is required. (The use of FC Form 4046, Figure 4-4 Security of AA&E Checklist meets this requirement).

(3) Arms Room Officers must be trained on Inventory/accountability of AA&E IAW AR 190-11 and this regulation. The Physical Security Office conducts monthly training at the Education Center on arms room operations that would be beneficial to newly appointed personnel. Units can schedule personnel through DTMS or by contacting 798-7587/0437 or 956-4346.

c. Armorers.

Only personnel who have been favorably screened utilizing DA Form 7281 will be allowed unaccompanied access to AA&E facilities/listed on the unaccompanied access roster. Armorers will be sub-hand receipted for all AA&E and sensitive items stored in the arms room from the unit CDR. Armorers will be familiar and enforce all applicable regulations (AR 190-11 & CAM Reg 190-1). Within six months of being appointed as Armorers, will attend the Installation Physical Security Class given monthly by DES (Contact DES at 798-7587 or 0437) or armorers can sign up through DTMS.

d. AA&E Key and Lock Control Custodians.

Only personnel who have a favorable screening on DA Form 7281 will be appointed in writing by the CDR as unit arms room Key & Lock Control Custodians. (Armorer are prohibited from this duty). The Key/Lock Custodian WILL NOT be listed on the Unaccompanied access roster. Alternate custodians are recommended. Custodians will be familiar with key/lock control procedures and will establish Key and lock control procedures IAW Paragraph 2.3.8 of this regulation.

e. Inventory Officers (Monthly PBO Sensitive Items).

Inventory Officers will be selected by the Commander. Inventory officers will be trained on proper inventory and documentation procedures. The monthly Weapons and Sensitive Items Inventory will be conducted by an NCO, Commissioned Officer, Warrant Officers, or DA Civilian equivalent. Armorer are prohibited from conducting/participating on these inventories. The same person is prohibited from conducting consecutive monthly inventories. See Paragraph 2.4.14 for specific responsibilities.

f. Unit Physical Security Officers.

Physical Security Officers (PSO) is required at all Command levels. Unit PSO will be appointed in writing by the CDR. PSO must be SSG/E-6 and above. PSO are required to conduct assessments/inspections of all unit AA&E facilities as directed by the CDR. PSO are required to enforce the Army's Physical Security Program. PSO and Arms Room Officers can be the same person.

2.1.3. Disciplinary actions

a. In accordance with the provisions and requirements of applicable laws and/or regulations, appropriate action will be taken with respect to the individual(s) responsible for any violations of the procedures and requirements imposed pursuant to this regulation. Failure to perform the requirements of this regulation provides a basis for disciplinary action under applicable law; e.g., MCM Article 92 or Article 108.

b. Violations of Federal criminal laws provide a basis for prosecution. Additionally, under the provisions of the Assimilative Crime Act, personnel not subject to the UCMJ may be prosecuted in the U.S. Magistrate Court and the U.S. District Court, as appropriate, for violations of any state laws, which are committed wholly or in part on the Fort Campbell military reservation. Violators may be cited on DD Form 1805 (United States District Court Violation Notice) by recording the specific paragraph or section of the Tennessee or Kentucky Penal Code that has been violated.

c. Personnel who experience a loss or theft of government-owned AA&E items while on the Fort Campbell reservation will report such loss/theft immediately (within 2 hours) to the Fort Campbell Police.

d. If a loss/theft occurs while participating in exercises (off the installation), (in a foreign country), or on (another installation), personnel responsible will immediately report such losses to the local authorities having jurisdiction and will then report the loss immediately to Fort Campbell.

e. Privately owned weapons will not be carried to field training exercises (FTXs) nor will they be carried or transported on unit deployments. The use of privately owned weapons by personnel other than general officers in the performance of their military duties is prohibited.

Section II Policy

2.2.1. Arms room Construction/Structure standards/DA Form 4604

Each unit arms room will have a current DA Form 4604 (Security Construction Statement) prepared/approved by a qualified DPW Engineer. A copy of the DA Form 4604 will be posted on the inside of each arms room. The DA Form 4604 will be updated every five years. Units can contact DES Physical Security for instructions on updating the form at 798-7587 or 956-4345/46.

2.2.2. Vault rooms/Use of the SF 700 (Security Container Check sheet)

SF 700 is required for all AA&E facilities that are secured with combination locks (digital or mechanical). A current SF 700 is also required for security containers/safes equipped with combination locks that store AA&E keys. Personnel completing the form will--

- a. Complete Part 1, Part 2, and 2a.
- b. The date of the combination change must be listed.
- c. List the first four persons (if applicable) to be notified in the event the container/vault is found open and unattended.
- d. Detach Part 1 and post on the inside of the vault door/drawer.

- e. Mark parts 2 & 2A with the highest classification stored in the container. (If applicable)
- f. Complete and detach Part 2A and insert in Part 2 (envelope). Issue this sealed copy (envelope) to the next higher S-2 for proper storage. (Recommend that a hand receipt or DA Fm 5513 be use to show transfer of document.)
- g. Combinations must be changed initially when vault/safe is put in service, annually, when there is a change in custodian or personnel, or when compromised.

2.2.3. Use of Standard Form (SF) 702 (Security Container Check Sheet)

The SF 702 will be used to record the opening and closing of AA&E facility as listed on the “note” below. SF 702 is no longer required for arms room facilities protected by an operational IDS alarm. The heading of each form will be completed. SF 702 is not required for separate NVD, ALSE storage facilities, however an SF 701 is required. The SF 702 or SF 701 if applicable will be maintained for at least 90 days.

Note: SF 702 is required for:

- a. Arms room without operational IDS alarm.
- b. All consolidated arms rooms (regardless if IDS is operational or not operational).
- c. All A&E Training bunkers.

2.2.4. Signs/Risk Analysis

- a. Local firearms laws: TN and KY state firearms laws will be posted on the exterior wall of the arms room.
- b. IDS Alarm signs: All alarmed facilities will have a permanent IDS Alarm sign posted by the exterior entrance door to each arms room where possible at eye level. Signs can be requested from the local DPW sign shop (798-5641/1200). A work order is required.
- c. Restricted Area signs: All AA&E facilities will have a permanent Restricted Area sign that contains the warning notice IAW AR 190-13, posted by the entrance door to all arms rooms where possible at eye level.
- d. Lautenberg Amendment Message: A copy of the HQDA. Message (dated 1720z May 2002) will be posted on the exterior wall adjacent to the arms room entrance door. The message is intended to alert CDR/Personnel that person(s) who have been convicted of domestic violence, will not be authorized to possess, carry, use firearms. The Lautenberg Amendment to the Gun Control Act of 1968, effective 30 September 1996, makes it a felony for those convicted of misdemeanor crimes of domestic violence to ship, transport, possess, or receive firearms or ammunition. The Amendment also makes it a felony to transfer a firearm or ammunition to an individual known, or reasonably believed, to have such a conviction. Soldiers are not exempt from the Lautenberg Amendment.
- e. Risk Analysis (DA Form 7278-R): All arms rooms are Mission Essential Vulnerable Areas (MEVA) and Restricted Areas (RA) and require Risk Level Worksheets (DA Form 7278-R). This form will be updated every 3 years and maintained in unit files, refer to AR 190-51, Chap 2 and DA PAM 190-51, Chap 2 for form completion. The analysis will be conducted by the unit Physical Security Officer (PSO) or Arms Room Officer jointly with the unit, using DA Form 7278-R in conjunction with DA PAM 190-51. Unit PSO may contact the Installation DES Physical Security Office (PSO) for assistance.

2.2.5. Inspection Requirements/Ratings/Definitions

- a. Arms room inspection ratings: Inspections will be conducted by a credential-bearing inspector every 18 months for arms storage facilities; this includes NAF weapons storage areas. Arms Rooms will be rated as “Adequate” or “Not Adequate”. A rating of “Not Adequate” will be given based on:
 - (1) One major deficiency.
 - (2) Five or more minor deficiencies.
 - (3) Any recurring deficiency from a previous inspection that is correctable at unit level.
 - (4) Failure to submit required work orders in a timely manner, for deficiencies that cannot be corrected at unit level.
 - (5) Arms room that failed their initial inspection and failed to reply within the 45 day suspense (listed in Block# 12 of the DA Fm 2806-1-R).
- b. Inspections/inspectors.
 - (1) The Physical Security Office has the authority and is required to inspect all AA&E facilities, forward ASP sites, ranges, and the transit/movement of AA&E to include control, accountability, and security on an unannounced basis.
 - (2) Reports of these inspections will be forwarded through command channels to the unit Commander.

Note: The Installation Commander under, AR 190-13, Paragraph 2-12, requires a report of action taken to correct all Not Adequate findings/deficiencies. Commanders will formally reply in writing indicating corrective actions

taken to correct findings/deficiencies for all Not Adequate ratings to the Director, DES, ATTN: Physical Security Office (PSO) within the 45-day suspense. Once that document is received, Units will coordinate with the PSO (798-7587 or 956-4345) to schedule re-inspections. The re-inspection for AA&E facilities must occur within 180 days of the initial inspection IAW AR 190-11, Para 2-6. Any recurring deficiencies noted on a re-inspection will result in the unit being rated as not adequate and reported as not adequate until their next scheduled physical security inspection.

- c. Arms Room Standards/Arms room inspection definitions.
 - (1) Major Deficiencies:
 - (a) Structural deficiencies not covered by a valid waiver or exception.
 - (b) Loss of accountability of weapons/ammunition and SI.
 - (c) Loss of accountability of arms room keys.
 - (d) Any deficiency that constitutes a major breach of arms room security (includes administrative errors that ultimately affect the security/accountability of arms, ammunition, and explosives (AA&E), poor operating procedures, or missing documentation).
 - (e) Sharing PIC codes.
 - (f) Failure to change combinations as required for arms storage vault doors or sharing combinations with unauthorized personnel.
 - (g) Storing ammunition or explosives in the arms room without proper authorization/documentation.
 - (h) Failure to meet the requirement for continuous surveillance of the arms room by an armed guard, duty personnel (personnel authorized unaccompanied access), or protection by IDS.
 - (i) A recurring deficiency when corrective action is within the means of the unit.
 - (2) Minor Deficiencies: Regulatory deficiencies noted in all other areas not covered in paragraph 2-5c above.
 - (3) Observation: A condition (where regulatory guidance is nonexistent or is unclear), which constitutes a weakness in the security posture.
 - (4) Note/Comment: Describes conditions/actions, which affect the overall security, e.g. description of waivers/exceptions and the fact that compensatory measures were fully implemented by the unit. MFR signed by Commanders do not negate the deficiency.

2.2.6. Personnel Training requirements

Only trained and competent personnel will be assigned duties involving the control and inventory of AA&E and Sensitive Items. The Commander has the overall responsibility to ensure that personnel are properly trained, develop training requirements and pro-active measures to ensure the safeguard of all AA&E/Sensitive Items.

2.2.7. Unaccompanied Access Rosters

- a. Each unit arms room will have only one current unaccompanied access roster which is approved and signed by the responsible Commander.
- b. Unit commanders and activity, facility, or office directors must provide the installation ICIDS Administrator (building 2704, telephone 798-1222/1225, fax 798-1223) current and updated access rosters for their respective alarmed areas. Copies of the access rosters will be issued to the SDNCO and S-2. Prepare an access roster IAW Figure 2-1.
- c. This roster must be protected from public view (posted inside the arms room/AA&E facility).
- d. Personnel not listed on the unaccompanied access roster are prohibited to enter arms rooms for the purpose of drawing/returning weapons/sensitive items.
- e. Personnel being escorted by the armorer will NOT be left unsupervised in the arms room.

2.2.8. Personnel evaluation/DA Form 7281, Command Oriented Arms, Ammunition, and Explosives (AA&E) Security Screening, and Evaluation Record (for unaccompanied access to arms and/or ammunition storage facilities/areas, and AA&E Keys)

- a. DA Form 7281 must be completed prior to personnel being appointed as the key and lock custodian, other personnel involved in the control, issue, and receiving of AA&E.
- b. Completed forms will be maintained on file in the arms room as long as the individual is authorized those duties. Personnel will be re-screened every three years.
- c. This form must be completed in the sequence listed (see sample at Figure 2-2). The processing of Section IV (Provost Marshal), of DA Form 7281 will be conducted at Bldg# 2704, DES Emergency Communications Center (ECC).
- d. In-coming Commanders are encouraged to review approval screening records/form from previous

Commanders. Continue to accept the form signed by the previous CDR as long as it is not expired. (Older than 3 years)

Section III

Physical Security Planning (*Consolidated AA&E/IDS/PIC/Guard Force Plans/Key & Lock Control*)

2.3.1. Arms room Bi-Lateral/Consolidated Storage Agreements

When more than one unit shares the same facility for the storage of AA&E, a formal written agreement will be prepared and signed by all Commanders. The agreement will address:

- a. Unit that has overall responsibility for the storage facility.(Host)
- b. Maximum quantities to be stored. (Per tenant unit)
- c. Physical safeguards to be used. (Racks, locks...etc)
- d. Frequency of, and the responsibility for issuing/receiving, physical inventories or reconciliations.
- e. Reporting of losses for investigations.
- f. Key and lock control procedures.
- g. Procedures for authorization and identification of individuals to receipt for physically taking custody of AA&E.
- h. Risk categories of items to be stored.

2.3.2. Intrusion Detection Systems (IDS)/Alarms

All unit level arms rooms will be protected by at least two types of alarm sensors (Balance magnetic and volumetric sensor such as passive infrared). A&E bunkers that store CAT I and CAT II A&E munitions require only one type of sensor. The Integrated Commercial Intrusion Detection System (ICIDS) is the approved alarm system on Fort Campbell.

2.3.3. Alarm activations

The following procedures will be initiated upon alarm activation:

- a. An alarm received during normal duty hours, monitoring point personnel will immediately inform the unit/activity concerned and request they conduct a security check of the affected area. The name and rank/title of the person conducting the security check will be provided to the alarm monitoring point personnel. If a security violation is observed or suspected, the Ft Campbell Police will be notified immediately. If no security violation is found, the unit will ensure authorized unit personnel reset the alarm.
- b. The Fort Campbell Police and unit SDO/SDNCO or activity representative will be notified of all alarms received during non duty hours. If the area is determined to be secure and only one alarm was activated, the unit/activity representative may request alarm monitoring personnel reset the alarm. If the alarm is again activated, the unit/activity will be required to provide an individual on the unaccompanied access roster to enter the facility and reset the alarm.
- c. In the event of an alarm malfunction, i.e., power or mechanical failures, an armed guard (with firearm and like ammunition) is required to be posted in accordance with AR 190-11. Commanders will ensure persons who are armed receive special instructions on the use of deadly force in accordance with AR 190-14, Chap 3.

2.3.4. Alarm tests

All units/activities with AA&E/sensitive items storage facilities protected by ICIDS will conduct a monthly test of the alarm system. An individual on the unit's unaccompanied access roster will conduct the test by calling the alarm monitoring point (798-1221/1224), giving building number and zone number and the name of person conducting the test. The alarm-monitoring person will provide instructions on how to perform the test. After the test is completed, the person conducting the test will annotate the test results on a memorandum. Memorandums reflecting alarms tests will be IAW Figure 2-3 and maintained on file in the arms room for a period of one year.

2.3.5. PIN/PIC codes

Current and accurate unaccompanied access rosters are required to generate the Personal Identification Code (PIC) or Personal Identification Numbers (PIN) and verify all personnel with authorized access by the monitoring personnel. A PIC number is issued to individuals requiring unaccompanied access to alarmed areas; this PIC number will not be shared. Any individual found to have compromised his/her PIC number will be deleted immediately from the system and the unit/activity commander/director notified.

Note: The individual who compromised their PIC/PIN can not receive a new PIC/PIN until receipt of Commanders

Action is submitted to the Emergency COMMS Center, Bldg 2704.

2.3.6. Security breach of arms room/sensitive item storage areas

All units/activities with AA&E/Sensitive items will report security breaches to the PMO (798-7111 or 798-7112) SDNCO/CQ offices are required to maintain current notification rosters of each AA&E facilities.

- a. Actions taken in the event of actual breach:
 - (1) Notify PMO and Chain of Command.
 - (2) Detain suspect(s) until arrival of PMO/Ft Campbell Police.
 - (3) Notify Physical Security Office (798-7587 or 956-4345/46 duty hours only).
 - (4) Conduct a 100% by serial number inventory of all AA&E/Sensitive Items (SI).
 - (5) Record the Inventory. (Requires signature from CDR or representative)
 - (6) If nothing is missing, conduct a test of the alarm with the monitoring point, if test is successful then secure the arms room when instructed by the monitoring station.
- b. In the event of actual loss, missing or stolen AA&E and SI. Refer to Chapter 8 of this regulation.

2.3.7. Unit Guard Forces

- a. **IDS Failure:** In the event of IDS alarm failure in unit arms rooms that store CAT II Arms (fully automatic/burst type), and CAT I & II Ammunition & Explosives Storage areas/bunkers. The unit is required to immediately provide armed guard(s) with firearm and like ammunition. The type of weapon and ammunition quantity to be issued is determined by the CDR as addressed in the arms room SOP. All guard personnel will be briefed on the "Use of Deadly Force" IAW AR 190-14.
- b. **Security checks:** Designated personnel such as SDNCO and CQ are required to conduct security checks during non-duty hours of unoccupied alarmed CAT II arms rooms not exceed every 8 hours. All security checks will be recorded on SF 702 and or DA Fm 1594 (daily staff journal). Records of security checks will be retained in unit files for a minimum of 90 days.
- c. **Procedures for unsecure arms room:** If the arms room is discovered opened/unsecured, the SDNCO/or person will immediately post a dedicated armed guard on the outside of the door of the arms room and immediately report the discovery to the Ft Campbell Police, telephone 798-7111/7112/7113. Upon arrival of the Military Police, a 100% serial number inventory will be conducted using the PBO Sensitive Items copy. If discrepancies are discovered, the Ft Campbell Police will take charge of the arms room. If there is nothing missing, the duty officer/NCO will have the armorer retest the alarm system, record the test on memorandum, and secure the arms room. If the alarm system is not operable, the duty officer/NCO will place a dedicated armed guard at the entrance outside the arms room until the alarm is repaired or the weapons and sensitive items can be relocated to another secure arms room. The Physical Security Office will submit a report for arms rooms found unsecured to the next higher Command.

2.3.8. AA&E Key and Lock control/DA Form 5513 (Form dated SEP 06)

Only DOD approved padlocks will be used to secure AA&E racks/containers. Authorized locks for securing entrance doors to AA&E facilities are the S&G Model 833c High Security Padlock (HSP) with High Security Hasp; or Combination locks that meet (UL) Standard 768, Group 1. Example of a Group 1 is the S&G Group 1 Mechanical Combination lock. For information/ordering, refer to the DOD Lock Program at the below web address: Link for S&G Model 833c (key operated):

https://portal.navfac.navy.mil/portal/page?_pageid=181.5353098,181_5353127&_dad=portal&_schema=PORTAL

Link for Mechanical Combination lock:

https://portal.navfac.navy.mil/portal/page?_pageid=181.5340809,181_5344051&_dad=portal&_schema=PORTAL

- a. Use of DA Form 5513 (Key Control Register and Inventory)

DA Form 5513 will be used to record the issue, receipt of AA&E storage facility keys, and key inventories for continuous accountability. (Refer to sample Figure 2-4)
- b. Completion of DA Form 5513 (Key Control Register & Inventory).
- c. Personnel (Key Custodian) completing the form will--
 - (1) List all keys by serial numbers, their lock location and total quantity of keys for each lock. {Note, The High Security Padlock (HSP) has 3 keys, two operational and one maintenance key}
 - (2) The key custodian will update the DA Form 5513 when keys/locks are added or removed from the AA&E facility to reflect the change.
 - (3) Complete all information, when issuing or receiving returned keys information in the "Key Issue and Turn In" blocks TO INCLUDE DATES/TIMES.

(4). Maintain completed registers (DA Fm 5513) for AA&E facilities for one year.

(5) SDNCO/CQ completed registers recording the issues/returns of AA&E key containers will be maintained for a minimum of 90 days.

d. Security of AA&E keys and locks

The following procedures will be used by personnel responsible for the security of AA&E keys and locks. A two person control rule is required for access to AA&E keys. (For example; key container stored with SDNCO and key that opens the container maintained by unit OPNS, 1SG, etc.) Armorer will make contact with two different persons for total access to AA&E keys. Under no circumstances will the locked sealed container and the key that opens the locked container be issued by the same person. These containers will be stored separate from other administrative-type keys.

(1) Commanders will appoint in writing an arms room key and lock custodian. (DA Fm 7281 is required). (Armorer and other personnel listed on the unaccompanied access roster are prohibited from this duty)

(2) Both the primary and alternate sets of AA&E keys will be separately maintained from other keys in the following manner:

(a) The primary and alternate sets of keys will be maintained in separate locked containers or sealed envelopes (alternate set) with controlled access.

(b) The primary arms room keys (when not in use) will be placed in a locked metal container and secured with a DOD approved padlock at the end of the duty day. The locked/sealed container will be signed in/out to the battalion SDO/SDNCO on DA Form 5513.

(c) The key to the locked container securing the arms room keys will be incorporated into an admin key control system (DA Fm 5513) and signed out/in to authorized personnel. The key that opens the key container will not be personally retained.

(d) Keys and containers will not be stored in the same container with classified material. (Segregated in individual drawers is acceptable) The primary and alternate set of arms room keys will not be stored in the same container. The armorer may (for short periods i.e. lunch break or equipment turn-in) secure the locked key container inside a safe of at least 20 gauge steel that is secured with a low security padlock or combination lock (1SG or Commander Safe). Containers do not need to meet the 500 LB rule as long as the container/safe is located in a secure room or under continuous surveillance. Keys to the arms room/storage area will not be removed from the battalion area.

(e) The transfer of arms room keys between armorers will be recorded on DA Form 5513.

(f) A single diagonal signature for multiple key/lock issues is prohibited.

(g) The use of master/keyed alike locks (lock sets) in AA&E facilities is prohibited.

(h) Combinations padlocks are prohibited for the security of AA&E/Sensitive Items containers/racks.

e. The arms room key and lock custodian will ensure that:

(1) The arms room key/lock custodian will inventory the AA&E keys, initially, semi-annually or when there is a change of custody and record the results on page#2 of the DA Form 5513. Inventories and completed DA Form 5513s will be maintained on file for a period of one year.

(2) Only the appointed key/lock custodian is authorized to add or remove keys/locks from the AA&E/arms room key control system.

(3) AA&E keys will be only issued to authorized personnel on DA Form 5513, The form will be properly completed.

(4) Any changes in the status of locks and keys will be documented (MFR required, signed by the Key Custodian).

(5) Retain inventory records and completed DA Form 5513 registers for one year.

(6) The Key/lock custodian will issue the Primary arms room keys to the senior armorer on a DA Form 5513. (This is a one time initial issue.)

Note: If armorer is going on Leave, TDY, etc for longer than 30 days, the Key Control Custodian will have the Alternate Armorer sign for the arms room keys. (One time)

(7) The Key/lock custodian will Issue the Alternate set of arms room keys (one key to each lock of the primary keys to include the maintenance key to the high security padlock) (in sealed envelope or locked container) to the next higher S-2 on DA Form 5513 (One time initial issue) The container will then be placed in a lockable container; e.g., a safe. The Unit Key/lock custodian is solely responsible to conduct the semi-annual inventory of both primary and alternate keys.

Note: The interior gate key and escape key is not to be included into the arms room key control system as they are not part of the barriers of protection.

f. Lost/stolen keys and locks.

When a key to a lock used to secure AA&E is determined missing or stolen, the affected lock will be replaced immediately with the necessary changes made on all records and forms. If keys are determined to have been stolen, the Military Police will be notified immediately.

g. Replacement locks.

Replacement or reserve locks are authorized and will be incorporated into the arms room key control system with the keys/locks issued to authorized personnel by the appointed AA&E Key Control Custodian. The locks will be secured in a locked container (stapled) or secured to the chain securing the weapons racks inside the AA&E facility to prevent unauthorized removal.

Section IV Protection of AA&E

2.4.1. Arms Room Security Lighting

Interior and exterior lighting is required for all AA&E facilities. The light switch will be inaccessible to unauthorized personnel. Newly constructed arms room facilities are equipped with a dedicated ceiling light and do not require protective mesh or screens. If the arms room is located within another secure room, the entrance door to the secure room will be illuminated.

2.4.2. Arms Racks and Security Containers/Modifications & Certifications/Chains

All arms racks and security containers in use to secure AA&E/Sensitive Items will be TACOM approved NSN equipment. Locally fabricated arms racks/containers will require approval and certification from the local TACOM LAR Office. Exception are metal standard issue wall lockers do not require certification, as long as exposed screws/pins are rendered inaccessible from disassembly from the exterior. All arms racks/containers with an empty weight of 500 lbs will be chained, bolted together to accumulate 500lbs and secured with DOD approved padlocks. Certification numbers issued by the LAR will be visibly displayed on the modified racks/containers. Chains used to secure racks or containers will be of heavy-duty, hardened steel chain, welded, straight-link steel. The steel will be galvanized of at least 5/16-inch thickness or of equal resistance required to force, to cut, or break an approved low security padlock. An example of such a chain is Type 1, Grade C, Class 4 NSN 4010-0-149-5583.

2.4.3. Privately Owned Weapons & ammunition

Commanders may authorize the storage of Privately Owned Weapons (POW) in the arms room, under the following conditions:

- a. Firearms registered with DES at the Gate# 4 Vehicle & Weapons Registration Center (Copy of registration maintained with POW).
- b. POW ammunition limited to 100 rounds per POW.
- c. POWs will be secured separately from military weapons/ammo.
- d. POWs and their ammunition will be signed in (initial entry) and accounted for at all times on the FC Form 2171.
- e. A written authorization is required from the CDR, before a POW can be removed from the arms room.
- f. POWs and their ammo will be inventoried in the same manner as military AA&E. (Written in on the last page by quantity, type, caliber, serial number on the Monthly Sensitive Items inventory.
- g. A DA Form 3749 (Equipment receipt) will be prepared for each POW and issued to the POW owner as required.

Note: All non firearms to include BB guns, paint ball guns, bows, knives with a blade over 4 inches do not require DES registration. Refer to Chapter 9 of this regulation for further guidance.

2.4.4. Commercial weapons & ammunition/(AAFES)

Commercially owned weapons/ammo are not authorized for storage in military arms rooms.

2.4.5. Contract Guard weapons & ammunition

Contract guard weapons and their ammunition if authorized for storage in military arms rooms will be accounted for and secured like military AA&E. (Unless specified in the written contract.)

2.4.6. Demilitarized War Trophies (DEWAT)

Non firing DEWAT items that are authorized for unit storage will be secured and accounted for as directed by the responsible CDR. If DEWAT items are stored inside the arms room, they will be accounted for and inventoried in

the same manner as military AA&E.

2.4.7. Foreign Weapons & Ammunition

Fully functional (firing) foreign weapon(s)/AA&E for operational, training requirements, or intelligence purposes, will be accounted/inventoried and stored like military AA&E. Prior registration with IPBO/DPBO is required and unit will be required to have functional AA&E permanently listed in the unit's PBO Sensitive Items hand receipt. Note: AA&E that has been temporary hand receipted to the unit by Pratt Museum; the unit will NOT permanently list them on their unit PBO hand receipt.

2.4.8. Use of FC Form 2171 (Weapons/Sensitive Items Register)

FC Form 2171 will be used to record the daily (when accessed) operational requirement inventory (visual count) and the issue/return of weapons and sensitive items. FC Form 2171 will be closed out at end-of-duty day not to exceed midnight/2400hrs if on continuous operation. Personnel completing the weapons/SI register form (refer to sample Figure 2-5) will—

a. AA&E/SI stored in locked containers that have a protective seal applied requires a joint inventory conducted by the armorer and Commander. This inventory will be recorded on a memorandum signed by both parties listing contents by type/nomenclature, quantity, serial number if applicable, and annotate the protective seal number used. Post a copy of this memorandum on the exterior of the locked/sealed container. The armorer conducting the daily when accessed and the person conducting the monthly sensitive items inventory are not required to break the seal, as long as the memorandum is validated by matching the protected seal number listed on the memorandum against the locked/sealed container. An entry in the remarks section of FC Form 2171 and PBO inventory will reflect the property as "validated by" protective seal # _____".

b. Personnel completing the weapons/sensitive register form (sample at Figure 2-5) will—

(1) Enter a single line entry with signature for each AA&E and other sensitive item that are signed out and in.

(2) Compare the last inventory from the previous day with the first inventory of the present day. Any differences in the inventories will be reported immediately. Should any discrepancies be noted, a joint inventory must be conducted by the individual opening the facility and an officer or NCO designated by the commander.

(3) If a change of custody of the AA&E/sensitive items storage container keys occurs, conduct a joint second or third inventory as required. (Transfer of arms room keys will be recorded on DA Fm 5513)

(4) Ensure the person accepting responsibility for the arms room and the contents prints his/her name and affixes his/her signature in the "Signature of Accepted Individuals" blocks of FC Form 2171 (see Figures 2-5 and 2-6) as accepting responsibility.

(5) All AA&E and additional items (authorized by the CDR) stored in the arms room, to include spare barrels, ammunition, bayonets, POWs, silencers, suppressors will be included in the daily inventories.

(6) Total block: Indicate the total quantity of AA&E/SI authorized by MTOE. The "In Arms Room" block and "Signed Out" block must add up to the "Total" block. (The total amount will be same as listed in the PBO Sensitive Items listing)

(7) Armorer(s) are authorized to conduct the daily closing number count (verifying official) of all AA&E and other sensitive items. This will be recorded on the FC Form 2171, by printing, signing their name and dating the form. Verify items not present in arms room, the armorer has supporting documents and items are properly signed out/in of the FC Fm 2171.

(8) Maintain properly completed FC Form 2171 on file for a minimum period of 90 days in order to establish a chronological inventory record. If a weapon or sensitive item remains signed out after 90 days, retain the form on file until the weapon/sensitive item is returned, signed back in on the same/original FC Form 2171 and until the next monthly weapons/ammunition inventory confirms the return.

(9) The FC Form 2171 in conjunction with Hand receipts or DA Fm 3749 will continue to be used for issue and turn-in of crew-served weapons regardless of the time the weapons are to be removed from the arms room.

(10) Weapons and other sensitive items that have been laterally transferred or are forward deployed will be accounted for on the FC Form 2171, until such property is deleted from the unit's PBO hand receipt.

c. Use of FC Form 2171 during deployments:

(1) Maintain original form (that list weapons/sensitive items issues) in the arms room. (A copy of the FC Fm 2171 should be taken with the deploying unit.)

(2) Create an additional column on the FC Form 2171 for property pending deployment. (That is still present in arms room. Example: (M4 R/D) and additional adjacent column would list (M4 DEP).

Note: RD=Rear Detachment; DEP=Deploying -currently present in arms room.

(3) Once deployed property has been deleted from the Rear DET hand receipt, the armorer can then drop the

count (deployed property) from the FC Form 2171. (An entry in the remarks block is required.)

Example of FC Form 2171 (Nomenclature block)

Type	M4 RD	M4 DEP	M68 RD	M68 DEP
In arms room	10	120	0	120
Signed out	0	0	0	0
Total	10	120	0	120

2.4.9. Master Authorization List (MAL)

The armorer is responsible to establish and maintain a current (hard copy) MAL for all assigned and unassigned AA&E and other sensitive items stored in the arms room. The MAL at a minimum will list the full name of the soldier, unit, serial number, and the number of the equipment receipt. The armorer when issuing weapons/sensitive items will compare the soldier's information against the MAL for proper issuance of equipment. The MAL should not be displayed where it is visible to the public.

2.4.10. Use of DA Form 3749/Issue and Turn in procedures

a. The armorer will prepare a DA Form 3749 (Equipment Receipt) for all assigned weapons and other assigned sensitive items. The signature of the bearer and approval signature from the CDR will be completed in ink. If a Change of Commander has occurred, continued to accept the DA Form 3749 as long as the soldier is assigned the same equipment. The loss of a DA Form 3749 will be reported to the CDR immediately. Duplicate cards that are prepared will be marked/stamped with the words "DUPLICATE"

b. When individually assigned weapons are issued for 24 hours or less the turn-in of DA Form 3749 is required and will be retained in the arms room until the equipment is returned. An entry on the FC Form 2171 is not required.

(1) Assigned weapons will only be drawn by the assigned bearer of the DA Form 3749.

(2) The Turn-in of weapons will normally be made by the person to whom it was issued. Commanders will establish an SOP for emergencies. Crew served weapons may be turned in by any member(s) of the crew.

(3) AA&E issue over 24 hours regardless of duration period requires two tracking documents, example; signed out on FC Form 2171 and turn-in of DA Form 3749. Refer to the issue chart below.

Figure: Issue chart for AA&E and Sensitive Items

	MAL	DA Fm 3749	Hand Receipt	FC Fm 2171	Turn-in document	Maint Work Order
<24 Hr and Individually Assigned	X	X				
>24hr and Individually Assigned	X	X		X		
Assigned Crew served	X	X		X		
Unassigned	Note#1		X	X		
Turn-in/lateral transfer				X	X	
Maintenance				X		X
Assigned but no card on hand	X		X	X		

Legend:

X= Required

<= Less than

>= Greater than

Note#1: Validate that the weapon is unassigned as listed on the MAL.

2.4.11. Arming of unit armorers

The decision to arm the unit armorers (When on duty) with firearm and like ammunition lies with the Commander.

Under higher Force Protection Conditions (FPCON Charlie and Delta) unit armorers when on duty in the arms room will be armed with firearm and like ammunition. Note: arms rooms are MEVAs.

2.4.12. Security of armorer's Tools

Armorer's tools when stored inside the arms room will be secured in locked tool boxes or secured inside containers with DOD approved padlocks. At no time will tools, like hammers, crow bars, bolt cutters, and other large tools be left unsecured.

2.4.13. Security of (NON-AA&E), Bayonets, NVD, Lasers, Combat Optics, and Other high dollar items

a. In the absence of other secure areas, Commanders may authorize in writing the storage of Non-AA&E items inside the arms room. In this case, all non-AA&E items will be accounted for and secured in the same manner as military AA&E. This includes accountability on FC Fm 2171 by nomenclature, quantity, and added (in writing) on the Monthly PBO Sensitive Items "Working Copy" report by nomenclature, quantity, and serial number if applicable.

b. NVD, lasers, and other Combat Optics identification number plates tend to become separated from these devices. Serial numbers not embedded on the equipment will be permanently affixed by an alternate means, i.e., engraving, paint pen, etc.

c. When units are on FTX; NVD, Lasers, and optics will be secured and accounted for like weapons (included in sensitive items reporting).

2.4.14. PBO Monthly Sensitive Items Inventories

a. Units will use the current property book/sensitive items listing ("Working Copy") to conduct the monthly weapons/sensitive items inventory. The last 3 months of completed working copies of the inventories will be readily available in the arms room for inspections. Units will retain a two year history of these inventories in the supply room. (4 years if discrepancies noted/reported.)

b. An individual designated by the commander (Officer, CPL & above, Warrant Officer, or DOD Civilian appointed by the responsible officer) will conduct the inventory. The same individual can not conduct consecutive monthly inventories. The unit armorers are not authorized to conduct/participate in this inventory. The inventory Officer/NCO must review all supporting documentation for items not physically present during the inventory. (See Figure 2-7)

c. The disposition of weapons and sensitive items not present for inventory will be recorded adjacent to the items serial number. The following codes are recommended to record the disposition: (S/O) Signed Out, (M) Maintenance, (L) Lateral Transfer, or (T/I) Turn In. Armorers must provide documentation for items not physically present during the monthly sensitive items inventory.

d. A serial number inventory of all AA&E (including privately owned weapons and ammunition), military ammunition by lot number, bayonets, and any other item the commander has directed to be stored within the facility must occur.

e. The inventory Officer/NCO will record the results of this inventory on the "working copy". He/she will print, sign their name, list rank, and date the property book/sensitive items listing on the date the Arms Room weapons/sensitive items inventory was completed. Additionally, if inventory takes longer than one day, the inventory Officer/NCO will list the date the arms room inventory was completed.

f. Sealed containers will be inventoried by validating the protective seal number against the memorandum posted on the exterior of the container. Such containers will be checked for signs of tampering. The inventorying officer/NCO will record "as validated by protected seal# _____", adjacent the LIN.

2.4.15. Use of the FC Form 2170 (Unit Arms Room Weapons/Ammunition/Equipment Inventory Register)

Purpose:

a. This form is authorized for use to record inventories of the additional items (that are not permanently on PBO Monthly Sensitive Items listings) to include non-AA&E items stored inside the arms room. A copy of this form when completed and signed by the Inventory Officer/NCO will be attached to the Unit's PBO "Working Copy" and maintained on file in the arms room. See sample Figure 2-9.

b. This form can also be used to document/inventory property staying with Rear Detachment. Refer to Section VII (Transportation) of this regulation and sample Figure 2-8.

Section V

Protection of Ammunition & Explosives (A&E)

2.5.1. A&E Bunkers

Non-nuclear missiles, rockets, ammunition and explosives listed in Appendix B, AR 190-11 will be stored in approved Igloo/bunker storage facilities at the Fort Campbell ASP. Designated unit Training Bunkers are only authorized to store CAT III and CAT IV A & E. Units/activities will establish and maintain a current SOP.

2.5.2. Security Requirements for CAT I and CAT II A&E

- a. Requires an IDS Alarm (one type on sensor) or requires continuous surveillance by armed guards. IDS alarms will be tested monthly with the Emergency Communications Center (798-1221/24). Alarm records will be maintained in unit files for 1 year.
- b. Key & lock control will be IAW Section III of this regulation. Note: If A&E stocks are segregated in locked cages/containers inside the bunker, these keys will be incorporated into an admin key control system. Keys will NOT be personally retained.
- c. Requires unaccompanied access roster and supporting DA Form 7281 for each personnel listed.
- d. SF 702 is required to record entry/exit and guard security checks.
- e. After duty hours guard checks are required not to exceed every 8 hours. Retain records on file for 90 days.

2.5.3. Security Requirements for CAT III and CAT IV (Including TNG Bunkers)

- a. IDS alarms are not required.
- b. Key & lock control will be IAW Chapter 3 of this regulation. *Note:* If A&E stocks are segregated in locked cages/containers inside the bunker, these keys will be incorporated into an admin key control system. Keys will NOT be personally retained.
- c. Requires unaccompanied access roster and supporting DA Form 7281 for each personnel listed.
- d. SF 702 is required to record entry/exit and guard security checks.
- e. After duty hours guard checks are required not to exceed every 48 hours. Retain records on file for 90 days.

2.5.4. Security of Field Level Munitions Storage Areas (FLMSA)/Field ASP

- a. FLMSA:
 - (1) All Field Level Munitions Storage Areas will be designated by the CDR and used for temporary storage during a field training event. After firing the FLMSA can be used to reconcile the munitions prior to turn-in.
 - (2) All FLMSA will be guarded by armed guards at all times regardless of the FPCON.
 - (3) FLMSA facilities will be secured with High Security Padlocks when not in use.
- b. Field ASP/FARP (OPEN STORAGE): Field ASP will meet same requirement as for FLMSA
 - (1) Access will be strictly controlled. The 2-person rule will apply to Category I missiles and rockets at these locations.
 - (2) Perimeter barriers, either temporary or permanent, must be placed to preclude unauthorized entry into the storage area.
 - (3) Storage areas will be posted as a restricted area.
 - (4) Armed guards will be posted to control entry, to protect CAT I through CAT IV A&E and in the event Category I missiles and rockets are stored there, to enforce the 2-person rule. The guards will be equipped with a primary and alternate means of communications (A dedicated cell phone may be used as secondary means). At a minimum, armed guards will be checked every 4 hours by an individual appointed by the commander.
 - (5) Positive measures (for example, security lighting or additional guards so that visibility between guards is maintained and so on) will be implemented during hours of darkness or reduced visibility.
 - (6) Accountability procedures will be established.
 - (7) Category I missiles and rockets stored in open areas are vulnerable to theft. The responsible commander should consider placing these Category I missiles and rockets in either an approved container (MILVAN, SEAVAN, or CONEX), or in a totally enclosed storage building. The following additional PS measures apply if the container or building is used:
 - (a) Doors will be secured with 2 approved medium security or low security locks.
 - (b) Access to, or possession of, both keys to the building by 1 person is prohibited.
 - (c) A key control system will be established so that no 1 person will be allowed to have access to keys to installed A and B locks.

(8) Commanders of units that routinely deploy for field training and live firing should consider having the support engineer activity construct a storage building to be used at the FLMSA. This building need not meet the minimum construction standards for Category I storage buildings in this regulation (earth covered), but should provide a degree of security necessary to enforce 2-person access and provide shelter from the weather. A Type 2 outdoor magazine may also be used as a temporary storage structure.

(9) When more than 1 unit uses the same area, stocks will be separated and identified by unit. One unit will be designated as responsible for the security of the entire area, including access control.

2.5.5. Portable Armories

Portable/deployable armories are authorized for the storage of Category II through IV arms provided they are built to U.S. Government specification (Naval Surface Warfare Center (NSWC) 3046-93.2. Each portable armory will have a current DA Form 4604 that includes the serial number of the armory vault.

2.5.6. Ammunition and Explosive (A&E) Amnesty Policy

The amnesty program is intended to ensure maximum recovery of military ammunition and explosive outside the supply system. It is not intended to circumvent normal turn-in procedures.

a. Commanders will--

(1) Establish and implement a program that does not intimidate the individual from freely turning in ammunition. Amnesty containers will be located in an area that is accessible 24/7.

(2) Commanders will monitor the amnesty program by appointing person(s) to inspect the container at least monthly. The keys that secure the amnesty container will be maintained/controlled in a key control system.

(3) Brief unit personnel semiannually on policies and procedures of the amnesty program.

(4) Monitor the program to ensure units do not abuse it in lieu of proper ammo turn-in procedures.

(5) Post the location and telephone number of the nearest turn-in point and provide directions to anyone (military or civilian) who wants to turn-in under the program.

(6) Develop Standing Operating Procedures (SOP) detailing specific functional responsibilities and explosives safety handling requirements.

b. Soldier(s) will only recover .50 caliber ammo and below for turn-in at the nearest amnesty container.

Ammunition above .50 caliber or explosives procedures are:

(1) Identify exact location where ammunition/explosives are found.

(2) Secure area as best as possible.

(3) Notify Ft Campbell Police at 798-7111/12/13. (They will determine if EOD is required.)

(4) Notify your chain of command and SDO/SDNCO.

(5) Safety First.

c. Amnesty containers: Amnesty containers will be of at least 26-gauge steel and secured with a DOD approved padlock. Containers will be affixed to a fixed structure to prevent unauthorized removal/pilferage. The hole/opening will not be greater than one inch in diameter.

2.5.7. Operational "Guard" ammunition (Not training)

Each arms room is authorized to store limited amount of "Operational" guard ammunition (5.56mm Ball, 9mm Ball, or .45 Cal) for the purpose of arming a guard(s) in the event of AA&E storage facility IDS Alarm failure. The quantity of ammunition stored will be based on "operational necessity" and will not exceed 100 pounds of Net Explosive Weight (NEW).

Maximum quantities allowed for storage in arms rooms:

26,385 rounds of 5.56mm ball, M855 (DODIC A059) is 100 pounds of NEW.

109,769 rounds of 9mm ball, M882 (DODIC AA49) is 100 pounds of NEW.

128,205 rounds of .45 Cal ball, M1911 (DODIC A475) is 100 pounds of NEW.

Note: Combinations of the different ammunition calibers is authorized as long as the cumulative weight does not exceed 100 pounds of NEW.

The following measures are required:

a. CDR will authorize in writing the storage of "Operational" ammunition.

b. Operational ammunition (Not Training) will be requested by the unit's ammo section/supply section as appropriate.

c. Ammunition will be hand receipted to the armorer on DA Form 5515, or DA Form 3161, and on Armorers'

Hand receipt by DODIC, lot number, type, and quantity.

- d. Ammunition will be accounted/listed on the FC Form 2171 by type and quantity.
- e. Operational Ammunition (Not Training) will be permanently placed on the unit's PBO Sensitive Items hand receipt by DODIC, Lot number, caliber, and quantity.
- f. Operational ammunition can be placed in magazines; in this case the magazine will contain a red diagonal stripe. Note: At no time will loaded magazines be inserted in the weapon when stored inside the arms room.
- g. If Training ammunition is stored, the cumulative weight will not exceed 100 pounds of NEW. Stocks will be segregated by "training" and "operational" loads and accounted separately on the FC Fm 2171. Written guidance is required for the storage and duration of training ammunition being stored.
- h. Units on funeral Detail are authorized to store up to 1150 rounds of "BLANK" 5.56mm. Measures listed in item "b", "c", "d", and "g" listed above applies.

Section VI Disposal and Demilitarization

2.6.1. Military AA&E

- a. A report (transaction) for military arms by serial number will be made to DOD Central Registry upon the demilitarization of each arm.
- b. Ammunition: DRMO is not permitted to receive live ammunition. DRMO may receive inert ammunition components.

2.6.2. Disposal of abandoned & confiscated Privately Owned Weapons (POW) firearms:

Any POW (firearm) that is abandoned at the unit level will be disposed by:

- a. Contact Rock Island Army Depot for instructions at DSN 793-4780.
- b. Complete DD Form 1348-1 (DOD Single Line Item Release/Receipt Document) and assign a document number.
- c. Rock Island Army Depot will provide shipping instructions. Ship firearms via registered mail, return receipt requested. Ship to Anniston Army Depot, ATTN: SDSAN-DSP-PPC, Anniston, Alabama 36201. DSN: 571-6639.
- d. Clear firearms from (Vehicle Registration Office, by Gate# 4, telephone 798-5047) prior to shipment
- e. Disposal of non-firearm POWs, i.e., knives, martial arts weapons, etc.
 - (1) Unit will attempt to forward items to owner/next of kin.
 - (2) If above meets with negative results, after 60 days, the POW (non-firearm) will be destroyed and a memorandum for record signed by unit CDR will be retained on file for 90 days. (Example of knife; blade will be broken from the handle) (Any other non-firearm POW will be rendered in operable) exercise caution when performing the task.

Section VII Transportation

2.7.1. Unit Deployment from Home Station AA&E Inventories

Commanders are responsible to ensure that 100% serial number inventories are conducted prior to shipment of equipment. The following procedures will be implemented during periods of unit deployment from home station (off the installation):

2.7.2. 100% serial number Deployment inventory/procedures

- a. The unit will conduct a 100 % serial number inventory of all arms, ammunition, and other sensitive items prior to deploying unit's departure from home station.
- b. After the unit is uploaded, a responsible officer or NCO of the deploying unit and a responsible officer or NCO of the rear detachment, which has been added to the unaccompanied access roster, will conduct a joint serial number inventory of all items remaining in the arms room.
- c. The results of this joint inventory will be recorded on FC Form 2170 (Equipment Inventory Register) (sample at Figure 7-2) (the unit's PBO Hand receipt inventory form can be used in lieu of the FC Form 2170).
- d. A copy of the joint inventory will be given to the Rear Detachment Commander (RDC), and a copy left inside the deploying unit's arms room. Both Deploying and Rear Detachment inventorying officers are required to print, sign and date the inventory. These inventories will be retained until the Fwd deployed unit returns and both PBO hand receipts (Fwd Deployed and Rear DET) have merged and the next month's inventory reflects the merge.

e. AA&E Keys and locks will be transferred to the Rear DET AA&E Key custodian via DA Form 5513, who will then re-issue keys/locks to the armorer. Spare set/alternate keys will be issued to S-2 via DA Form 5513.

f. If arms room is not storing any AA&E/SI; leave the alarm in the “access mode”. The unit CDR is required to prepare/sign a written memorandum stating “no AA&E/SI being stored.” This memo will be provided to the Alarm Monitoring Point (Bldg # 2704) Tel# 798-1225. The arms room can then be secured with a DOD approved padlock.

g. Stay Behind Equipment (SBE) weapons/sensitive items should be consolidated to the greatest extent possible.

h. Retain the original copy (list of deployed property issued out) of the weapons/sensitive items register (FC fm 2171) in the arms room.

2.7.3. Redeployment

Activate arms room by:

a. Prepare unaccompanied access roster with completed DA Form 7281 (bring it to DES, Alarm Monitoring Point, Building 2704. For issuing of PIC, refer to chapter 3 of this regulation).

b. Validate arms room key/lock control system and update as necessary (Key/Lock Custodian, Inventories).

c. Change combinations on vault doors/safes as applicable.

d. Items left in the arms room at the time of deployment MUST BE accounted for, prior to re-introducing returning AA&E/SI. Conduct a 100% serial number inventory using the sensitive items listing or the FC Form 2170.

e. All returning weapons/sensitive items will be signed back in on the original copy of the FC Fm 2171.

2.7.4. In-transit Security of AA&E and NVD

Military AA&E and other sensitive items will be in the possession of the person to whom issued/signed out, at all times while in training or transporting on Fort Campbell. Military weapons/AA&E will NOT be transported in Privately Owned Vehicles (POV).

NVD(s) can be transported in POV if they meet the following requirements;

(a) Written approval from the first O-5 in the chain of command.

(b) NVD(s) transported by an NCO or above.

(c) NVD(s) will be signed in/out utilizing proper hand receipt procedures.

(d) NVD(s) will be in the possession of the assigned person at all times.

(e) NVD(s) will only be transported on-post directly to and from official duty locations.

2.7.5. Shipments on/off Fort Campbell reservation

All shipments of AA&E, both on and off the Fort Campbell reservation, will be conducted with the following security procedures:

a. Shipments of AA&E and NVD departing the Fort Campbell military reservation will be in compliance with the Department of Transportation regulations, AR 190-11, DTRM 55-135, and DOD 4500.76M. It is required that all shipments of AA&E and NVD be coordinated through the Installation Transportation Office, telephone 798-5678. Transportation of AA&E and NVD during unit deployments will be provided double barrier protection; e.g., in a locked container, inside a locked CONEX.

b. Refer to AR 190-11, Chap 7 and CAM REG 700-2 for Movement of AA&E

2.7.6. Temporary military vehicle

Any vehicle procured by the government whether rented/leased is considered a temporary military vehicle (validated by military travel orders) therefore authorized to be used in the transportation of military weapons. For off-post travel, units will coordinate with local Law Enforcement agencies.

Section VIII

Lost/Stolen Military AA&E and Other Sensitive Items

2.8.1. General

Sensitive Items: Those items identified in the Army Master Data File (AMDF) FEDLOG by a Controlled Inventory Item Code (CIIC) 1,2,3,4,5,6,8,9,N,P,Q,R,\$,Y, and Night Vision Devices. Refer to Fort Campbell Chart 47 (Listed on the intranet) is available as a pocket guide. When a weapon or sensitive item is lost/stolen, the senior ranking person at the scene must initiate the following actions:

a. Immediately notify the entire chain of command after discovering a loss/stolen sensitive item(s), notify the Ft Campbell Police (telephone 798-7111/7112) within TWO hours, update the Emergency Operations Center (EOC)

(798-6160) and the Division Staff Duty (798-9793) every two hours or as directed by the Incident Commander.

b. Immediately cordon off the scene of the loss/stolen item and assemble all personnel who had possible access to or responsibility for the missing item.

c. The IC retains approving authority for granting an amnesty period. However, Commanders must coordinate with Staff Judge Advocate, (SJA) prior to granting an amnesty period.

d. Initiate a detailed search, to include a complete inventory of weapons and other sensitive items. Seek advice from the SJA before inspecting personal areas or gear. Segregate personnel who may have knowledge of the loss/theft and make available these personnel to the CID or investigating officials.

f. Notify adjacent units regarding the incident to ensure they are aware of the incident and have not located the lost/stolen item.

g. The unit will remain in the field/location of the loss/theft until the weapon or sensitive item is found or the unit receives a release from the search by the Assistant Division Commander (Operations) or Assistant Division Commander (Support) based on recommendations of the major unit commander and the Provost Marshal.

h. Use the procedures outlined below in aiding your search.

(1) Search procedures:

(a) The senior person assumes the position of on-scene commander and initiates a search of the immediate area. He/she will notify the chain of command within one hour.

(b) A search party is formed (the size of the search party is determined by the unit commander and/or the chain of command). As a minimum, the areas searched should include the area from where the weapon or sensitive item was discovered lost/stolen to the last place it was accounted for.

(c) Refer to AR 190-45, Chapters 8 and 9 for SIR reporting requirements.

2.8.2. Sensitive Items

For purposes of this regulation, the following are considered sensitive items:

- a. Weapons (firearms).
- b. Ammunition/Explosives.
- c. All NVDs.
- d. Military radios.
- e. ANCDs/SOIs.
- f. COMSEC equipment (e.g., KY13, KY57, etc.).
- g. Any other item listed/coded in AMDF FEDLOG as a sensitive item.

2.8.3. Lost/Theft of AA&E Shipments

Transportation officers or their designated representatives will report all information, which concerns the loss/theft of AA&E/sensitive item shipments to the Fort Campbell Police.

2.8.4. Off-Post/Installation Loss/Theft of AA&E/Sensitive Items

Personnel who experience a loss/theft of government-owned AA&E/sensitive items while off the Fort Campbell reservation will report such losses/thefts to the local police and will then immediately notify the Fort Campbell Police of the loss. If participating in exercises off the installation, in a foreign country, or on another installation, personnel responsible will report such losses to the local authorities having jurisdiction and will then report the loss immediately to the Chain of Command and within 2 hours notify the local Military Police Desk.

Section IX

Privately Owned Weapons/Registration

2.9.1. Control of weapons/Conceal Carry Permits

- a. Purpose: To control firearms, weapons, and other dangerous items.
- b. Civilian firearm Conceal Carry Permits (CCP) are not authorized/approved on the Fort Campbell Installation.
- c. Violations of this section are separately punishable as violations of a lawful general regulation under Article 92, Uniform Code of Military Justice and Title 18 USC.

2.9.2. Definitions

a. FIREARMS: A small arms weapon from which a projectile is fired by gunpowder.

(1) RIFLE: A shoulder firearm with spiral grooves cut in the inner surface of the gun barrel to give the bullet a rotary motion and thus a more precise trajectory. Rifle barrel at a minimum must be 16 inches in length.

(2) SHOTGUN: A smoothbore gun for firing small shot to kill birds and small quadrupeds, though often used with buckshot to kill larger animals. Shotgun barrel at a minimum must be 18 inches in length. With an overall length of greater than 26 inches in length.

(3) PISTOL: A short firearm intended to be held and fired with one hand. Usually a semi-automatic type with magazine containing cartridges.

(4) REVOLVER: A pistol having a revolving chambered cylinder holding a number of cartridges that may be discharged in succession.

(5) ANY OTHER WEAPON (AOW): This type of firearm classification must be approved/listed by Bureau of Alcohol, Tobacco, & Firearm (BATF) as legal to own.

(6) MUZZLE LOAER: A firearm that is loaded through the muzzle.

b. FULLY AUTOMATIC WEAPONS: These type of firearms are not legal to own/possess unless approved by BATF/Federal Firearms License.

2.9.3. Inventories

a. Privately Owned Weapons (POW), to include knives and ammunition secured in the unit arms room, will be inventoried in conjunction at the same frequency as government weapons and ammunition. Must be included in the daily inventory and recorded on the FC Form 2171 and included/listed on the monthly property book Sensitive Items Inventory. POW and ammunition will be stored separately (in separate containers) from government weapons and ammunition. POW and ammunition may be stored in the same enclosed wall locker or suitable container. No more than 100 rounds of privately owned ammunition will be stored for each POW.

b. A DA Form 3749 (Weapons Receipt card) will be issued for each POW firearm secured in the arms rooms.

c. When POWs are stored in the arms room, the armorer must have access to the POW, in order to validate the daily (number count) inventory and during the monthly sensitive items inventory inspection.

2.9.4. Registration required

Except as provided in subparagraphs a, b, and c below, it is unlawful and a criminal offense for anyone to carry or possess any non-government-owned firearm while on the Fort Campbell military reservation unless such item has been properly registered with the Installation Vehicle and Weapons Registration Office (VEH REG) at Gate# 4, Gate# 7, or VEH REG Office in Building 2577 (IN/OUT Processing) during operational hours.

a. In the event the VEH REG Office is closed:

(1) The POW firearm will be stored in the unit arms room,

(2) or Kalsu Replacement Company arms room if applicable,

(3) or if residing in GOVT quarters on Ft Campbell, POW can be stored in GOVT quarters.

b. The Commander must be notified, pending proper registration within 72 hours.

c. Personnel newly assigned to Fort Campbell and residing on the installation will register non-government-owned firearms/handguns with the VEH REG Office within 72 hours after arrival on the military reservation.

d. Civilians, military personnel, and personnel not stationed at Fort Campbell may bring a firearm onto the Fort Campbell installation for the explicit purpose of hunting. Provided their possession or use of the firearm meets all of the following criteria:

(1) During a designated hunting season.

(2) In a designated hunting area.

(3) A caliber and type specified for the given hunt and area.

(4) Transportation of firearm will be unloaded and encased.

e. Military personnel residing off-post and requiring storage of POWs in military arms room will comply with on post registration requirements. Commanders can direct soldiers residing on/off the installation to store POWs in the unit arms room.

2.9.5. Registration

Registration procedures for non-government-owned firearms are as follows:

a. Firearms owned by personnel residing on this installation will be registered with the Installation Security Office, Vehicle and Weapon Registration Section within 72 hours after bringing the weapon(s) onto this installation.

b. Temporary registration:

(1) Temporary registration will be authorized when an individual is awaiting unit assignment, residing in transit quarters, or TDY.

(2) The Vehicle and Weapons Registration office is authorized to effect temporary registration on non-government-owned firearms and handguns.

(3) The temporary registration Combined Operations Police Suite (C.O.P.S.) form with PMO stamp

c. Permanent registration:

STEP 1: Complete "FC Form 2635 (Application for Firearms Registration). Note: E-6 and below will require Commanders signature for approval.

STEP 2: Take completed application form (FC Fm 2635) to the VEH/Weapons Registration Office. Note: Firearms will not be transported inside the Registration building.

STEP 3: Once application has been submitted by the POW owner, you will receive a C.O.P.S. registration form with PMO stamp. The registration WILL BE MAINTAINED with the firearm.

(1) Personnel residing in government quarters will register all POW firearms with VEH REG within 72 hours of the POW entering the installation.

(2) Personnel residing in the barracks will store POW firearms in the unit arms room and will provide the arms room a copy of the C.O.P.S. form with PMO stamp. In order to remove a POW from the arms room, written authorization must be granted by the commander.

(3) A copy of the registration will be carried when transporting any POW.

(4) POW firearms are not authorized for conceal carry on the Fort Campbell reservation. Local state Conceal Carry Permits are not recognized/approved on Fort Campbell.

2.9.6. Possession and transportation of firearms

Except as provided in subparagraphs a through g below, no one will possess, carry, or transport, on his/her person or in his/her vehicle, a firearm or handgun on the Fort Campbell Military Reservation.

a. Soldiers may possess, carry, and transport firearms/handguns that are military property of the United States in the course of military duties as directed by their commander.

b. Subject to the approval and regulation of the Commanding General, civilian law enforcement officers may possess, carry, and transport appropriate firearms or handguns in the course of their official duties.

c. An individual may transport a properly registered personal firearm/handgun directly to and from locations off the installation.

d. An individual (military/civilian) may transport a properly registered personal firearm or handgun directly to and from hunting areas and marksmanship practice at an authorized location on the installation.

e. An individual may transport a blank or starter pistol directly to and from athletic events requiring their use or training sessions involving hunting dogs.

f. An individual may transport a properly registered firearm or handgun directly to and from sanctioned gun shows in which the firearm or handgun is to be displayed.

g. Firearms transported in accordance with subparagraphs c through f above will be unloaded, and the ammunition will not be near the weapon(s). The weapon(s) and the ammunition will be inaccessible to all occupants of the vehicle. The weapon(s) will not be concealed. The weapon(s) will not be carried on the person (concealed or not concealed) of any occupants.

2.9.7. Prohibited items

Except as provided below, no one will possess or use the following prohibited items on the Fort Campbell Military Reservation:

a. A knife having a blade in excess of four inches unless such knife is:

(1) A kitchen knife in a dining facility, family quarters, or bachelor quarters.

(2) A hunting or fishing knife being utilized in the course of an authorized hunting or fishing outing or in family quarters or bachelor quarters.

(3) A hunting or survival knife being utilized by military personnel during field training exercises or flight missions, subject to the approval and regulation of the unit commander.

(4) A souvenir sword, bayonet, and medieval style edged maintained and appropriately displayed within government offices, museums, historical or instructive displays, or within government quarters as part of a personal collection or for decorative purposes.

(5) Stored in a unit arms room, subject to the approval and regulation of the unit commander, and possessed, carried, transported directly to and from the strictly authorized activities (e.g., hunting, martial arts demonstration, etc.), and used solely during those authorized activities.

b. Blackjacks, sappers, nun-chucks, cudgel type weapons or clubs, nightsticks, riot batons, homemade clubs, kung fu sticks, garrotes, or other related martial arts weapons. Military Police, CID agents, security guards, and other law enforcement personnel are authorized to possess or use any of the following items when authorized by the individual's commander: clubs, nightsticks, riot batons, and expandable batons. Personnel may possess or use nun-

chucks and kung fu sticks only in connection with martial arts training, practice, and exhibitions. They will not be used in a threatening manner towards any non-participant and may never be carried in a concealed manner. Personnel residing in the barracks will store the item in the unit arms room.

c. Brass knuckles, "sap gloves," "Knuckles," or any other device fitting over or inside of the hand which may be used for the purpose of striking another person, or to amplify the effect of a bare-handed blow.

d. Homemade percussion-type weapons. Exceptions: percussion weapons sold in kit form for assembly and legal for hunting, gun shows, or displays. These weapons, if in firing condition, must be registered as required in paragraph 9-4 above.

e. Pyrotechnics and explosives of any type (other than ammunition for firearms and handguns), including simulators and grenades, except when authorized for military use. Exception: Gunpowder and primers for legitimate reloading or muzzle weapons; however, these items will not be maintained in troop barracks.

f. A shotgun having a barrel(s) less than 18 inches in length.

g. A weapon made from a shotgun if such weapon, when modified, has an overall length of less than 26 inches or a barrel(s) of less than 18 inches in length.

h. A rifle having a barrel(s) less than 16 inches in length.

i. A weapon made from a rifle if such a weapon, when modified, has an overall length of less than 26 inches or a barrel(s) of less than 16 inches in length.

j. A machine gun not registered with the Federal Government [as defined by Title 26 United States Code Section 5845(b)].

k. A muffler or silencer not registered with the Federal Government for any firearm or handgun or any weapon or device from which a shot can be discharged through the energy of an explosion.

l. Any pistol or revolver with a smooth bore. Exceptions: a smooth bore weapon sold in kit form for assembly and legal for hunting, gun shows, or displays.

m. Any knife having a switchblade, automatic opener, or spring loaded.

n. Any razor, ice pick, or letter opener carried in a concealed manner. This includes the following items: sword canes, sword umbrellas, automatic batons, penknives, lipstick knives, and any other blade that is disguised to resemble everyday items.

o. Home made IEDs.

p. Dummy hand grenades/explosives.

q. Stun guns.

r. TASERS

s. Biological agents of any type. (Exception are authorized pepper spray like items)

2.9.8. Air powered weapons

a. Paint-ball guns, SIMUNITION type guns, air rifles, air pistols, air soft, BB guns, or pellet firing devices may be used for target practice in authorized target areas.

b. Firing these weapons is PROHIBITED in on-post housing areas.

c. Air powered weapons do not need to be registered on post.

2.9.9. Bows, Arrows, Crossbows, and Slingshots

Bows, arrows, crossbows, and slingshots are not required to be registered on post and may be used for hunting or target practice in authorized hunting or target areas only. (Prohibited from use in on-post Housing areas).

Personnel living in the barracks will store these items in the arms room subject to the same controls as firearms. The owners of these items may draw the items from the arms room once written approval has been obtained from the unit commander.

2.9.10. Post Exchange (Fire arm/Ammunition sales)

Approval from the Bureau of Alcohol, Tobacco, & Firearms (BATF) is required before the Post Exchange is authorized to sell firearms/handguns and ammunition. *The Post Exchange (AAFES) will;*

a. Not sell firearms/long guns to anyone under the age of 18.

b. Not sell any handgun to anyone under the age of 21.

c. Not stock or display any type illegal type firearm or any knife having a switchblade or automatic opener. The Post Exchange may take orders for the sale of long guns/handguns to authorized persons. Such weapons will, upon receipt, be registered with the Installation VEH REG Office, and be stored and controlled as stated in paragraph 2.9.5 above, unless the person who purchases the firearm or handgun resides off post. The Post Exchange will control weapons in accordance with applicable Federal gun laws, regulations, and installation policies.

d. Personnel authorize to purchase firearms and reside on the installation must register their firearm(s) with DES VEH REG Office within 72 hours of purchase.

e. Establish written procedures for the safe transfer and sales of POW and ammunition to the buyer.

2.9.11. Safeguarding

The manager of the Post Exchange and other activities possessing firearms and/or ammunition will safeguard them in accordance with all applicable local state laws and BATF requirements. Owners and sponsors owning/storing POWs are solely responsible for security/safety of their POWs.

2.9.12. Installation Physical Security Office (PSO)

The Installation Physical Security Office will maintain liaison with local civilian law enforcement agencies to exchange information concerning the sale and control of firearms and handguns.

2.9.13. Commanders

Commanders' will--

a. Give particular attention to the detection of non-government-owned handguns and firearms and ammunition or other dangerous/unauthorized weapons during regular inspections of their areas of responsibility. Unauthorized and/or unregistered weapons will be impounded or confiscated and disposed of in accordance with current directives and regulations.

b. Secure and maintain accountability for non-government-owned weapons and knives with blades greater than four inches in accordance with the requirements of AR 190-11 and AR 710-2. Non-government-owned weapons, ammunition, and knives with blades greater than four inches, owned or possessed by personnel residing on post in other than family quarters or bachelor quarters, will be stored in the unit arms room and will not be introduced into troop living areas.

c. Brief the contents of this section to the attention of all personnel of the command.

d. Post the Fort Campbell, State of Tennessee, and the State of Kentucky registration requirements on the unit bulletin board.

2.9.14. Sale

a. The establishment of a firearms dealership in Government quarters on the installation is prohibited.

b. Authorized firearms dealers are prohibited from conducting sales or other transactions with privately owned weapons on the installation.

c. Individual sale of a Privately Owned Weapon is authorized; however, the sale of an on-post registered firearm must be reported to the VEH REG Office within 24 hours of such sale.

2.9.15. Loss/Stolen

Military personnel, civilians, and their family members who have registered POW(s) on the installation, will report the loss or theft of a registered firearm or handgun to the Ft Campbell Police within 24 hours of the discovery of such loss or theft.

Appendix A Explanation of Forms/Records

<u>Retention Form Number</u>	<u>Title</u>	<u>Responsible Personnel</u>	<u>Period</u>
DA Form 3749	Equipment Receipt	Armorer	Change in MAL
DA Form 4604	Construction Statement	Armorer/DPW	Updated every 5 years
DA Form 5513	Key Control Register & Inventory	Key custodian and armorer	1 year
DA Form 7281	Command Oriented Arms, Ammunition, and Explosives (AA&E) Security Screening and Evaluation	Battalion S2	Renew every 3 years
Standard Form 700	Security Container Information	S-2/Security manager	Updated annually, or changes in personnel, or compromised
Standard Form 702	Security Container Check Sheet	Armorer, NVD Custodian	90 days after Completion
FC Form 2170	Unit Arms Room Weapons/ Ammunition Inventory Register	Commander, unit	As required
FC Form 2171	Weapons/Sensitive Items Register	Armorer	90 days or until Equipment is Returned
Monthly PBO	Sensitive Items Inventory Report	Directed by CDR	Working copies in arms rooms for last 3 months

UNIT LETTER HEAD

OFFICE SYMBOL

DATE

MEMORANDUM FOR RECORD

SUBJECT: Unaccompanied Access Roster

1. The following individuals are authorized unaccompanied access to the ARMS ROOM in BLDG # _____, ZONE # _____

<u>NAME</u>	<u>RANK</u>	<u>SSN (last four)</u>
-------------	-------------	------------------------

2. Above personnel have been screened and have a completed and approved DA Form 7281 on file IAW AR 190-11 Chap 2-11.

3. POC telephone numbers are DUTY HOURS: 798-XXXX
AFTER DUTY HOURS: STAFF DUTY 798-XXXX

Commander's Signature Block

Figure 2-1 Sample Unaccompanied Access Roster

COMMAND ORIENTED ARMS, AMMUNITION, AND EXPLOSIVES (AA&E) SECURITY SCREENING AND EVALUATION RECORD For use of this form, see AR 190-11; the proponent agency is PMG.			
When completed, this form is considered personal in nature and should be protected by a For Official Use Only Cover Sheet.			
NAME OF INDIVIDUAL BEING SCREENED	GRADE	SSN	
Doe, John B.	E-4/SPC	111-22-3333	
SECTION I - IMMEDIATE COMMANDER'S INTERVIEW			
The interview required by AR 190-11 has been conducted.			
NAME OF COMMANDER	GRADE	SIGNATURE	DATE
Smith, Jane	O-3/CDR	signature	4 JAN 08
SECTION II - PERSONNEL RECORDS SCREENING			
Personnel records have been reviewed in accordance with the AR 190-11. Information <input type="checkbox"/> is <input checked="" type="checkbox"/> is not attached which may preclude assignment.			
NAME OF REVIEWING OFFICIAL	GRADE	SIGNATURE	DATE
Ramirez, Jeff	E-5	signature	7 JAN 08
SECTION III - MEDICAL RECORDS SCREENING			
Medical records have been reviewed in accordance with the AR 190-11. Information <input type="checkbox"/> is <input checked="" type="checkbox"/> is not attached which may preclude assignment.			
NAME OF REVIEWING OFFICIAL	GRADE	SIGNATURE	DATE
Visger, James	1LT	signature	9 JAN 08
SECTION IV - PROVOST MARSHAL/SECURITY OFFICE RECORDS CHECK			
A law enforcement/security records check has been conducted in accordance with AR 190-11. Information <input type="checkbox"/> is <input checked="" type="checkbox"/> is not attached which may preclude assignment.			
NAME OF REVIEWING OFFICIAL	GRADE	SIGNATURE	DATE
Borja, Boris	1LT	signature	14 JAN 08
SECTION V - LOCAL CIVILIAN LAW ENFORCEMENT AGENCY RECORDS CHECK (If permitted by state, city, or local laws)			
Local civilian law enforcement agencies in the area of the individual's residence have been checked in accordance with AR 190-11. Information <input type="checkbox"/> is <input type="checkbox"/> is not attached which may preclude assignment.			
NAME OF REVIEWING OFFICIAL	GRADE	SIGNATURE	DATE
N/A			
SECTION VI - IMMEDIATE COMMANDER EVALUATION			
Individual has been screened in accordance with AR 190-11. After thorough review of all information provided, I find this individual <input checked="" type="checkbox"/> suitable <input type="checkbox"/> unsuitable to perform duties which involve responsibility for the control, accountability, and shipment of AA&E.			
NAME OF REVIEWING OFFICIAL	GRADE	SIGNATURE	DATE
Smith, Jane	O-3/CDR	signature	21 JAN 08

DA FORM 7281, SEP 2006

APD PE v1.00

Figure 2-2 Sample DA form 7281

UNIT LETTER HEAD

Office symbol

Date

MEMORANDUM FOR RECORD

SUBJECT: Monthly AA&E ALARM TEST

1. Date/Time alarm test conducted: _____

2. Name or initials of person from Alarm monitoring point: _____

3. The following sensors were tested BMS (door, window), motion sensor, and duress, if applicable.

Results of alarm test (CIRCLE ONE that applies) Operational/Non-Operational

Note: If non-operational explain: _____

4. Point of contact for this action is the undersigned.

UNIT ARMORER

(Must be signed by person who conducted the test and listed on the unaccompanied access roster)

(Note: Retain alarm test memo for 1 year)

Figure 2-3 Sample Alarm Test Memorandum

- List keys by:
- serial numbers
 - their lock location
 - quantity of keys per lock

KEY CONTROL REGISTER AND INVENTORY					
For use of this form see AR 190-11; the proponent agency is PMG.					
UNIT/ACTIVITY			PERIOD COVERED		
Your Unit or Activity			FROM: 1 JAN 08 TO:		
KEY CONTROL NUMBER(S)					
(Insert serial number or other identifying number from the key)					
1.	K-227, main door High Sec P/lock has 3 keys	(3)	A7160, Guard Ammo can	21.	31.
2.	2aa, interior barred door		Alternate keys in locked & sealed container/ or envelope	22.	32.
3.	H3261, Issue window	(2)		23.	33.
4.	H1230, Rack#1	(2)		24.	34.
5.	M4567, Rack#2	(2)		25.	35.
6.	H9987- 2ea, H1940- 2ea Universal container	(4)		26.	36.
7.	I-194-2ea, J-551-2ea HVASC container	(4)		27.	37.
8.	H980714, 5/16 inch Chains	(2)		28.	38.
9.	H5510, 5/16 inch Chains	(2)		29.	39.
10.	H032095, Wall locker	(2)		30.	40.
KEY ISSUE AND TURN IN					
KEY NUMBER	ISSUED (Date/Time)	ISSUED BY (Printed Name/Signature)	ISSUED TO (Printed Name/Signature)	TURNED IN (Date/Time)	RECEIVED BY (Printed Name/Signature)
1-11 Primary	1 JAN 08 0830	Print name	Print name		(One Time Initial Issue)
		KEY CUSTODIAN	UNIT ARMORER		
12 Alternate	1 JAN 08 1330	Print name	Print name		(One Time Initial Issue)
		KEY CUSTODIAN	S-2 Representative		Includes HSP Maint key
	Instructions:	1. Key custodian keeps	he original signed copy.		
		2. Give armorer a copy	of signed register.....		
	Instructions:	3. Armorers are required	to maintain a seperate DA		
		Fm 5513 to transfer keys	with the assistant armorers		
		4. (KEEP COMPI FTED	REGISTERS FOR 1 YR)		
		Note: The key that opens	the key container is not....		
		to be listed on this form	(on admin register)		

DA FORM 5513, SEP 2006

Page 1 of 2
APD PE v1.00

Figure 2-4 Sample DA Form 5513 (page #1)

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SAMPLE

WEAPONS/SENSITIVE ITEMS REGISTER														DATE				
(For use of this form see CAM Regulation 190-1. The proponent of this form is DES)														18 Jan 08				
JOINT INVENTORY AND TRANSFER OF ACCOUNTABILITY																		
TYPE OF WEAPONS/ AMMUNITION	M-4	M-9	M259/ SB	M240/ SB	5.56 amm	PVS-7 D	M-68 ets	POW Pistol	POW amm	ASIP	AK 47	SIGNATURE OF ACCOUNTABLE INDIVIDUALS						
												BOX FROM	KEY FROM	ACCEPTED	RELIEVED			
1 ST INVENTORY	IN ARMS ROOM	172	∅	5/3	10/10	∅	83	172	160	2	100	5	1	SDNCO				
	SIGNED OUT	∅	∅	∅	∅	∅	1	∅	∅	∅	∅	∅	∅	Opns				
	TOTAL	172	∅	5/3	10/10	∅	84	172	160	2	100	5	1	Robert Brown				
2 ND INVENTORY	IN ARMS ROOM																	
	SIGNED OUT																	
	TOTAL																	
3 RD INVENTORY	IN ARMS ROOM	171	10	5/5	10/10	∅	84	171	160	1	∅	5	1	Robert Brown				
	SIGNED OUT	1	∅	∅	∅	∅	∅	1	∅	1	100	∅	∅	Robert Brown				
	TOTAL	172	10	5/5	10/10	∅	84	172	160	2	100	5	1	SPINCO				
ISSUE AND TURN IN OF WEAPONS AND SENSITIVE ITEMS																		
DATE/TIME	TYPE	SERIAL NO	AMMUNITION		ISSUED TO		ISSUED BY (Initials)	TURNED IN BY (Signature)	RECEIVED BY (Signature)									
			IN	OUT	PRINTED NAME	SIGNATURE												
19Jan 18Jan	m74	W014012			Smith, Jon	Jon Smith	RB	Jon Smith	Robert Brown									
1000 0900					Smith, Jon	Jon Smith	RB	Jon Smith	Robert Brown									
19Jan 18Jan	m68	56412			Jones, Bill	Bill Jones	RB	Bill Jones	Don Chudler									
1000 0900	Colt																	
19Jan 18Jan	45	112134	50	100														
1432 1400																		
REMARKS (Anything that cannot be justified above)										DATE								
Bayonets Verified by Serial #1002 in original (signed in original 2171)										18 Jan 08								
PVS 7B Returned from Maint (signed M-4 + M68 - WLC)																		
POW M240 00 File																		

Page 1 of 2
v1.00

(FC FORM 2171 DECEMBER 2005, IS OBSOLETE)

SAMPLE

Figure 2-5 Sample FC Form 2171 (Single Armorer Open/Closing)

SAMPLE

WEAPONS/SENSITIVE ITEMS REGISTER														DATE	
(For use of this form see CAM Regulation 190-1. The proponent of this form is DES)														19 Jan 08	
JOINT INVENTORY AND TRANSFER OF ACCOUNTABILITY														SIGNATURE OF ACCOUNTABLE INDIVIDUALS	
TYPE OF WEAPONS/ AMMUNITION	M-4	M-9	M249/ SB	M240/ SB	556 amm	PVS-7 D	M-68	Bayon ets	POW Pistol	POW amm	ASIP	AK	AMMUNITION	SIGNATURE OF ACCOUNTABLE INDIVIDUALS	
														IN	OUT
1 IN ARMS ROOM	171	10	5/5	10/10	20	84	171	160	1	0	5	1	0	0	SDMCO
SIGNED OUT	1	0	0/0	0/0	0	0	0	0	1	100	0	0	0	0	Ops
TOTAL	172	10	5/5	10/10	20	84	172	160	2	100	5	1	0	0	Robert Brown
2 IN ARMS ROOM	172	10	5/5	10/10	20	84	172	160	1	0	5	1	0	0	Robert Brown
SIGNED OUT	0	0	0	0	0	0	0	0	1	100	0	0	0	0	Robert Brown
TOTAL	172	10	5/5	10/10	20	84	172	160	2	100	5	1	0	0	Don Chuckles
3 IN ARMS ROOM	172	10	5/5	10/10	20	84	172	160	2	50	5	1	0	0	Don Chuckles
SIGNED OUT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Don Chuckles
TOTAL	172	10	5/5	10/10	20	84	172	160	2	50	5	1	0	0	SDMCO
ISSUE AND TURN IN OF WEAPONS AND SENSITIVE ITEMS														KEY TO	
														Ops	
DATE/TIME		TYPE	SERIAL NO	AMMUNITION		PRINTED NAME	SIGNATURE	ISSUED BY (Initials)	TURNED IN BY (Signature)	RECEIVED BY (Signature)	DATE				
IN	OUT			IN	OUT										
REMARKS (Anything that cannot be justified above)											DATE				
Bayonets verified by seal # 1002											19 Jan 2008				
5 Brooks POW Ammo & expended															
Keys: 32															
Keys Transferred to SS13															
FC FORM 2171, FEB 2007															
(FC FORM 2171 DECEMBER 2005, IS OBSOLETE)															
SAMPLE															

Figure 2-6 Sample FC Form 2171 (Arms Room Transfer Between Armorers)

DATE PREPARED:	03/11/08	SENSITIVE ITEM INVENTORY LISTING	PCN:	ALV-XXX
UIC:	XXXXX		PAGE:	1
R97234	1005012310973	8	RIFLE 5.56 MM M4	EA 2 0076
W014405 ✓	W014405 ✓			W014422 ✓
W014430 ✓	W014434 ✓			W014473 ✓
W014543 ✓	W014712 ✓			W014807 ✓
W014831 ✓	W014832 - L (LETICAL TRANSFER)			W014919 - TX (Turned-in)
W014920 ✓	W014952 ✓			W015017 ✓
W015066 ✓	W015077 ✓			W015257 ✓
W015296 ✓	W015471 ✓			W015509 ✓
W015640 ✓	W016069 ✓			W016256 ✓
W016436 - M (MOUNT)	W016947 ✓			W017261 ✓
W017269 ✓	W017270 ✓			W017278 ✓
W019234 ✓	W019235 ✓			W019796 ✓
W020501 ✓	W020503 ✓			W020550 ✓
W020600 ✓	W020659 ✓			W020838 ✓
W020842 ✓	W020843 ✓			W020877 ✓
W020886 ✓	W020904 ✓			W020912 ✓
W020938 ✓	W020956 ✓			W020985 ✓
W020991 ✓	W020992 ✓			W020995 ✓
W020998 - 50	W020999 ✓			W021012 ✓
W021042 ✓	W021059 ✓			W021127 ✓
QTY ON HAND = <u>70</u> QTY IN MAINT = <u>1</u> QTY SIGNED OUT = <u>3</u> QTY OTHER = <u>24/71</u> REMARKS <u>76</u>				
C39136	1305011729558	8	CTG 5MM BALL NATO	EA 4 00024
WCC96F02 ✓				
QTY ON HAND = <u>24</u> QTY IN MAINT = <u>0</u> QTY SIGNED OUT = <u>0</u> QTY OTHER = <u>0</u> REMARKS <u>24 (locked container, verified by protective seal # 980320)</u>				
D78555	5810013931973	8	D T I ANCYZ-10 V3	EA 9 00028
425498 - 50	425708 ✓			426645 ✓
426696 ✓	426738 ✓			426897 ✓
427007 ✓	427113 ✓			427208 ✓
427227 ✓	428379 ✓			428388 ✓
428426 ✓	430977 - 50			505134 ✓
505142 ✓	505148 ✓			505164 ✓
505192 ✓	505198 ✓			505203 ✓
QTY ON HAND = <u>26</u> QTY IN MAINT = <u>0</u> QTY SIGNED OUT = <u>2</u> QTY OTHER = <u>0</u> REMARKS <u>28</u>				

Figure 2-7 Sample Monthly PBO Sensitive Items Inventory

DATE PREPARED: 03/11/08
SENSITIVE ITEM INVENTORY LISTING
UIC: XXXXX
PCN: ALV-XXX
PAGE: 2

LIN	SUBLIN	NSN	PBIC ECS	NOMENCLATURE	UI	CIIC	O/H
D78555	N02758	5810010951312	8	KYA-15A/TSEC	EA	9	00002
18629 ✓		4950 ✓					
QTY ON HAND = <u>2</u> QTY IN MAINT = <u>0</u> QTY SIGNED OUT = <u>0</u> QTY OTHER = <u>0</u> REMARKS <u>2</u>							
RR5035		100501X904490	8	RIFLE 7.62MM AK47 CHI	EA	2	00003
001806 ✓		2184 ✓		2200 ✓			
QTY ON HAND = <u>3</u> QTY IN MAINT = <u>0</u> QTY SIGNED OUT = <u>0</u> QTY OTHER = <u>0</u> REMARKS <u>3</u>							
T40405		5810010269620	8	TAPE READ KOI-18/TSEC	EA	9	00002
24410 ✓		67913 -50					
QTY ON HAND = <u>1</u> QTY IN MAINT = <u>0</u> QTY SIGNED OUT = <u>1</u> QTY OTHER = <u>0</u> REMARKS <u>2</u>							

NOTE: ITEMS STORED IN THE ARMS ROOM, BUT NOT LISTED IN THE PBO HAND RECEIPT/INVENTORY WILL BE LISTED ON THE "WORKING COPY" OF THE PBO INVENTORY

- 157-M9 Bayonets
- 1- POW 45 Cal Pistol Sn#12345, Model "Colt"
- 30- Rounds of 5.56 Ball Ammunition Lot #54321 /DODIC# A059 (SEAL# 1056227)
- 15- Compasses
- 150- Body Armors (IBA)

"Inventory officer/WCO signs the working copy"
Bob DoRight
SFC
24 MAR 08

ALL SENSITIVE, EXPLOSIVE, AND HAZARDOUS ITEMS HAVE BEEN INVENTORIED

NO DISCREPANCIES WERE DISCOVERED

DISCREPANCIES HAVE BEEN REPORTED AND/OR ACCOUNTED FOR IN ACCORDANCE WITH APPLICABLE REGULATIONS.

SIGNATURE WITH INAPPROPRIATE SENTENCE DELETED

Figure 2-7 Sample Monthly PBO Sensitive Items Inventory (Continued).

CHAPTER 3: Security of Unclassified Army Property (Sensitive and Non-Sensitive)

Section I

Introduction

3-1. Purpose.

This regulation—

- a. Describes Physical Security (PS) requirements from regulatory sources.
- b. Prescribes support documentation and records that each unit must maintain.
- c. Is a tool that Commanders will use to effectively manage their PS program.

3-2. General

a. Physical Security (PS) is a critical part of the Army's Force Protection Program. PS measures are designed to detect, deter, delay, and defend against threats to U.S. Forces assets. PS measures are a combination of active or passive systems, devices, and security personnel. Measures may be physical (for example, barriers, fences, lights, walls), electronic (for example, alarms, cameras, Electronic Entry/access Control Systems, and procedural (for example, security checks, inspections and surveys, security training and awareness programs, property inventory and accountability procedures). A successful PS program cannot be achieved without appropriate command emphasis and the cooperation of every element of a commander's staff. PS personnel must be fully engaged in and remain active participants in the Fort Campbell Force Protection Program.

b. This Section II—

(1) Implements the requirement in AR 190-13 for Major Army command (MACOM) commanders to establish a PS program.

(2) Prescribes policy and procedures and assigns responsibility for developing a practical and effective physical security program for Fort Campbell.

3-3. Responsibilities

Commanders have an inherent PS responsibility for their commands. This responsibility will not be delegated or transferred, except by official orders.

a. Installation responsibilities.

(1) INSTALLATION PHYSICAL SECURITY OFFICE (PSO):

(a) Inspect all administrative areas not to exceed 24 months or as directed.

(b) Inspect all Arms Ammunition & Explosive (AA&E) facilities to include bunkers, not to exceed 18 months.

Note: Units will coordinate with the Physical Security Office @ 798-7587 or 798-4345 to schedule unit inspections. Scheduling will be included in unit training calendars.

(c) Conducts surveys and Risk Analysis per AR 190-13.

(d) Inspect Field ASP/FARP/FLMSA..

(e) Support Inspector General (IG), QASAS, and Safety inspections.

(f) Conducts U.S. Customs missions.

b. Unit responsibilities.

(1) BDE/MAJOR COMMANDS:

(a) Have assigned Physical Security Officers/managers appointed in writing.

(b) Conduct/review physical security and crime prevention inspections of the organization and recommend improvements to Commanders.

(c) Present physical security and crime prevention measures to unit personnel.

(d) Advise unit commander on information which would impact crime trends and/or problems in the unit.

(e) Maintain Staff Duty Officer (SDO) and/or Staff Duty NCO (SDNCO). Require the SDO or SDNCO to conduct random checks of subordinate units during the hours of darkness as required by Army regulations, to ensure proper crime prevention and physical security measures are implemented. The SDO and SDNCO will ensure checks of the units are entered in the SDO/SDNCO journal and maintained on file for a minimum of 90 days.

(f) S-2 Coordinate with the Physical Security Office @ 798-7587 or 956-4345 to schedule unit inspections. Scheduling will be included in unit training calendars.

(g) Forward a copy of the BDE Physical Security Plan to the Physical Security Office.

(2) BN CDR:

(a) Have assigned Physical Security Officers/managers appointed in writing.

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- (b) Develop Physical Security Plans and Crime Prevention SOP
 - (c) Conduct quarterly physical security inspections of all subordinate units, maintains these inspection records on file until the next inspection is conducted.
 - (d) Review physical security and crime prevention inspections and recommend improvements to commanders.
 - (e) Present physical security and crime prevention measures to unit personnel.
 - (f) Advise unit commander on information which would impact crime trends and/or problems in the unit.
 - (g) If the BN is the highest level of command coordinate with the Physical Security Office @ 798-7587 or 956-4345 to schedule required inspections. Scheduling will be included in unit training calendars.
 - (h) Maintain Staff Duty Officer (SDO) or Staff Duty NCO (SDNCO). Require the SDO or SDNCO to conduct random checks of major subordinate units during the hours of darkness as required by army regulations, to ensure proper crime prevention and physical security measures are implemented. The SDO and SDNCO will ensure when they make checks of units, it is entered in the SDO journal, maintain security checks on file for a minimum of 90 days.
- (3) UNIT CDR/ACTIVITY MANAGERS:
- (a) Appoint in writing a Physical Security Officer/manager.
 - (b) Implement and enforce Physical Security measures and Crime Prevention policies.
 - (c) Maintain Physical Security and Crime Prevention SOP.
 - (d) Maintain inspection records on file until the next inspection is conducted.
 - (e) Review physical security and crime prevention policies and recommend improvements to next higher level commanders.
 - (f) Incorporate physical security and crime prevention measures to unit personnel.
 - (g) Advise next higher command on information which would impact crime trends and/or problems in the unit.
 - (h) Recommend having Charge of Quarters (CQ). Require the CQ to conduct random checks of unit areas during the hours of darkness as required by army regulations, to ensure proper crime prevention and physical security measures are met.
- (4) SEPARATE COMMANDS:
All of Chapter 1 listed above applies. (If applicable)

Section II

Physical Security Officers (PSO)

3.2.1. Duties and responsibilities

- a. PSO are required at Company/Troop Level and above. PSO will be appointed in writing by the Commanders and will be in the grade of E-6 and above. PSO will be proactive in their duties and ensure the unit's physical security and Crime Prevention programs are implemented, followed, and makes recommendations as necessary.
- b. At a minimum, liaison will be established with the following agencies:
 - (1) Installation Physical Security Office.
 - (2) Local MI field offices.
 - (3) Installation Criminal Investigation Division, Force Protection and Military/Police agencies.
- c. PSO will establish/develop a written unit level security checklist. The checklist(s) will provide the frequency of checks to conduct as required by the appropriate risk level for the asset being protected.

3.2.2. Use of risk analysis/Mission Essential and Vulnerable Areas (MEVA)

- a. Commanders are required to safeguard and protect military property in accordance with the risk level associated (Level I (Low), Level II (Medium), or Level III (High)). DA Pamphlet 190-51 provides the instructions/procedures for determining security requirements and conducting a risk analysis for all categories of Army property.
- b. The risk analysis will be conducted by the PSO in coordination with the unit or activity commander.
- c. A risk analysis will be conducted on all MEVA—
 - (1) When a unit or activity is activated.
 - (2) When a unit permanently relocates to a new site or facility.
 - (3) When no formal record exists of a previous risk analysis.
 - (4) At least every 3 years or more frequently at the discretion of the unit or activity commander.
 - (5) During the planning stages of new facilities, additions to facilities, and facility renovations.
 - (6) When an incident occurs in which an asset is compromised.
- d. After completion of the risk analysis (DA Form 7278). The PSO will then refer to AR 190-51 to determine the

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level of Physical and Procedural security measures that are required based on risk level indicated.

e. Other approved DOD automated versions of the risk analysis are authorized, but must be used in conjunction with AR 190-51.

f. Mission Essential and Vulnerable Areas (MEVA)

Facilities or activities within the installation that, by virtue of their function, are evaluated by the commander as vital to the successful accomplishment of the installation's, State National Guard, or MUSARC mission. This includes areas nonessential to the installation's/facilities operational mission but which, by nature of the activity, are considered vulnerable to theft, trespass, damage, or other criminal activity.

3.2.3. Unit level inspections

PS inspections are formal, recorded assessments of PS procedures and measures implemented by a unit or activity to protect its assets.

a. PS inspections will be conducted according to AR 190-13, paragraph 2-11; and this regulation.

b. Physical Security Inspectors (PSI) will not engage in illegal or dangerous conduct to demonstrate security deficiencies or weaknesses observed during an inspection.

c. Inspections may be unannounced. However, before conducting an unannounced inspection, PSI should review unit training schedules to ensure that the inspection will not interfere with training.

d. PS inspections will be conducted—

(1) When a MEVA, unit, or activity is activated.

(2) When no record exists of a prior PS inspection.

(3) When a unit or activity changes in a way that may affect existing PS plans and there is an indication or a report of significant or recurring criminal activity.

(4) Every 18 months for conventional-arms and ammunition-storage activities.

(5) Every 18 months for critically sensitive, multiple-customer ADP service-center activities or facilities.

(6) Every 2 years for MEVA other than those in (4) and (5) above.

(7) All other activities will be inspected within a 24 to 36 month window.

(8) Inspections can be conducted more frequently at the discretion of the Commander.

e. Courtesy inspections will not be conducted as a substitute for inspections required by regulation.

f. Requests to change the date of a scheduled inspection must be approved by the organization's next-higher commander.

g. PSI will be granted ACCOMPANIED access to U.S. Forces facilities, records, and information on a need-to-know basis consistent with the PSI clearance for access to classified information and the provisions of applicable regulations.

h. PSI will give units and activities a verbal out briefing at the completion of the inspection.

i. On the spot corrections are authorized by the PSI.

j. When a deficiency is identified, the unit or activity commander will correct it immediately or use adequate compensatory measures until the deficiency can be corrected. The submission of work order requests alone is not considered a compensatory measure.

k. Deficiencies that are beyond the capability of the local commander to correct because of a lack of resources will be reported to the next-higher commander with a request for resource assistance and listing justification and impact statement.

l. DA Form 2806-1-R or CIP Checklist (FC Form 4046), or both will be used to prepare and record all PS inspections. Attachments may be added to the printed report to clarify unique command requirements.

m. INSPECTION REPORTS (DA Form 2806-1-R):

(1) Units or activities storing AA&E and other sensitive items that receive a "Not Adequate" rating on an Installation PS inspection (DA Form 2806-1-R) will submit in writing a report of corrective action to the inspecting activity (ATTN: Chief, Physical Security) within 45 consecutive days after the INITIAL inspection. The corrective action memo must be received before a re-inspection can be scheduled.

(2) A report of corrective action must identify corrective actions taken, compensatory measures implemented, or both to address findings on the survey, inspection, or vulnerability assessment.

(3) The results of a survey, inspection, or assessment often identify critical deficiencies or vulnerabilities in an installation or facility PS program.

(4) According to AR 190-13, paragraph 2-13, reports of completed inspections or surveys will be classified and safeguarded according to DOD 5200.1-R and AR 380-5.

(5) At a minimum, reports will be marked "UNCLASSIFIED/FOR OFFICIAL USE ONLY."

(6) DES Physical Security Office will send by e-mail the completed inspection reports to the inspected unit

within 7-10 workdays after the inspection. Copies of PS inspection reports will be provided to the—

- (a) Commander or director of the organization inspected.
- (b) Commander or director at the next-higher level above the organization inspected.
- (c) Installation PSO. (When requested)
- n. Units and activities must keep inspection reports until the next inspection is complete.
- o. Recurring findings will be reported on future PS inspections until the deficiency is corrected.

Section III

Physical Security Plan (BDE, BN, CO, and Directorate level)

3.3.1. Physical Security Plan (PSP)

a. Commanders will develop a Physical Security Plan (PSP). The PS plan will be developed according to AR 190-13, paragraph 2-9, and guidelines outlined in FM 3-19.30, appendix F. PSP will be integrated with the unit antiterrorism/force protection (AT/FP) program.

b. The MSC/BDE CDR/Director are responsible for coordinating/establishing PSP for subordinate units and activities. PS plans will—

- (1) Assign responsibilities and establish procedures.
- (2) Addresses contingency procedures.
- (3) Address changes in requirements at higher Force Protection Conditions (FPCON).
- (4) Ensure subordinate and tenant activity plans integrate with and complement the BDE/Directorate PS plan.
- (5) Be reviewed annually by the next higher Command.
- (6) List of Primary/Inhabited areas to include barracks IAW DOD UFC Reg 4-010-01.
 - (a) Fifty or more personnel in one single structure is considered a “Primary Gathering Area”.
 - (b) Eleven but less than fifty personnel occupying a single structure is an “Inhabited Area”.
- (7) At a minimum the PS Plan will address:
 - (a) Copy of current Installation Threat Statement
 - (b) Terrorism counteraction plan (refer to CAM Reg 525-13 & AR 525-13)/additional unit requirements identified.
 - (c) Bomb threat plan/emergency evacuation plan required at FPCON “A” measure#3
 - (d) Closure plan/control access to unit areas, when 100% ID check is required at FPCON “B” measure 12.
 - (e) Natural disaster plan (refer to CAM Pam 500-1)
 - (f) Civil Disturbance/Unit Guard Force (When required at higher threat/tasking).
 - (g) Resource plan (if required barriers, c-wire, etc to create a stand off distance for high occupancy buildings and other critical areas).
 - (h) Communication plan (Address all COMMO needs for paragraph a-g listed above. Establish COMMO with local law enforcement on sharing information about possible threats.)
 - (i) List of unit Restricted Areas. (if applicable)
 - (j) List of unit MEVA. (If applicable)

Note: Annexes to the PS plan (a-j) will be exercised at a minimum every two years. The PS Plan will be approved/signed by the responsible Commander.

Section IV

Crime Prevention

3.4.1. Responsibilities

a. Unit Commander(s):

- (1) Establish viable and continuous crime prevention programs through policies and SOPs.
- (2) Appoint in writing a unit Crime Prevention Officer (CPO), and an assistant Crime Prevention Officer/NCO (Corporal or higher) to establish and maintain the unit's crime prevention program. This includes the coordination of all crime prevention activities within the unit (such as annual training, refresher training, unit crime prevention awareness programs, etc.)
- (3) Monitor the program to ensure its effectiveness.

Note: CPO can also be the appointed PSO, in this case the individual will be in the rank of SSG/E-6 and above.

b. Unit Crime Prevention Officers (CPO) (BN/CO Level)

Unit CPO will;

- (1) Establish and maintain the Commander's crime prevention program.

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- (2) Include crime prevention briefings as a part of in-processing at the unit for newly assigned personnel.
 - (3) Schedule and conduct unit crime prevention briefings and training semi-annually. Maintain records of attendance. (Made readily available for inspection)
 - (4) Conduct quarterly unit crime prevention inspections, and maintain the results on file within the unit for a minimum of 12 months.
 - (5) Ensure secure storage areas are available to store soldiers' personal property and TA-50 during their absence.
 - (6) Encourage soldiers to participate in "Operation Identification" and ensure their high value dollar items (\$100.00 or more) are inventoried and verified by a witness's signature on Personal Property Record (FC Form 4986). Maintain their record in a secure filing area and update regularly. Each soldier should complete a Personal Property Record whether or not he/she wishes to inventory his/her property. A memorandum for Record (MFR) will be completed and witnessed for personnel who decline to inventory their property.
 - (7) Ensure the SDO/SDNCO has a current roster of unit personnel and their assigned rooms in the billets (posted in the SDO/SDNCO Duty Log Book).
 - (8) Control access to billeting areas in accordance with troop policy. Post visitors policy on unit bulletin board.
 - (9) Post the locations of "OFF LIMITS AREAS" on unit bulletin boards.
- c. Individual Soldier will:
- (1) Secure both private and government property at all times. Avoid situations conducive to crime. All soldiers are encouraged to report to the Commander, or his/her representative, any criminal acts observed or suspicious acts which might indicate the presence of criminal activity.
 - (2) Ensure assigned wall/foot lockers are in serviceable condition. If these security containers are unserviceable, request a secure location to secure valuables until defects are corrected. Request (through your unit supply) to have locks replaced if the keys have been lost or combinations have been compromised. Government issue locks are authorized for official use only and will not be used to secure personal property.
 - (3) Register all items of personal property valuing \$100.00 or more (includes items of sentimental value) on a Personal Property Record (FC Form 4986) and ensure that items listed on this form are verified by a witness. The form is also signed by the same witness prior to returning to the unit CPO.
 - (4) A memorandum for Record (MFR) will be completed and witnessed for personnel who decline to inventory their property.
 - (5) Recommend marking property with "USA (Last four numbers of soldier's SSN)."
 - (6) Not leave valuables and money in pillows, mattresses, or unsecured night stands, desks, or lockers.
 - (7) Not leave easily removable items in Privately Owned Vehicles (POV), whether or not the POV is secured.
 - (8) Do not store/keep military MTOE equipment inside of POV.
 - (9) Refrain from carrying large sums of money (over \$100.00) on your person.
 - (10) The storage of CTA-50 is PROHIBITED in unattended parked POV and Military vehicles on and off-post. Soldiers are allowed to transport CTA-50 for duty requirements, but at no time will CTA-50 be left unattended.
 - (11) OCIE
 - (a) Issued clothing will be marked as indicated in AR 700-84.
 - (b) Individual clothing and equipment of personnel living in troop billets and reserve component personnel will be secured by one of the following means to be determined by the commander:
 - In a locked wall locker or footlocker.
 - In a locked duffel bag, further secured to the building structure, or a separate locked room.
 - (c) Access to reserve component OCIE will be controlled by designated individuals. Locked duffel bags, wall lockers, or footlockers will be placed in a separate locked room or cage. In lieu of a separate room, access to wall lockers may be controlled by modifying the lockers to accept a locking bar or by adding a second hasp and securing the locker with a second lock. Keys to access reserve component OCIE will be placed in the unit key depository and access will be controlled by the unit key custodian.
- d. Consideration should be given to marking items as indicated in appendix C, AR 190-51.
- e. Unit Supply:
- (1) Establish security control measures for bolt cutter issue.
 - (2) Ensure all high dollar items have double barrier protection, i.e., camera stored in locked wall locker inside locked supply room.
 - (3) Identify a segregated secure location/wall locker for property belonging to AWOL soldiers.
 - (4) Pilferage/high dollar items (commercial/military) will be marked as directed by the unit Commander.
- "Permanently marked" is defined as not being easily removed (i.e., inscribed into the item's surface). This should be done in a manner so as not to deface or devalue the item being marked. For further guidance of marking government property, refer to AR 190-51, Security of Army Property at Unit and Installation Level, Appendix C,

“Marking of Government Property”.

- (5) Supply storage rooms will be posted as “Off Limits to Unauthorized Personnel”
- (6) Access rosters will be prepared/posted.

f. SDNCO/CQ responsibilities:

- (1) Conduct security checks as directed on the PSO/unit security check sheet or record results in the SDO/SDNCO Journal (Refer to Para 3.4.8 for security lighting control measures).
- (2) Comply with fire and safety requirements, and secure all doors except the main entrance doors after duty hours. Ensure exits provide required safety, but preclude entry.
- (3) Secure any property found unsecured. Annotate findings in the journals.
- (4) Report all incidents to the Command
- (5) Report observed criminal acts or suspicious activity to the Ft Campbell police immediately.

3.4.2. Unit storage facilities:

The unit will provide secure storage facilities for personal property belonging to personnel on leave, TDY, deployed, AWOL, or in field training.

3.4.3. Health and welfare inspections:

Commanders will coordinate with their SJA prior to conducting Health & Welfare inspections. During routine health and welfare inspections, the unit inspector(s) will attempt to detect and, if possible, make corrections for unsecured valuables, personal and government property. Units will keep a record of these inspections. These records will not indicate personal findings. The CDR is required to notify the Ft Campbell Police of any prohibited/suspected item(s) found. Confiscated items will not be stored in unit arms rooms. Illegal items will be released to Ft Campbell Police as appropriate. Unit commanders can request/coordinate in advance with PMO (K-9/narcotics team) to assist in the health and welfare inspections.

3.4.4. Security measures for Privately Owned Vehicles (POV):

All personnel will take the following security measures to prevent larceny of motor vehicles or their contents:

- a. Secure all motor vehicles when unattended, regardless of location or time of day.
- b. Remove from sight all valuable items left inside the vehicle.
- c. Ensure DVD/CD players, CB radios, or any other electronic equipment are permanently mounted inside the vehicle.
- d. The storage of OCIE/TA-50 items inside POV is prohibited.

3.4.5. Dayroom/Barracks

- a. Copies of the Installation’s “Off Limits Establishments” list will be posted on all unit bulletin boards.
- b. Signs warning non-unit personnel to report to the orderly room/CQ WILL be posted on all perimeter doors to the billets
- c. Visitation procedures will be established by the Commander. Visitor' sign-in logs will be used and maintained for a minimum of 90 days.
- d. All rooms will be adequately secured when individuals are asleep or not present.
- e. Personal high dollar value items (recommend value of \$100 or more) will be inventoried and recorded on FC Fm 4986, for every unit member for whether they participate or not. (Required for personnel residing in barracks) These forms will be updated at a minimum on a semi-annual basis. See sample Figure 3-1.
- f. Dayroom televisions/DVD players and other high dollar Government (GOVT) property will be sub-hand receipted to the barracks NCO or supply NCO. The property will be properly secured to stands and/or fixed objects.
- g. Privately Owned Weapons (POWs) are prohibited in the barracks (Martial arts/firearms/bows/knives with a blade > 4” in length.) Refer to the POW section of this regulation in Section I, Chapter 9.

3.4.6. Operation Identification

CPO will develop a program that would identify private property in the event loss/stolen property is recovered. A program such as "Operation Identification" for marking high dollar property is recommended. (Recommend marking with Soldiers Last name's initial and last four, example B-9876.) Ensure electrostatic engravers or other methods are made available to unit/activity personnel for marking personal property for identification.

Note: Identification markings should be engraved were possible.

3.4.7. Light control measures:

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Leave lights on in designated areas in order to reduce potential for crime. These areas should include, but are not limited to, vehicle parking lots, troop paths, sidewalks, outside areas where troops congregate, and those areas declared "OFF LIMITS". Report in-operative lights to unit Command/R&U. Record findings on the journal. CPO in conjunction with the unit PSO, conduct lighting surveys of areas, to determine if lighting is adequate or not adequate.

3.4.8. Security during deployments

a. Commanders and supervisors are required to conduct recorded inventories of all Stay Behind Military property. Inventory all barracks soldiers' Stay Behind Property. All Stay Behind Property will be secured in approved containers, wall lockers, or other secure locations. A security protective seal should be used in addition to the padlock for all secure storage containers/areas.

b. Commanders can designate a secure area within their area of responsibility. The secure area/room must meet structure standards IAW AR 190-51, Appendix B-2. All high dollar property listed on the FC Fm 4986 requires a witness signature for verification.

c. POV to include ATVs, Boats, RVs, etc., will be secured in the designated POV storage area during deployments.

3.4.9. Unit Funds

a. The Commander may authorize the storage of limited funds, not to exceed \$300 in U.S. currency for the purpose of a taxi fund, or approved unit funds for legitimate purposes. Written policies will be established for the control, accountability, and storage of these funds.

b. Funds will be stored in approved DOD containers or equivalent safes. These funds will not be stored in safes that contain classified materials or AA&E keys.

Section V

Administrative Key and Lock Control

3.5.1. Key & lock control custodians

a. Commander will appoint in writing a Primary key and lock custodian. Recommend appointing alternate custodian(s). The primary Key/lock control custodian is authorized to approve and sign the key depository access roster.

Note: Key control should be established at section level. This would require appointing section key custodians.

b. The access roster will be posted on the exterior of all key depositories. (Appointment orders can not be substitute as an access roster.)

c. If a unit has multiple key depositories located side by side, only one access roster is required as long as each key depository has been numbered. The access roster will then reflect "The following personnel have access to key box#1, #2, #3, etc."

d. Master keys are not authorized, unless a unit has a HQDA waiver, exceptions are:

(1) A room with multiple doors that opening one or all doors leads to the same interior.

(2) Vehicle doors that lead to the same area i.e., M1114 Armored HWMMWV/M1117 ASV.

(3) Storage containers with multiple doors that opening one door leads to the same interior of the container.

e. All keys/locks in use to secure GOVT equipment will be incorporated into a key control system.

f. If a change in custodian occurs, a joint inventory of keys and locks is required with the departing custodian and incoming custodian. Results will be recorded on DA Form 5513.

g. Keys that secure containers storing recovered military ammunition (AMNESTY BOX) will be controlled as administrative keys. Keys to the amnesty box will not be personally retained.

3.5.2. Use of the key control register (DA Form 5513)

a. Appointed Key/lock Control custodians (Primary/Alternate) are responsible to ensure the key register is accurate, properly completed, and accounts and list all keys by their serial numbers, location of their locks, and total quantity of keys per lock.

b. The appointed Key/lock Control Custodian is required to conduct an initial 100% key/lock inventory by serial number, and semi-annual inventories thereafter. Inventories will be recorded on page#2 of DA Form 5513.

Inventory records for admin keys will be maintained until the next semi-annual key & lock inventory is completed. Refer to sample Figure 3-2.

3.5.3. Key depositories

Key depositories will be made of at least 26 gauge steel and equipped with a tumbler type lock. These key depositories/boxes will be securely affixed to a wall. The key box will be stored in a secure room when unattended. The key box will be secured when not in use.

3.5.4. Locks

a. Only DOD approved padlocks will be used to secure GOVT property. The locks will meet the following specifications:

(1) All keys shall be captive (key retaining/un-removable) in the cylinder when unlocked. Each padlock shall be furnished with two (2) keys.

(2) Marking. The markings "U.S." shall be .25 inch minimum size and can be located on either side of the padlock.

(3) Hardened shackle – usually stamped in the curve of the shackle.

(4) Heal and toe locking notches – with the lock in the open position there will be a notch on each end of the shackle.

(Low security padlocks are listed below)

KA - Keyed Alike	KI - Keyed Individually	CID-Commercial Item Description
NSN	DESCRIPTION	
5340-00-158-3805	Padlock (without chain): Steel case and shackle. (KI)	CID A-A-59487-2S
5340-00-158-3807	Padlock (with chain): Steel case and shackle. (KI)	CID A-A-59487-2SC
5340-01-437-0625	Steel case 1 3/4" body width. Set: 6 Locks. (KA)	CID A-A-59486-2AS06S12



Note: Above list is not all inclusive. Some of the most common DOD approved locks are manufactured by "American Lock TM", "Master", and "Federal".

b. The appointed key/lock custodian will be notified of any lock changes within the unit/activity. A reason/justification will be given to the custodian for replacement of lock(s).

c. DOD padlocks will not be cut/broken-off unless approved by the responsible Commander or 1SG.

Section VI

3.6.1. Security of computers and components

a. GOVT portable computers and their components (CPU) will be provided double barrier protection when left unattended.

b. Computers that are located in rooms with windows that are above 12 feet from ground level do not require security cables as long as the room is secured when unattended.

c. Computer cable locking devices that require keys will be listed on the DA Fm 5513 and accounted for IAW AR 190-51, Appendix D.

d. Computers will be sub-hand receipted to the user level.

e. Marking of computers for identification purposes will be conducted at the Commander's discretion. Marking for identification purposes will be IAW AR 190-51, Appendix C-4. (Recommend paint markers or engraving were possible.)

Example of markings:

US Army or "USA", 101st ABN DIV

Unit UIC or unit name

Hand Receipt #

Serial number of property

Preferred way to attach security cables:

Recommend attaching the flat screen to the CPU. If using stick-on locking hasp devices, avoid direct attachment to desk furniture.



Lap top security cable looped around a structure.

VGA Port Laptop Lock



Section VII

Security vaults, safes, and containers

3.7.1. Specialized security equipment

a. GSA-approved field safes and special purpose, one and two drawer, light-weight, security containers, approved by the GSA, are used primarily for storage of classified information in the field and in military platforms, and will be used only for those or similar purposes. Such containers will be securely fastened to the structure or under sufficient surveillance to prevent their theft or compromise.

b. GSA-approved map and plan files are available for storage of odd-sized items such as computer media, maps, charts, and classified equipment.

c. GSA-approved modular vaults, meeting Federal Specification AA-V-2737, can be used to store classified information as an alternative to vault requirements described in section III of this Chapter. For guidance in storing classified material refer to AR 380-5.

Note 1: GSA approved field safes that are serviceable can be used to store AA&E storage key containers as long as the safe does not contain classified material. The safe would be under continuous surveillance or in a locked room when unattended.

Note 2: For approved safes refer to the DOD lock program:

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https://portal.navfac.navy.mil/pls/portal/docs/PAGE/NAVFAC/NAVFAC_WW_PP/NAVFAC_NFESC_PP/LOCK_S/PDF_FILES/GSA%20Approved%20Containers.pdf

3.7.2. Forms

- a. SF 700: (Security Container Information) will be used for all DOD approved combination locks. (Digital or mechanical). Part 1 will be posted inside the safe/vault and reflect the date the combination was changed and by whom, listing of contact/POC information. Parts 2 and 2A will be issued to the next higher S-2 for proper storage.
- b. SF 701: (Activity Security Checklist) is required if maintaining classified material, keep records for a minimum of 90 days. SF 701 is also required for areas, rooms, storing military Equipment and supply storage areas.
- c. SF 702: (Security Container Check Sheet) is required for combination type safes/vault. If not storing AA&E keys, keep the SF 702 for 24hrs from the last entry date. If storing AA&E keys (separate location) with in the safe/vault, keep the SF 702 for a minimum of 90 days.

3.7.3. IDS Alarms

Vaults or secured rooms storing classified material/sensitive items that are protected by ICIDS will conduct a monthly test of the alarm system. An individual on the unit's unaccompanied access roster will conduct the test by calling the DES Emergency Communications Center (798-1221/1224), giving building number and zone number and the name of person conducting the test. The alarm-monitoring person will provide instructions on how to perform the test. After the test is completed, the person conducting the test will annotate the test results on a memorandum. Memorandums reflecting alarms tests will be IAW Figure 3-1 and maintained on file in the unit for a period of one year.

Section VIII

Security of supply rooms and equipment storage areas

3.8.1. Requirements

- a. Commanders will designate a secure location for unit supply rooms and equipment storage areas. Caging material is authorized as long as walls extend to the true ceiling and is completely enclosed.
- b. Supply rooms will meet at least Risk Level I structure security requirements identified in AR 190-51, Appendix B-2.
- c. "Off Limits to Unauthorized Personnel" signs will be posted by each entrance door.
- d. Access roster posted by main entrance. This roster can be signed by Supply NCO or CDR.
- e. Keys and locks will be DOD approved and controlled IAW AR 190-51, Appendix D and this regulation.

3.8.2. Accountability

- a. Expendable/perishable items will be controlled/issued as directed by the CDR.
- b. High dollar property/equipment will be provided double barrier protection.
- c. Secure any soldiers AWOL CTA 50 and personal property in designated location segregated from GOVT property. This includes proper recorded inventories.
- d. Establish sign out procedures for bolt cutters.

Section IX

Security of Army Property (High Dollar/Pilferage like items, NVDs, Optics, NBC,...etc)

3.9.1. High Dollar Items:

- a. All military property that are considered as either high dollar items, vulnerable to theft, or portable equipment for example NVD, CBRNE Equipment, Tactical Radios, Lasers, Combat optics, IBA vest/plates, bayonets,...etc will be protected by at least two barriers of protection. EXCEPTIONS ARE LISTED (1) and (2) BELOW
 - (1) AA&E items will be protected IAW AR 190-11
 - (2) Any other property that has a security Controlled Item Inventory Code (CIIC) will be protected IAW AR 710-2 and this regulation.
- b. Examples of double barrier protection can be;
 - (1) A locked Government vehicle inside A perimeter fence that is at least 6 feet tall (not including the top guard.)
 - (2) ICAM locked inside a wall locker that is located inside a secured room.
 - (3) Portable Government Laptop computer secured with a security cable and stored inside a locked room. (A

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cable or other means of security is required for rooms that are less than 12 feet from ground level)

3.9.2. Storage rooms:

- a. All items listed above in Paragraph 9-1 and other government high value items, requires two barriers of security.
- b. In order for a room to be considered a secured area, the room must meet construction standards listed in AR 190-51, Appendix B.
- c. Door must be a minimum of 1 ¾ inch thick solid wood or hollow steel
- d. All hinge mounting screws that are exposed, will be spot welded, peened, covered, or filled to prevent removal.
- e. Windows in excess of 96 square inches and less than 12 feet from ground level equipped with a locking device and covered with bars 6-inch on center each way, with 5/16-inch expanded metal mesh, or 9-gauge chain link fabric. (Note: exception to barring windows is to provide a secure container/wall locker within the room.)
- f. Doors that are secured from the outside will have locking devices conforming to U.S. Army Corps of Engineers guide specifications or with DOD approved padlocks.
- g. Rooms used to secure high value items will have signs posted by the entrance door(s) that state "Off Limits To Unauthorized Personnel" posted and access will be controlled.
- h. Keys and locks will be controlled in accordance with AR 190-51, Appendix D.
- i. SF 701 (Activity security checklist) will be used at the end of the duty day and maintained for a minimum of 90 days.

Section X Protective Seal Control

3.10.1. Requirements

Protective Seals are intended to be used as a supplement to verify the integrity of secured property. At no time will a protective Seal replace the use of a padlock. A protective seal is a closure device that serves as a check against tampering or unauthorized opening. If designed and attached properly, a seal will show signs of tampering/forced entry. When protective seals are used at unit/activity level, the following will be required;

3.10.2. Issuing Office (This will normally be the S-2, Supply Section)

- a. CDR will appoint in writing a Protective Seal Custodian.
- b. List all seals by their serial numbers in a log book.
- c. Issue seals to authorize individuals. Record the date/time of issue, person receiving, seal numbers)
- d. Inventory all unissued seals on a monthly basis (modified DA Fm 5513 or equivalent form may be used)

3.10.3. Receiving Office

Actual use by unit custodian/person.

- a. CDR will appoint in writing a Protective Seal Custodian.
- b. List all seals by their serial numbers in a log book.
- c. Inventory all unissued seals on a monthly basis (modified DA Fm 5513 or equivalent form may be used).
- d. Record the date/time applied, location of item applied, seal serial number(s), and the name of the person applying the seal. Example: The S-2 (Issuing Office) signs out a batch of Protective Seals to the unit SUPPLY NCO (user/custodian). When a seal is destroyed/removed, the unit custodian (user level) will be notified for his/her record. Seals Approved by the Department of Defense. Several seals that have been procured by the Defense Logistics Agency (DLA) are listed in Ref 3.10.4. The following seals are required for the protection of AA&E and classified shipments.

3.10.4. Table of approved seals for AA & E Shipments.

Reference:

Description	National Stock Number (NSN)*
Cable Seal Lock (Figure 10-1)	NSN 5340-00-084-1570
Cable Seal Lock (Figure 10-2)	NSN 5340-01-177-7405
Bolt Seal (Figure 10-3)	NSN 5340-01-260-9935
Bolt Seal (Figure 10-4)	NSN 5340-01-334-0791
Bolt Seal (Figure 10-5)	NSN 5340-01-318-6771

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Car Ball Seal (Figure 10-6)	NSN 5340-01-237-7646
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*Current information on National Stock Numbers can be obtained by contacting the DLA at:

Toll Free: 1-877-DLA-CALL (352-2255)

DSN: 661-7766

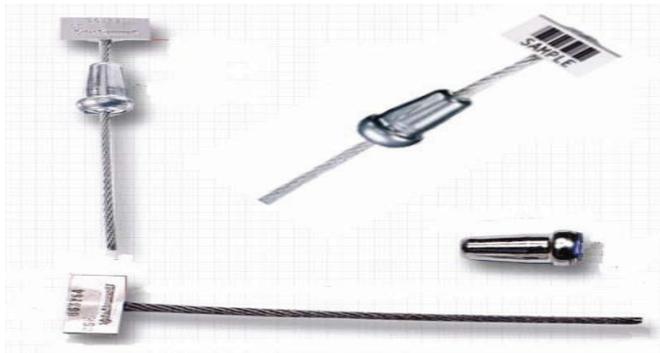
Commercial: 269-961-7766

DLA Web Site: http://www.supply.dla.mil/dla_call.asp

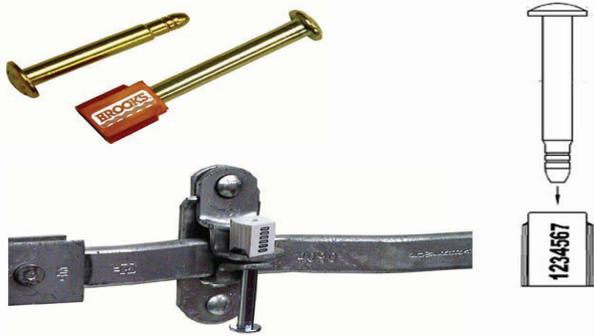
Note: Pictures are not to scale.



Cable Seal Lock (Figure 10-1)



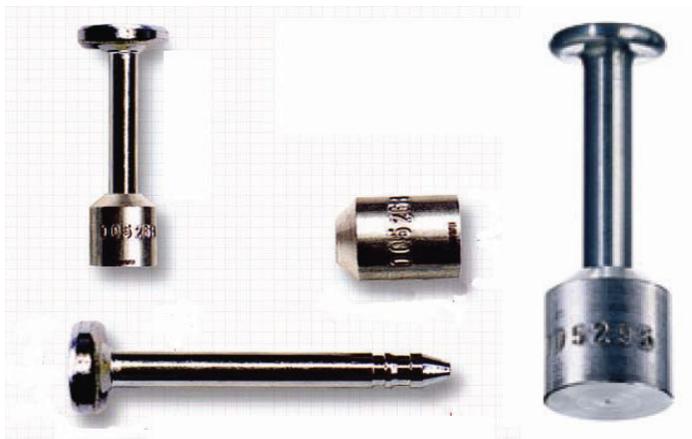
Cable Seal Lock (Figure 10-2)



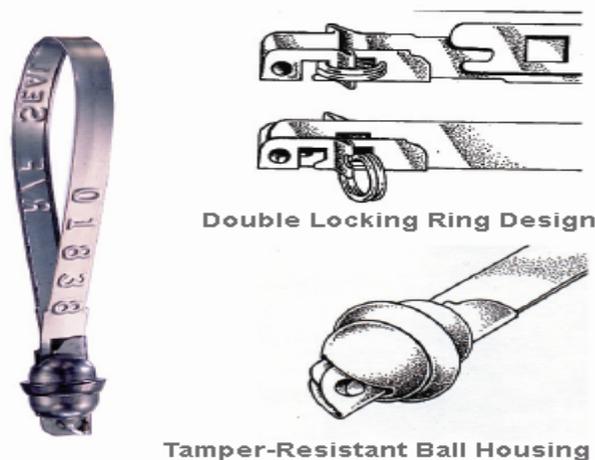
Bolt Seal (Figure 10-3)



Bolt Seal (Figure 10-4)



Bolt Seal (Figure 10-5)



Car Ball Seal (Figure 10-6)

Section XI Security of Controlled Medical items (notes R, Q, C)

3.11.1. Definitions

- a. **Controlled medical substance:** A drug or other substance, or its immediate precursor, listed in current schedules of 21 USC 812 in medical facilities for the purpose of military treatment, therapy, or research. Categories listed in this section are narcotics, amphetamines, barbiturates, and hallucinogens.
- b. **Bulk Storage:** Storage in a facility above the using or dispensing level specifically applicable to logistics warehouse and depot stocks. This applies to activities using controlled medical substances and items (such as pharmacies, wards, or clinics) only when a separate facility (building or room) is used to store quantities that exceed normal operating stocks.
- c. **Note C controlled medical items:** Sets, kits, and outfits containing one or more component Note Q or Note R items.
- d. **Note Q controlled medical items:** All standard drug items identified as Note Q in the Federal Supply Catalog, Nonstandard Drug Enforcement Administration (DEA) Schedule III, IV, V Controlled Substances.
- e. **Note R controlled medical items:** All items identified as Note R in the Federal Supply Catalog, Nonstandard DEA Schedule II Controlled Substances.

3.11.2. Storage requirements

- a. Items identified as Note R will be stored in an approved safe or vault secured with a Class 5 vault door. (Small quantities may be stored in GSA approved safe, IAW AR 190-51, Para 4-7a). At existing facilities where a vault is not feasible, a storage site/room can be used as long as it meets App. B, AR 190-51 secure room standards. (Double doors can be used as long as they are of equivalent structure to a vault door).
- b. Items identified as Note Q will be stored as Note R, however, dual door protection may be eliminated provided entrance door is as specified in Appendix B IAW AR 190-51
- c. Items identified as Note C chests, kits, outfits, other assemblages, or withdrawn controlled medical items stored as per Note R and Q.
- d. Containers storing Bulk Notes R, Q, & C medical items secured in a vault, room require Intrusion Detection System (IDS) alarm.
 - (1) The IDS must consist of at least two types of intrusion sensors. These IDS alarm systems will be tested with the monitoring point on a monthly basis. Maintain alarm test records for one year.
 - (2) Bulk storage areas will be designated and posted as Restricted Areas. Requests for designation of a "Restricted Area" must be FORMALLY STAFFED FOR APPROVAL by the Installation Commander (IC).
 - (3) Facilities storing Notes R, Q, & C will be required to use the SF 701 to record security checks (Containers/Safes require SF 702) (Combination type locks will require SF 700)

3.11.3. Inventories

An inventory of all Note R and Q controlled items, except aviation survival kits will be conducted monthly by a disinterested officer (E-7 or above, or GS-7 or above). The same person can not conduct consecutive monthly inventories.

Section XII

Security of unit motor pools

3.12.1. Definitions

a. Motor pool: A group of motor vehicles used as needed by different organizations or individuals and parked in a common location when not in use. On an Army installation, all units/activities to include non tenant units with 10 or less assigned commercial-type vehicles with no local organizational maintenance support does not have a motor pool, under this regulation, even though the vehicles are parked together.

b. Motor vehicle: A self-propelled, boosted, or towed conveyance used to transport a burden on land. This includes all Army wheeled and track vehicles, trailers, and semitrailers, but not railroad locomotives and rolling stock.

3.12.2. Requirements

a. A formal risk analysis (DA Fm 7278-R) or equivalent automated version is required for all tactical motor pools to determine the level of “physical protective “and “security procedural” measures required.

b. All tactical vehicles when not in use will be parked in unit level motor pools. Exceptions are in time of deployment, ranges, training areas, or when authorized parking at Rail Shipping yards or airfields as appropriate.

c. When not in use and in non-combat areas all tactical vehicles will be secured rendering them inaccessible by locking the doors or steering wheel is made inoperable with security chains or cables IAW appropriate TMs.

d. “Off Limits to Unauthorized Personnel” signs will be posted by all entrances.

e. “No POV” signs will be posted by all entrances.

f. Tactical vehicle parking areas will be at a distance from the perimeter fence as determined by the risk analysis. (Risk Level II requires a 20 feet stand-off or as far as possible)

g. Perimeter fencing.

h. Protective lighting.

i. Unit security guard checks as determined by the risk level.

3.12.3. Perimeter fencing and lighting

a. Perimeter fence: Fencing used will meet the requirements of U.S. Army Corps of Engineers Drawing Code STD 872-90-00 Series. The minimum height will be 6 feet tall not including the top guard. Fencing will be at least 9 gauges and the bottom of the fence will not be above 2 inches off the ground. For further fencing requirements refer to FM 3-19.30, Chapter 4.

b. Perimeter wall: Any wall over 6 feet tall which delineates a boundary and serves as a portion of the perimeter fence. These walls may be constructed of reinforced concrete, masonry, or stone.

3.12.4. Key and Lock control

a. All units/activities will establish SOPs for the control and accountability of keys/locks for vehicles, buildings, storage areas, and perimeter access points.

b. Use of master keys or lock sets to secure vehicle steering wheels are prohibited.

c. Consolidated motor pools will designate one unit as overall in charge of motor pool security. This includes responsibility for perimeter fencing, lighting, key and lock control IAW AR 190-51, Appendix D. A local SOP will be developed to address specific responsibilities.

3.12.5. Security of Tactical Vehicles

While in garrison, all tactical vehicles, trailers with lockable compartments, Gators, etc., will be secured when parked and unattended. Locks will be DOD approved. Security chains will be at least 5/16th inch steel. (Unless manufacturer equipped cables are installed). Exemption to vehicle security will be POL vehicles, the steering wheel or doors will not be secured. The rear hatches (fuel dispensers) and top hatches (if applicable) will be secured if vehicle contains fuel. Locks will be DOD non-sparking padlocks. Master keys or keyed alike keys will not be used to secure vehicle steering wheels.

3.12.6. Security of PLL Property

Unit repair parts will be stored in a single area accessible only to maintenance or supply personnel.

- a. Access roster is required and posted by the entrance to the storage location.
- b. "Off Limits to Unauthorized Personnel" signs will be posted by entrances.
- c. Storage area will meet at least Risk Level I security and structure requirement IAW AR 190-51, Para 3-11 and Appendix B.
- d. Locks in use will be DOD approved.
- e. Local sign out procedures will be established for accountability of repair parts.

3.12.7. Security of Tool Rooms

Commanders will appoint in writing a tool room custodian. Tools will be hand receipted to the custodian and tools will be signed out on DA Fm 5519 or equivalent form. Maintain these forms until all tools are returned.

- a. Access roster is required and posted by the entrance to the storage location.
- b. "Off Limits to Unauthorized Personnel" signs will be posted by entrances.
- c. Storage area will meet at least Risk Level I security requirement IAW AR 190-51, Appendix B (Secured Room). Caging material is authorized as long as it completely encloses the room to include top portion. Tool containers loaded on military trucks will be secured when not in use.
- d. Locks in use will be DOD approved.
- e. High dollar tools will be marked for unit identification and provided double barrier protection.
- f. Mechanics will sign for their tool kits/box and the key can be personally retained by the mechanic, a copy of the key can be retained by their supervisor or CDR if it is stored in a locked container with controlled access.
- g. SOP will address issue/receiving procedures and reconsolidation at end of duty day.
- h. Tool kits/boxes will be secured when not in use.

Section XIII**Airfield Security****3.13.1. Airfield Management responsibilities**

Airfields will be designated as "Restricted Areas". Signs that contain the warning notice IAW AR 190-13 will be prominently posted at a distance not to exceed 100 feet apart on the perimeter fence line.

- a. The Airfield Commander/Manager will have a current and executable written Physical Security plan formatted IAW AR 190-13. Copies of the PS Plan will be forwarded to appropriate Commands on the airfield and the Installation Physical Security Office. Privately Owned Vehicles (POV) are prohibited from the flight line or other areas where aircraft are parked, except when authorized in writing by the airfield Commander.
- b. A Physical Security Officer (PSO) will be appointed in writing and will maintain liaison with tenant units on the airfield. Risk Analysis will be conducted on respective areas to ensure security measures are met or exceeded.
 - (1) The PSO as directed by the Airfield CDR is required to conduct assessments/inspections of tenant units to ensure compliance.
 - (2) Establish access badge procedures IAW AR 190-13
- c. Key control custodians will be appointed in writing by the Commander. All keys to gates and other locations in used by the airfield management will be controlled IAW AR 190-51, Appendix D.
- d. Access Control: Entry to and exit from all buildings associated with the aviation facility, aircraft parking areas, and support equipment storage areas controlled at all times. Entry and exit can be controlled through manpower and procedural means, mechanical means, or electronic means.
- e. The Airfield Management will develop a terrorism counteraction contingency plan. At a minimum this plan will address;
 - (1) Hijackings on the airfield
 - (2) Bomb Threats/Explosions
 - (3) Shootings
 - (4) Suicide/Aircraft attack
 - (5) Any other threat identified by the Airfield CDR.

Note: Focus is to have a "Plan of Action"/Contingency plan in the event of such incidents occur on the airfield.

3.13.2. Unit level responsibilities

- a. Aircraft mounted weapons: When not in use, aircraft with weapons mounted will be parked inside an aircraft parking area. The parking areas for aircraft with mounted weapon(s) will be lighted and have IDS or continuous

surveillance. When operational readiness permits, weapons mounted on aircraft that are easily removable, will be removed and stored in an arms room storage area meeting the requirements for storage of category I or II AA&E, or will be under continuous armed surveillance. Weapons that remain installed on the aircraft will be made inoperable by removing barrels or firing mechanisms when practical. Removed components will be stored in a secure location.

(1) Weapon systems that are impractical to dismount, due to operational readiness or damage to the weapon system will be made inoperable by the removal of essential component or components. Electrical power may be considered an essential component on the 20mm and 30mm weapon systems. When electrical power is the only essential component removed from the weapons systems, AMMUNITION for those weapons systems will not be stored on board the aircraft. Level II security measures per AR 190-51 will apply.

(2) A secured location is an arms room, an area under continuous armed surveillance, or any structure meeting the requirements for storage of category I or II AA&E in AR 190-11.

b. When not in use, aircraft equipped with manufacturer-installed or approved modification work order ignition and other door-locking devices will be secured. Keys to locking devices and ignitions will be controlled and accounted for on DA Form 5513. Aircraft keys are PROHIBITED from personal retention. Duplicate keys serving as operational keys at maintenance facilities are also PROHIBITED. When aircrafts are not stored in hangars, they will be in close proximity to each other.

c. Parked aircraft will be checked by the responsible unit as determined by the appropriate risk level. Security checks/records will be maintained at unit level for a minimum of 90 days.

(1) Risk Level I: Requires security checks not to exceed every 4 hours for unattended aircrafts.

(2) Risk Level II: Requires security checks not to exceed every hour for unattended aircrafts.

(3) Risk Level III: Requires guards providing continuous surveillance.

d. Privately Owned Vehicles (POV) will be prohibited from the flight line or other areas where aircraft are parked, except when authorized in writing by the aviation facility or airfield Commander.

e. Entry to and exit from all buildings associated with the aviation facility, aircraft parking areas, and support equipment storage areas will be controlled at all times. (Entry and exit can be controlled through manpower and procedural means, mechanical means, or electronic means)

f. Badge control measures will be strictly enforced in areas designated as restricted areas.

g. Tenant CDR will coordinate with the Airfield CDR/Manager regarding any security requirements/issues.

3.13.3. Flight Operations

If more than one unit stores property (ie., NVDS, aircraft keys, fuel cards, etc.) in the same room/location, a bi-lateral storage agreement is required to established responsibility, control, and accountability of consolidated property. One CDR will be designated as overall responsible. All CDR will approve and sign this agreement.

3.13.4. Aviation Life Support Equipment (ALSE)

a. ALSE/high dollar items will be provided double barrier protection, i.e., in a locked container in a secured room. Access roster to the equipment storage area will be posted. "Off Limits To Unauthorized Personnel" signs will be posted by the entrance(s). A bi-lateral storage agreement is required for consolidated storage facilities. All CDR will approve and sign this agreement.

b. Pen Distress flares: CAT 1.3 and Signal Smoke Illums: CAT 1.4 will be stored and secured in approved containers. Quantities will be limited to operational necessity.

c. End of duty day checks will be established utilizing SF 701 (Activity security checklist) and maintained for a minimum of 90 days.

Section XIV

Military Customs Operations

3.14.1. Purpose:

The Military Customs Program (MCP) is a written joint agreement between the Garrison Commander, Fort Campbell and the Port Director of Customs Border Protection (CBP) Office at Memphis, TN. The program is intended to supplement rapid deployment and redeployment forces. The program will not circumvent regulatory US Customs and United States Department of Agriculture (USDA) laws. This regulation prescribes responsibilities for customs/law enforcement matters on Fort Campbell and updates Ft Campbell police/criminal investigation reporting procedures involving customs violations. It provides guidelines concerning required training for personnel performing customs/law enforcement services within the Customs Territory of the United States.

3.14.2. Applicability:

This regulation applies to all units of the Active Army, other branches of the Armed Services, the U.S. Army Reserve, the Reserve Officers Training Corps (ROTC), and the Army National Guard (ARNG) when in Federal Service that perform a military customs law enforcement service. Authorized Military Dependents and DOD Civilian employees with official orders will comply with this regulation, CBP, and USDA requirements while processing at Fort Campbell. This regulation is applicable during full mobilization/demobilization of units.

3.14.3. Scope.

The Military Customs Program (MCP) is a valuable asset to the Fort Campbell Military Community. In order to facilitate the customs missions, the Passenger Processing Center (PPC) building# 7162 on Campbell Army Airfield can be utilized for processing incoming personnel. Currently the PPC can accommodate up to 250 passengers. Sterile boundaries will be established at the PPC to include the surrounding area and the aircraft. This area will remain isolated and free of interference from unit members and family members from the start to completion of customs mission. All disembarking passengers will be customs cleared to include baggage clearance via RAPISCAN X-ray system. This policy will be adhered to; otherwise, returning OCONUS aircraft will be diverted to another port of entry.

3.14.4. Responsibilities.

a. UNITS.

(1) It is the parent unit's responsibility to coordinate all incoming flights with Campbell Army Airfield Flight Operations (270) 798-7146/7147 at least 72 hours in advance to arrange customs. Units will provide the following information to Flight Operations. Failure to provide accurate information will result in the aircraft being diverted to another air terminal to clear customs or delay arrival time and or proper Customs clearance at CAAF.

- (a) Type of aircraft.
- (b) Number of military passengers (# of Space A/civilians) and unit.
- (c) Type of cargo.
- (d) Point of origin.
- (e) Scheduled arrival date and time.

(2) Homecoming ceremonies will not be held on the airfield. The parent unit will arrange the facility to conduct homecoming and bus transportation for the returning soldiers. Homecoming celebrations are encouraged and is very important for the moral support of soldiers. Possible homecoming sites other than the PPC, include gyms, D.W. Recreation Center, Dryer Field House, Hangar#1, #2, and #3, or unit areas.

b. FLIGHT OPERATIONS will contact (at least 72 hours in advance) the Directorate of Emergency Services, Physical Security Office at (270) 798-7740 or 956-4345/4346 or 798-3990 to coordinate for military customs inspectors. After duty hours contact the MP Desk at 798-7111/7112.

(1) The Military Police Desk will contact the Military Customs Coordinator through the Installation Physical Security Office.

(2) The Military Customs Coordinator will coordinate the customs mission with the following personnel:

- (a) Flight Operations Campbell Army Airfield.
- (b) Directorate of Logistics (DOL) for utilization of PPC, Hangar# 3, or as directed.
- (c) Military Police Company responsible for providing Military Customs Inspectors. (When applicable)
- (d) Military Police Working Dog Section (If available).
- (e) U.S. Customs, Nashville or Memphis.
- (f) U.S.D.A., Nashville or Memphis.

c. INSPECTORS: Personnel selected for Customs operations will be provided by the DES Physical Security Office, D.A. Civilian Police, and on order form the 716th MP BN. All selected inspectors will be OPCON to the Director of DES. All inspectors will be trained and certified annually by the appropriate CBP office. Personnel that have been trained are designated as Military Customs Inspector Excepted, MCI(e). Personnel performing duties as MCI(e) will be directly performing duties in support of Homeland Security-CBP. MCI(e) Inspectors will follow guidelines and regulations identified in Custom Form 55 (Designation, Custom Officer (Excepted)).

Note: Procedures for conducting Customs operations:

d. US CUSTOMS CLEARING PROCESS:

- (1) Inspect & clear aircraft.
- (a) Check General Declaration Form (CBP Form 7507) (Signed by pilot in charge or designated crew chief).
- (b) PAX manifest.
- (c) Cargo manifest.

- (d) Issue A/C clearance & safeguard order (PPQ Form 250) (When authorized by CBP).
- (e) Inspect aircraft for cargo manifest compliance and USDA requirements.
- (f) Supervise & download all international trash (double bag & tag w/ USDA tape).
- (2) Once above is completed.
 - (a) Senior Customs official will authorize download of PAX & Cargo.
 - (b) Each person must turn in Customs Declaration Form 6059B or DD Form 1854.
 - (c) Inspect for cargo, equipment/shoes (For USDA compliance).
 - (d) All carry on bags are subject to inspection.

Section XV

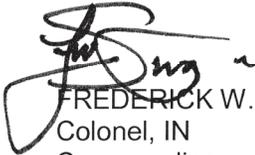
Unit Mail Rooms (UMR)

3.15.1. Purpose:

This chapter provides the Physical Protective and Security Procedural measures required for a military mail room. This chapter does not replace the requirements specified in DOD 4525.6-M and AR 600-8-3.

3.15.2. Responsibilities

- a. **COMMAND:** Commanders will provide a dedicated room for the storage and handling of US mail. UMR should be located at a corner of the building. The room will meet security structural standards for doors, locks, walls, windows, ceiling, and floors (minimum of Risk Level I) specified in Appendix B-2, AR 190-51. Appoint in writing a Mail Clerk/handler, and Mail Room Officer.
- b. **ACCESS CONTROL:** An "Off Limits to Unauthorized Personnel" sign will be posted for each entrance to the mail room. DD Form 1115 "No admittance" is acceptable. Access roster will be prepared and posted by the entrance (SSN are not required). This roster can be signed by the Mail Room Officer or CDR.
- c. **KEY CONTROL:** Keys that are in use for the mail room entrance door(s), internal areas (includes padlocks) will be accounted for and signed for on DA Form 5513 IAW AR 190-51, Appendix D. Mail box keys/combinations are exempt; these keys/combinations will be tracked on mail form DD Form 2262 (Receptacle Record) and PS Form 1628 (Key register) IAW DOD 4525.6-M. When soldiers permanently depart the unit, mail box combinations (if applicable) or key cylinders will be rotated between other mail boxes or left inactive for 3-months.
- d. **SAFES/CONTAINERS:** A secure container/safe or caged room will be used for safeguarding insured/registered mail/packages. Combinations (if applicable) to safes/containers require the use of SF 700. Combination locks will be changed initially when safe is in operation, when compromised, annual basis, or change in custodian. Field safes (if used) will be secured to a fixed object within the mail room.
- e. **HANDLING SUSPICIOUS MAIL:** Written procedures will be established for the handling and reporting of suspicious mail or packages that are received/discovered.



FREDERICK W. SWOPE
Colonel, IN
Commanding

DISTRIBUTION:
Intranet

- SAMPLE -

PERSONAL PROPERTY RECORD (For use of this form see CAM Regulation 190-1. The proponent of this form is DES)										PAGE 1 OF 1
NAME OF OWNER Jones, Erik M.		RANK SPC	LAST 4 OF SSN 6789	SIGNATURE OF OWNER <i>Erik M Jones</i>		DATE OF PREPARATION 15/04/2008				
ITEM NO.	NAME OF ITEM	QTY	BRAND NAME, MODEL OR STYLE/DESCRIPTION	SERIAL NO.	DATE	VALUE	VERIFIED BY: PRINTED NAME & SIGNATURE			
1	IPOD Digital Player	1	APPLE, 30GB (New condition)	5722	15/04/2008	\$350.00	Smith, Bryan T <i>SL</i> <i>Bryan T Smith</i>			
2	Media Video Game	1	X-BOX 360 (New condition)	112980320	15/04/2008	\$425.00	Smith, Bryan T <i>Bryan T Smith</i>			
3	DVD	25	Assorted/ variety (Used condition)	N/A	15/04/2008	\$400.00	Smith, Bryan T <i>Bryan T Smith</i>			
4	Ring	1	14k gold (Scratched condition)	EMJ	15/04/2008	\$200.00	Smith, Bryan T <i>Bryan T Smith</i>			
5	TV/ DVD	1	Samsung 20" UltraSlimfit SDTV (Used condition)	txt2082	15/04/2008	\$249.00	Smith, Bryan T <i>Bryan T Smith</i>			
6	Jacket	2	Mens Brown leather-SHORTS size:L (worn condition) Mens-Black leather-Bomber size:L	N/A	15/04/2008	\$400.00	Smith, Bryan T <i>Bryan T Smith</i>			
7	Boots	1	Danner, Brown Leather size: 10 (Worn condition)	N/A	15/04/2008	\$100.00	Smith, Bryan T <i>Bryan T Smith</i>			
8	SOFA /Recliner	1	Manhattan, brown leather recliner (Used condition)	N/A	15/04/2008	\$399.00	Smith, Bryan T <i>Bryan T Smith</i>			

Figure 3-1 Sample FC Form 4986 (Personal Property Record) "DO NOT LIST TA-50"

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APPENDIX HH
Ft. Campbell Environmental Requirements

FORT CAMPBELL, KENTUCKY

TECHNICAL

DESIGN

GUIDE

Instructions for Use

This Document has been prepared jointly by the Fort Campbell Directorate of Public Works and the Louisville District Army Corps of Engineers. Contents of the document are controlled by Public Works. It is updated and housed on the Directorate of Contracting website under LINKS. The document contains mandatory criteria, policies, and procedures that apply to all design and construction at Fort Campbell.

To aid the reader, the document utilizes (blue) hyperlink text, which can be accessed by “clicking” the colored text. In addition, much of the document is formatted using construction-industry “CSI” standards and Unified Facilities Guide Specifications (UFGS).

Highlighted text is part of the most recent document update 15 November 2010.

TECHNICAL DESIGN GUIDE

CHAPTER 2

General Requirements

PARAGRAPH

2.0 General Design Provisions

[General Design Criteria](#)

[Deliverables](#)

[Antiterrorism / Force Protection](#)

[Fire Protection/Life Safety](#)

[Metric Design](#)

[Surveying and Mapping Requirements](#)

[Geotechnical Requirements](#)

[Cost Engineering](#)

[Engineering Instructions for Field Personnel](#)

[Transfer and Acceptance](#)

2.1 Special Ft. Campbell Criteria

[Energy Program](#)

[Historic District](#)

[Environmental](#)

[Underground and Aboveground Storage Tanks](#)

[Solid Waste Disposal / Recycling Diversion Practices](#)

[Erosion and Sedimentation Control](#)

[Permits](#)

[Fort Campbell DPW Computer Software Capabilities](#)

[Installation Internet Addresses](#)

2.0 General Design Criteria

MILCON Projects

For new construction in the MILCON program, design effort will be completed in accordance with the approved Project Management Plan (PMP), design contract scope of services, and identified criteria. The ACSIM, [Installation Design Standards](#), together with this document shall both apply to engineering and construction actions.

OMA Projects

For Operations and Maintenance projects, design effort will be completed in accordance with the DPW contract scope of services. Scope of design services shall be based upon the designer prepared project specific Scope Definition Document that is completed after a pre-design conference and site evaluation.

2.0.1 Deliverables

Hard-copy Drawings

Final construction contract drawings and as-built drawings submitted for official government records shall be digital and placed on 24" x 36" plastic film (Mylar) sheets. Sheet border shall be provided by DPW-EDB. A graphic scale shall be shown on each sheet of the drawings.

Electronic drawings submitted for review shall be reproduced on 8-1/2" x 11" or 11" x 17" paper using a laser printer.

Digital Drawings

CADD Drawings containing Geographic data (Site Plan, Survey and Mapping Plan, Storm Sewer Plan, Electrical Utilities Plan...) will use the Tennessee (TN) State Plane Coordinate System. The Datum used will be the North American Datum of 1983 (NAD83). The mapping units will be US feet. Vertical upland topographic surveys will use North American Vertical Datum (NAVD) 1988.

Digital geographic data will have accuracy within two feet unless otherwise stated in the Scope of Work.

Digital geographic data will be 99% free of topological errors including, but not limited to: the absence of dangling nodes, undershoots, overshoots, and snapped nodes for line segments (road centerlines, edge-of-curb, elevation contours...); the existence of features that have area square footage (building footprints, parking lots, sidewalks...) will have polygon representations in the CADD drawings.

All CADD drawings shall be done on Intergraph Microstation Release 5 or a compatible approved equal system.

The CADD Drawing file naming convention shall follow Chapter 2 of the "A/E/C CADD Standards" Document within the Spatial Data Standards Facilities/Infrastructure/Environment (SDS/FIE) model maintained by the CADD/GIS Technology Center (<http://tsc.wes.army.mil>).

Layer/Level assignments of feature data within the CADD drawings will follow 'Appendix A: *Model File Level/Layer Assignment Tables*' of the "A/E/C CADD Standards" Document within the Spatial Data Standards Facilities/Infrastructure/Environment (SDS/FIE) model maintained by the CADD/GIS Technology Center (<http://tsc.wes.army.mil>).

The "A/E/C CADD Standards" Document (26MB) are available at the following internet site: <http://tsc.wes.army.mil/products/tssds-tsfs/tssds/projects/sds/>

To request an "A/E/C CADD Standard" CD, go to http://tsc.wes.army.mil/comments/aecstds_comments/AECSDS-CommentForm.asp and fill out the CD request form.

The 'CADD Drawing file naming convention' is referenced in the '\Release 2_x Document\' folder on of the "A/E/C CADD Standards" CD. It is an Adobe Acrobat PDF document named 'volume1.pdf'. See Chapter 2 for 'CADD Drawing Naming Convention' standards.

The 'Layer/Level assignments of feature data within CADD drawings' is referenced in the '\Release 2_x Document\' folder on the "A/E/C CADD Standards" CD. It is an Adobe Acrobat PDF document named 'volume1.pdf'. See 'Appendix A: *Model File Level/Layer Assignment Tables*' within the PDF document.

For MILCON projects, Drawings shall also be prepared in accordance with COE Standards available from the PE/A.

For OMA projects, Drawings shall also be prepared in CADD format using standard 24" X 36" sheets.

Drawings for all projects that are Ready to Advertise (RTA) shall be in the approved electronic format.

Specifications-

For MILCON projects, specifications for projects that are RTA shall be included only in the approved electronic format.

For OMA projects, Construction specifications shall be prepared as agreed in the Scope Definition Document. Specifications for projects that are RTA shall be included only in the approved electronic format.

Design Analysis

For MILCON projects, design support documentation shall be provided. The Design Analysis shall be completed in the approved format. At the conclusion of the design effort, the documentation shall be provided in an approved electronic format.

2.0.2 Antiterrorist / Force Protection

All new construction projects including additions and alterations shall include antiterrorist / Force Protection (AT/FP) features in accordance with UFC 4-010-01, DOD Minimum Antiterrorism Standard for Buildings.

2.0.3 Fire Protection/Life Safety

Every project including MILCON and OMA shall be designed using only the following DOD directed criteria:

- [UFC 1-200-01, General Building Requirements](#) shall be used mandatory guidance concerning required model building codes for design and construction.
- Fire Protection requirements shall comply with [UFC 1-300-01, Fire Protection Engineering For Facilities](#).
- Exiting requirements shall comply with the Life Safety Code, NFPA 101.
- No asbestos containing materials shall be used for construction.

2.0.4 Metric Design

Consideration of Metric dimensioning (SI) is required for all MILCON projects. Project specific guidance is available through the Louisville District project PE/A. For OMA projects, metric dimensioning is used on a case-by-case basis: If the original project was developed in English (IP) units, follow-on OMA projects can also use English inch-pound (IP) units. If the original documents were developed in metric units, the OMA projects must also be executed in metric.

2.0.5 Surveying and Mapping Requirements

Fort Campbell has the following control point network and datum requirements for every MILCON project.

- Two new control monuments shall be established on site and tied to Tennessee State Plane Coordinate System NAD 83.
- The survey control points are GPS Class I and Class II Horizontal with additional elevation coming from an off-post USGS Class I bench mark to establish Second Order Class II vertical on all survey control points.
- Hardcopy books of existing points (including sketches) are maintained at both Fort Campbell (POC Scott Slade (270) 798-9724) and the Louisville District (POC Chris Heintz (502) 315-6408).
- For work contracted by Louisville District, the contractor is required to establish a permanent baseline at the project. In areas where existing concrete monuments are abundant, iron pins with caps are allowed. The contractor supplies CELRL-ED-M-SM (Survey and Mapping Section) with description sheets for the points they establish and the District forwards the information to Fort Campbell.

- Similarly, OMA work performed by Fort Campbell will have the survey control point data reported to the DPW POC for forwarding to the District.

2.0.6 Geotechnical Requirements

The following is a list of aggregate sources for concrete, asphalt, stone-base, sub-base, and DGA which met or exceeded the quality standards set forth in the technical sections of the COE specifications for Fort Campbell projects:

Coarse material sources for base course, bituminous paving, cast-in-place structural concrete, concrete pavements, and pre-cast architectural concrete.

- Hopkinsville Stone, Hopkinsville, KY, Ledges 11 to 17, about 85 feet.
- KY Stone Company, Canton, KY, Ledges 2 and 3, about 33 feet.
- Vulcan Materials, Gilbertsville, Kentucky. Ledges 4 and 26, about 393 feet.
- Martin-Marietta Aggregates, Smithland, Kentucky, Ledges 16 to 19, about 51 feet.
- Vulcan Materials, Clarksville, TN, Ledges 16 & 17, about 30 feet.
- Winn Materials, Clarksville, TN, Ledge 3, about 20 feet.

Natural fine aggregate sources for concrete, asphalt, stone-base, subbase and DGA are listed below.

- Delta Materials, Henderson, Kentucky.
- Ingram Materials, Paducah, Kentucky.
- Mayfield Aggregates, Mayfield, Kentucky.
- Delta Materials, Cairo, Illinois Manufactured fine aggregates for concrete:
- Hopkinsville Stone Company, Hopkinsville, Kentucky.

POC for further information at the Louisville District contact:

Mr. David Black (502) 315-6436

Mr. David Kiefer (502) 315-6445

2.0.7 Cost Engineering

Every project both MILCON and OMA requires a construction cost estimate. For MILCON projects the estimate shall be prepared using M-CACES software. Cost estimates for OMA projects shall be provided to the DPW at the time of submittal for bid issue. Official government cost estimates are not to be made public. They remain the property of the Government, and FOR OFFICIAL USE ONLY.

2.0.8 Engineering Considerations and Instructions for Field Personnel

This documentation is required for all MILCON projects, and is normally a part of the Design Analysis. It offers the designers an opportunity to provide a written document

providing important design facts to the construction field personnel. An example format of the [Engineering Instructions](#) is provided, which shall be revised and reflect project specific information.

2.0.9 Transfer and Acceptance

Completion of the Transfer and Acceptance of Military Real Property, DD Form 1354 is required for all projects. A draft copy of this information must be submitted with the Final Design submittal. This requirement applies to both MILCON and OMA program projects.

2.1 Special Ft. Campbell Criteria

2.1.1 Army Energy Program

2.1.1.1. AR 420-1, Chapter 22-4k(5), "Provide and require a prescriptive energy design guide for every scope of work at every installation if one is not in use or available."

2.1.1.2. Title I, Subtitle A, Section 104 of EPACT 2005, "To meet the requirements of an Agency for an energy consuming product, the head of the agency shall...procure an Energy Star product or FEMP designated product."

2.1.1.3. Title V, Subtitle C, Section 523 of EISA 2007, "[I]f lifecycle cost-effective, as compared to other reasonably available technologies, not less than 30 percent of the hot water demand for each new Federal building or Federal building undergoing major renovation be met through the installation and use of solar hot water heaters."

2.1.1.4. Title II, Subtitle A, Section 203a, Energy Policy Act (EPACT) of 2005 "... of the electric energy the Federal Government consumes during any fiscal year, the following amounts shall be renewable energy: (1) Not less than 3 percent in fiscal years 2007 through 2009"

2.1.1.5. Section 2, Executive Order 13423 "ensure that at least half of the statutorily requires renewable energy comes from new renewable sources."

2.1.1.6. The National Defense Authorization Act (NDAA) of 2007 signed on October 17, 2006 codified DoD's voluntary renewable energy goal of using 25% renewable energy by 2025.

2.1.2 Historic District

The "Clarksville Base" portion of Ft. Campbell cantonment area is eligible for the National Register of Historic Places as a significant Cold War historic district. Designers are

required to consult with the State Historic Preservation Office (SHPO) and the federal Advisory Council on Historic Preservation for any projects that are sited at the Clarksville Base. POC is DPW Environmental Division Cultural Resource Manager at 270-798-7437.

2.1.3 Environmental

The Environmental Division is under the guidance of the Directorate of Public Works at Fort Campbell. The [Environmental Division](#) Internet address will provide added information and points of contact.

Environmental Compliance is mandatory for all projects.

- **Designers shall NOT contact Kentucky or Tennessee regulators** regarding environmental issues. Contact the Ft. Campbell Environmental Div.
- A 40-hour "Environmental Quality Officer" course is available bi-monthly on post by Ft. Campbell's Environmental Division. Designers are encouraged to attend.
- Designs shall take into consideration wetlands and endangered species on the installation.
- Several environmental topics contained in this document include the following:

APPENDIX A:

[Occupational Health Considerations](#)

[Clean Air Act](#)

[Clean Water Act](#)

[Safe Drinking Water Act](#)

[TSCA \(Lead Based Paint and Lead Containing Paint\)](#)

[\(Radon\)](#)

[FIFRA \(Pesticides\)](#)

[Solid Waste Disposal/Diversion Practices](#)

[Hazardous Waste Disposal Practices](#)

[Emergency Planning and Community Right to Know](#)

[NESHAP National emission standards for hazardous air pollutants](#)

APPENDIX B:

[State Water and Sewer State Submittals](#)

2.1.4 Underground and Aboveground Storage Tanks

Aboveground and underground petroleum product storage tanks shall not be permitted at new construction projects without design review and approval by the Directorate of Public Works , Environmental Division Petroleum Storage Tank Program Manager.

Underground Storage Tanks (USTs) shall not be installed without approval from the DPW Environmental Division. If permitted, USTs shall be double walled steel fiberglass coated with interstitial monitoring and automatic tank gauging. The monitoring system shall be compatible with the systems already in use and capable of being remotely monitored by the Environmental Division. No used oil USTs shall be installed.

Above Ground Storage Tanks (ASTs) shall not be installed without approval from the DPW Environmental Division. If permitted, ASTs shall follow requirements outlined in the Ft. Campbell: [Standard Design Requirements For Aboveground Fuel Tanks](#) prior to submission for permit requests.

Design for used petroleum products holding and storage shall not include tanks. Only 55-gallon drum containers shall be used that are placed on approved pavement materials properly designed for hazardous spill containment.

2.1.5 Solid Waste Disposal / Recycling Diversion Practices

In the interest of reducing waste, Fort Campbell is actively recycling and reducing waste in all on-post operations. Contractors are required to participate in on-post programs. They are encouraged to find ways of reducing waste. Recycling shall be practiced to the maximum extent possible. Refuse materials shall be separated in accordance with installation policies and practices.

It is the intent of the installation to divert at least 50% (by weight) of all construction, renovation, and demolition debris from the Woodlawn C/D landfill. Recyclable waste materials shall not be landfilled on or off post. Recyclable materials shall be transported to designated locations for recycling or reuse.

Contractors must evaluate all diversion options and make good-faith effort to achieve the highest diversion rate within the project schedule and budget.

Contract specifications shall require at least a 50% diversion of construction and demolition (C & D) waste materials such as wood, plumbing fixtures, electrical materials (lights and panels), windows, doors, toilet partitions, HVAC equipment, and scrap metals be diverted from the landfill. Diversion can be accomplished by deconstructing the wood buildings and components per instructions below or by moving the structure off-post. Construction specifications shall require a C&D Waste Management Diversion Plan to be submitted and approved by DPW.

All material disposal and diversion shall be handled in accordance with Appendix A-7, [Solid Waste Disposal/Diversion Practices](#). Salvageable materials shall be disposed of as per the contract specifications. If salvageable materials are transported off the installation, the contractor shall provide the project COR with the following information, type of material, method of disposal, and weights of material.

2.1.6 Erosion and Sedimentation Control

Erosion and sedimentation control is required for activities that result from opening, operating, and closing all site excavation and excavation at present and planned borrow pits on the Fort Campbell Military Reservation.

The requirements contained in the Appendix I, [Erosion and sedimentation Control](#) shall apply at Fort Campbell, KY by its military units and all authorized subcontractors. It provides step-by-step procedures to help plan, design, and install soil and water Best Management Practices (BMP). It does not override any local, city, county, state, or federal rule, regulation, or law, including job safety and utility safety laws. Where there is a difference between this plan and any language contained in any contractual document, the contractual document must be followed.

The guidance provides criteria for the design, installation, and maintenance of water management and sediment control practices to abate nonpoint source (NPS) Pollution. Those responsible for design of these practices should evaluate the conditions existing on a particular site and determine if the minimum criteria contained in these standards are adequate or if more stringent criteria should be used.

Properly applied, this information will provide an efficient plan to operate the borrow pit site(s) while ensuring maximum safety and minimizing adverse impact to the environment. By following these guidelines, it is the intent of this management tool to furnish a uniform plan that will provide continuity throughout the life of the borrow pit.

2.1.7 Permits

Local permits are required for construction activities at Ft. Campbell. These permits must be Contractor completed and submitted prior to beginning any construction effort. Contract documents must identify and contain permits that will apply to the contract. . Local permits shall include demolition, digging, excavation, compaction, electrical, fuel tank installation, and environmental. Several of the specific permit forms that apply are located within sections this document along with information identifying appropriate installation drop-off locations and points of contact.

[Digging and Excavation Permits](#) [Borrow Permits](#)

In addition, Specifications requirements shall include Contractor requirements for obtaining all utility and state (Kentucky or Tennessee) permits. These are related to utility services and various environmental topics.

EXAMPLE

Engineering Considerations and Instructions for Field Personnel

B-1 General

B-1.1 Contractor's construction trailers on site must be wired per NEC, meet separation clearances, have electric meters but no water meters. COE is to coordinate with DPW Master Plans and utility personnel.

B-2 Civil

B-2.1 Notification of road closures during construction shall be given to the following agencies:

- Provost Marshall Office, Traffic Section (270) 798-6812.
- Directorate of Directorate of Public Works , Master Plans, (270) 798-2909.

B-3 Geotechnical

B-3.1 During stripping and rough grading, positive surface drainage should be maintained to prevent the accumulation of water. The exposed subgrade materials are likely to be soft in some locations. Also, if conditions are encountered which are different from those described in the plans, the geotechnical engineer should be notified. Once subgrades are established, concentrated loads from construction equipment could cause pumping of the subgrade and require re-compaction.

B-3.2 Foundation designs are based on the subsurface investigation program. To verify that the foundation designs are appropriate for the structures, inspection by Corps of Engineers of the footings and undercutting is very important. Linda Davis (502) 315-6437 or Steve Durrett should be notified of the contractor schedule for performing earthwork and foundations so that inspections of the materials can be performed.

B-4 Utilities / Landscaping

B-4.1 Care should be taken in placement of underground utilities so as not to cause interference with landscaping trees.

B-4.2 Railroad crossings for gas and water piping are to be included in the drawings. The portion of the AREA-03 (the reference from which the details are taken) dealing with railroad crossings is included with these instructions.

B-4.3 Where gas and water piping are shown to be valved and capped for future expansion, the valve should be a gate valve. These are installed to prevent the need to

shut down a section of the main and interrupt service in order to connect a new service line.

B-4.4 Valves should be placed to isolate each building from the main service (water and gas), and to allow only for minimal main shut down when tying to existing main lines.

B-5 Architectural

B-5.1 Hold metal roofing pre-submittal meeting, with construction, supplier, and contractor to discuss standing seam metal roof system specifications.

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Fort Campbell Standard Design Requirements For Aboveground Fuel Tanks (ASTs)

Effective date: 1 January 1999

This S.O.P. has incorporated the National Electrical Code (NEC), National Fire Protection Association (NFPA Code), Underwriters Laboratories (UL), and Industry standards.

1.0 General:

- 1.1 All aboveground petroleum/fuel tanks, (ASTs) shall conform to all Federal, State, Local regulations and guidelines, and with these design requirements. This includes tanks for permanent placement as part of new construction, as replacement of existing storage systems, and tanks used for temporary storage by construction Contractors and military units.
- 1.2 All ASTs shall be double-walled type tanks. Means shall be provided to establish the integrity of the secondary containment.
- 1.3 When there is a discrepancy between any or all of these guidelines, these requirements will be the final authority over all others except NFPA.
- 1.4 The Directorate of Public Works , Environmental Division, Petroleum Storage Tank Manager is the Installation Local Authority Having Jurisdiction (AHJ) who must approve any design proposal and construction before any installation of an AST.

2.0 Definitions:

Fuel tank: is any vessel containing more than 60 U.S. gallons of Class I or Class II flammable liquids.

Emergency Vent: An opening, construction method, or device that will automatically relieve excessive internal pressure due to an exposure fire.

Normal Vent: as a minimum size, all vents shall be at least 1-¼ inches in inside diameter. It must have a bug proof, rain cap secured on top of the vent. The vent must be at least 3 feet higher than the highest point within a 10-foot radius of the ATS.

Anti-siphon valve: a device to prevent any siphoning due to damaged fuel lines, broken pumps, leaky or leaking fuel pumps. This device is not a check valve.

Overfill protection device: a device to serve as a catch basin to prevent any and all overfill spillage. Minimum size shall be 5 gallons.

Fuel Level Gauge: a device that is easily readable that automatically indicates the actual fuel level in the AST. A standard float type gauge is acceptable.

Temporary AST: a fuel tank that will be used for up to 90 calendar days. At which time, it then becomes a permanent installed tank.

Emergency shut-off valve: A device to immediately shut off the fuel supply in case of an emergency or a fire.

Portable Fuel Tank: Any closed vessel having a liquid capacity over 60 U.S. gallons, and less than 2,000 U.S. gallons, and not intended for fixed installation.

Day Tank: A fuel tank, located inside a structure that provides fuel to a engine. The standard size of a day tank is 25 U.S. gallons, but may have the capacity of up to 100 U.S. gallons.

Secondary Containment Tank: A tank having an inner and an outer wall with an interstitial space between the walls and having means for monitoring the interstitial space for a leak.

Flammable Liquid: Any Liquid within the scope of this S.O.P. and subject to the requirements of this S.O.P. shall be known generally as either a flammable liquid or a combustible liquid and shall be defined and classified in accordance with this S.O.P.

Gasoline: Is a Class I B liquid that has a flash point below 73° F and a very high boiling point between 100° and 400° F. The Flash point of Gasoline is -40° to -50° F.

Diesel Fuel: Is a Class II Combustible Liquid, with a flash point of 125° F.

Combustible Liquid: A combustible liquid shall be defined as any liquid that has a closed-cup flash point at or above 100° F, as determined by the test procedures and apparatus set forth in 1-7-4, of NFPA 30.

3.0 Location of AST:

- 3.1 All proposed installations sites of ASTs must have written prior approval by the Local Authority Having Jurisdiction.
- 3.2 All permanently installed ASTs shall be of the concrete encased, double walled type. The concrete encased tanks shall be of at least 3,500-psi density and be at least 6 inches in thickness.

- 3.3 Clearance distances:
- 3.3.1 No AST shall be installed closer than 5-feet from any type of an electrical disconnect device.
 - 3.3.2 All ASTs between the size of 60 U.S. gallons and 2,000 U.S. gallons shall be located no closer than 10-feet from any building, lean-to, or property line.
 - 3.3.3 All ASTs shall have at the minimum of 5 ft of unobstructed clearance on all sides to facilitate refueling, maintenance and serviceability.
 - 3.3.4 No AST shall be installed without having at least a 15-foot aerial clearance from overhead or underground electrical lines, which includes but limited to weather heads, transformers, and fuses.
 - 3.3.5 The minimum distance between any two ASTs shall be 3-feet.
 - 3.3.6 The minimum distance between an AST with Gasoline or Diesel fuel and a LP tank shall be 20-feet.
- 3.4 All ASTs shall rest on the ground or on foundations, made of concrete, masonry, piling, or steel. Tank foundations shall be designed to minimize the possibility of uneven settling of the tank and to minimize corrosion in any part of the tank resting on the foundation.

4.0 Aboveground Fuel Lines:

- 4.1 Below ground fuel, lines shall not be permitted for use with an AST.
- 4.2 Aboveground supply and return lines.
 - 4.2.1 Fuel lines shall be suspended a minimum of 6 inches off the ground and be supported every 3-feet with some type of approved support.
 - 4.2.2 All AST fuel lines shall be protected against corrosion.
 - 4.2.3 All ASTs shall have some type of protective features that prohibit any collision from motor vehicles.
 - 4.2.4 All above ground fuel lines shall be insulated, heat traced, and protected with a covering equal to vinyl.
 - 4.2.5 The fuel lines shall be separated by a minimum distances of 6 inches.
 - 4.2.6 All AST aboveground fuel lines shall be of black carbon type steel.
 - 4.2.7 All AST aboveground supply fuel lines shall be ½-inch inside diameter, unless otherwise directed.
 - 4.2.8 All AST aboveground supply fuel lines shall have a shut off valve located as close as possible to the AST.
 - 4.2.9 All AST aboveground return fuel lines shall be ¾-inch inside diameter, unless otherwise directed by the Local Authority having Jurisdiction.
 - 4.2.10 There shall be no traps or check valves in the return fuel line to the AST.
 - 4.2.11 All pipe joints shall be of the threaded type, no welding of pipes or of the joints shall be permitted.

- 4.2.12 Joints shall be made liquid tight and shall be threaded, except that listed flexible connectors shall be permitted where installed with prior written approval of the Local Authority Having Jurisdiction.
- 4.2.13 All threaded joints shall be made up tight with a suitable thread sealant or lubricant. Joints in piping systems handling Class I liquids shall be welded when located in concealed spaces within buildings.

5.0 Normal Venting for aboveground Tanks:

- 5.1 Venting requirements shall be in accordance with current Unified Facilities Guide Specifications, Section 13202, Fuel Storage Systems requirements. Stage I vapor recovery is the process of recovering vapors when a storage tank is filled. Stage I vapor recovery is mandatory on all Army Facilities. Stage II vapor recovery is the process of recovering vapors during vehicle fueling operations. Stage II vapor recovery is optional and will be included if required by state and local clean air regulations.
- 5.2 Prevent the development of vacuum or pressure sufficient to exceed the design pressure due to filling or emptying and the atmospheric temperature changes.
- 5.3 If any tank has more than one fill or withdrawal connection and simultaneous filling or withdrawal can be made, the vent size shall be based on the maximum anticipated simultaneous flow.
- 5.4 The outlet of all vents and vent drains on tanks equipped with venting to permit pressures exceeding 2.5 psig shall be arranged to discharge in such a way as to prevent localized overheating of, or flame impingement on, and part of the tank, in the event vapors from such vents are ignited.
- 5.5 Where vent pipe outlets for tanks storing Class I liquids are adjacent to building or public ways, they shall be located so that the vapors are released at a safe point outside of buildings and not less than 12 ft. above the adjacent ground level. In order to aid their dispersion vapors shall be discharged upward or horizontally away from closely adjacent walls. Vent outlets shall be located so eaves will not trap the flammable vapors or other obstructions and shall be at least 5 ft from building openings.

6.0 Emergency Venting for Fire Exposure for Aboveground Tanks.

- 6.1 Every aboveground tank shall have some form of construction or device that will relieve excessive internal pressure caused by exposure fires. This requirement shall also apply to each compartment of a compartmented tank, the interstitial space of a secondary containment type tank, and the enclosed space of tanks of closed top dike construction.

- 6.2 The outlet of all vents and vent drains on tanks, equipped with emergency venting to permit pressures exceeding 2.5 psig shall be arranged to discharge in such a way as to prevent localized overheating of or flame impingement on any part of the tank, in the event vapors from such vents are ignited.

7.0 Miscellaneous Requirements:

- 7.1 All ASTs permanently installed shall have a device(s) for fuel leak detection, fuel level, and all other monitoring requirements.
- 7.2 All ASTs shall be marked in accordance with N.F.P.A. 704.
- 7.3 All ASTs shall be grounded, and wired in accordance with NEC 70.
- 7.4 All ASTs shall have some type of spill containment that will hold 100% of the AST capacity.
- 7.5 All ASTs that have filling and emptying connections for any Class I or Class II, flammable liquids shall be closed and liquid tight when not in use and shall be properly identified.
- 7.6 All ASTs fill caps shall have an AHJ approved means of locking when not being refueled.
- 7.7 All ASTs shall have some device of fire fighting equipment in the immediate area. (Contact Fort Campbell Fire Prevention Section for further details).
- 7.8 Means shall be provided for determining the level of liquid in the tank. This means shall be accessible to the delivery operator.
- 7.9 Precautions shall be taken to prevent the ignition of flammable vapors. Sources of ignition include, but are not limited to:
- a. Open Flames
 - b. Lightning
 - c. Hot surfaces
 - d. Radiant heat
 - e. Smoking
 - f. Cutting and welding
 - g. Spontaneous ignition
 - h. Frictional heat or sparks
 - i. Static electricity
 - j. Electrical sparks
 - k. Stray currents
 - l. Ovens, furnaces, and heating equipment.

End

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TECHNICAL DESIGN GUIDE

CHAPTER 3

Technical Requirements and Instructions

Division 01000

Section

01356	<u>Storm water Pollution Protection</u>
01560	<u>Environmental Protection</u>
01572 - 01670	<u>Construction and Demolition Waste Removal/Diversion</u> <u>Recycle of Recoverable Materials</u>

SECTION 01356

Storm water Pollution Protection

Ft. Campbell Requirements:

Ft. Campbell special requirements apply Section 01356 for all COE and DPW prepared projects.

Instructions to Designers:

Project plans and specifications shall include guidance and requirements contained in [Erosion and Sedimentation Control](#):

Additional required guidance is found in [Chapter 2](#).

For electronic copies of the document, contact the PE/A for MILCON and OMA projects by the COE. A-E's directly serving the installation should contact the PM.

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SECTION 01560

Environmental Protection

Ft. Campbell Requirements:

Ft. Campbell specification Section 1560, Environment Protection shall be used instead of UFGS 01355 for all COE and DPW prepared projects.

Instructions to Designers:

Project specifications shall include the Ft. Campbell Specification:

[Section 01560, Environment Protection.](#)

Additional required guidance is found in [Appendix A.](#)

For electronic copies of the document, contact the PE/A for MILCON and OMA projects by the COE. A-E's directly serving the installation should contact the PM.

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Ft. Campbell version:
Section 01560, Environment Protection.

SECTION C-01560

ENVIRONMENT PROTECTION

4/03

PART 1 GENERAL

1.1 SUMMARY (Not Applicable)

1.2 SUBMITTALS

The following shall be submitted in accordance with Section C-01300 SUBMITTAL PROCEDURES:

1.2.1 SD-8, Statements

Work Plans; GA.

1.2.1.1 Environment Protection

Prior to commencement of work at the site, the Contractor will submit within 10 calendar days after Notice to Proceed, his written detailed proposal for implementing the requirements for environmental pollution control specified herein. The contractor will then meet the representatives of the Contracting Officer upon their completion of review of his proposal as needed for compliance with the environmental pollution control program.

1.2.1.2 Preconstruction Survey

Prior to start of any onsite construction activities, the Contractor and the Contracting Officer shall make a joint condition survey, after which the Contractor shall prepare a brief report indicating on a layout plan the condition of trees, shrubs, and grassed areas immediately adjacent to the site of the work and adjacent to his assigned storage area and access routes(s) as applicable. This report will be signed by both the Contracting Officer and Contractor upon mutual agreement as to its accuracy and completeness.

1.2.1.3 Waste Disposal Scheme

As part of his proposed implementation under Paragraph 3.2, and prior to onsite construction, the Contractor shall submit a description of his scheme for disposing of waste materials resulting from the work under this contract. If any waste material is

dumped in unauthorized areas, the Contractor shall remove the material and restore the area to the condition of the adjacent undisturbed areas. Where directed, contaminated ground shall be excavated, disposed of as approved, and replaced with suitable fill material, all at the expense of the Contractor.

PART 2 POLLUTION PREVENTION PLANS

2.1 ENVIRONMENTAL PROTECTION REQUIREMENTS

Provide and maintain, during the life of the contract, environmental protection as defined. Plan for and provide environmental protective measures to control pollution that develops during normal construction practice. Plan for and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. Comply with all Federal, State, and local regulations.

2.1.1 Environmental Protection Plan

The contractor will develop a site specific Environmental Protection Plan which will address in detail the following:

a. Hazardous materials (HM) to be brought onto the post

Any hazardous materials planned or used on the post by the contractor will be managed with the same intent and purpose as the Hazardous Materials Management Program (HMMP) maintained by the DPW Environmental Division Pollution Prevention Branch. Ft. Campbell's HMMP was established to maintain effective and regulatory compliant management of hazardous materials used on the post. The HMMP provides establishment of source reduction methods, recycling and reuse opportunities, modifications of processes and procedures, shelf life management, authorized HM use list, full visibility of all HM at any given time, the least toxic and least amount of HM acquired, stored, or used, and proper handling, storage, and disposal of all HM. A hazardous material as per 29 CFR 1910.1200 will be included. A hazardous material as per 29 CFR 1910.1200 is any material which is a physical or health hazard. The Contractor shall complete the [FTCKY HAZMAT INVENTORY FORM](#), which appears as an appendix to this section. The inventory form requires a list (including quantities) of HM to be brought to the post and copies of the corresponding material safety sheets (MSDS). The completed form shall be submitted to the Contracting Office representative and to Fort Campbell Environmental Division - Pollution Prevention Branch. In the event the usage of additional Hazardous Materials are found necessary during the project, they will be included into the MSDS package of the Environmental Protection Plan. At project completion, any hazardous material brought onto the post shall be removed from the site by the Contractor. Ft. Campbell is required by Executive Order 12856, "Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements", to comply with the

requirements of the Emergency Planning and Community Right-to-Know Act (EPCRA). EPCRA requires Ft. Campbell to identify the amounts of chemicals present on, or released from its facilities, understand the potential problems that hazardous materials pose to the surrounding communities and environment, and provide information to the public and local emergency planning organizations. To comply with EPCRA requirements, Ft. Campbell must track and be accountable for hazardous materials (HM) used throughout the post. As required by the Emergency Planning and Community Right - to - Know Act (EPCRA), the Contractor will account for the quantity of HM brought to the post, the quantity used or expended during the job, and the leftover quantity which (1) may have additional useful life as HM and shall be removed by the Contractor, or (2) may be hazardous waste, which shall then be removed as specified herein. [This information will be provided to the Environmental Division Pollution Prevention Branch on a calendar year basis or project basis if less than a single calendar year, and must be submitted by the end of January following the year reported.](#)

b. Hazardous waste (HW) generated

The Environmental Protection Plan must list, quantify explain how any HW generated during the project will be disposed. Disposal of hazardous waste generated by the contractor shall be disposed off site according to applicable regulations at the contractor's expense. A report must be submitted annually of the generation of hazardous waste on post and must be provided to the Contracting Officer representative and to Environmental Division - Pollution Prevention Branch.

c. Storage of hazardous waste

In accordance with post regulations and 40 CFR 262, hazardous waste shall be stored near the point of generation up to a total quantity of (one quart) 1 L of acutely hazardous waste or (55 gallons) 200 L of hazardous waste (Satellite Accumulation Point). Any volume exceeding these quantities shall be moved to a HW permitted area within 3 days. Locations of hazardous waste storage areas must be approved by DPW-ED-PP. Containers must be labeled in accordance with 40 CFR 262 and must contain the words Hazardous Waste and other words which identify the contents of the container. Prior to shipment of hazardous waste on site or off, the waste must be placed into good condition Department of Transportation (DOT) specification containers for hazardous waste (49 CFR 172.101). Containers must be labeled with required labels for HW and for DOT shipping. The area selected for the storage of hazardous wastes must minimize the threat to human health or the environment in the event of a release.

d. Minimization of hazardous waste

In accordance with post regulations, the Contractor should substitute materials as necessary to reduce the generation of HW and include a statement to that effect in the Environmental Plan.

e. Environmental conditions likely to be encountered during this project

Contact the Contracting officer for conditions in the area of the project which may be subject to special environmental procedures. Include this information in the Preconstruction Survey. Describe in the Environmental Plan any permits required prior to working the area, and contingency plans in case an unexpected environmental condition is discovered.

f. Any Hazardous Waste removal or disposal must be manifested through Environmental Division's Pollution Prevention Branch, Hazardous Waste Program Manager and must be signed and numbered. Permitting plans for any transportation and disposal, excavation, or construction of hazardous waste that will require an environmental permit from an issuing agency

The Contractor is responsible for generating the permits and delivering the completed documents to the Contracting Officer. The Contracting Officer will review the permits and the Contractor shall file the documents with the appropriate agency and complete disposal with the approval of the Contracting Officer. The Contracting Officer shall advise Environmental Plan of any Hazardous Waste generated and shall send contractor to Environmental Pollution Protection Branch. Correspondence with the State concerning the environmental permits and completed permits shall be delivered to the Contracting Officer.

g. Radon mitigation design and testing

All residential and non-residential construction performed at Fort Campbell must have passive radon mitigation features implemented into the design. The contractor will install preliminary features as per drawings. The contractor will hire an independent testing company to perform radon monitoring prior to inhabitation of the units. The testing firm must be EPA accredited and approved to perform work in the State of Tennessee (Kentucky). A list of accredited testing firms in the state of TN (KY) can be obtained through the state Radon Program Coordinator (615) 532-0733. In the event radon concentrations greater than 4 pCi/L (pico curies per liter of air) are revealed consult Fort Campbell DPW through the Contracting Officer's representative for guidance pertaining to retesting. If upon further testing, elevated (unacceptable) levels are present, additional mitigation features will be installed followed by more testing. The buildings will not be inhabited until levels of less than 4 pCi/L have been achieved.

Extend the pipe of the passive radon mitigation system through the roof and leave it open (do not Cap).

Place electrical outlets near (e.g. within 6 feet) of the radon vent pipe riser in the attic.

The riser should be located in an area of the attic with at least 3-4 feet of clearance to allow for easy access to install and maintain the fan.

If at all possible, the aggregate bed under the slab should not be compacted in order to provide the maximum subslab vacuum coverage.

With respect to the number of risers, suggest an interval of 1 for every 3-5000 SF of slab.

2.1.1.1 Environmental Protection Plan Format

The Environmental Protection Plan shall follow the following format:

1. Hazardous materials to be brought onto the post
2. MSDS package
3. Employee training documentation
4. Hazardous materials/waste storage plan
5. Hazardous waste to be generated
6. Pre-construction survey results
7. Permitting requirements identified
8. Waste Disposal Plan
9. Site Specific Spill Contingency Plan

2.1.1.2 Environmental Plan Review

Fourteen days after the environmental protection meeting, submit to the Contracting Officer the proposed environmental plan for further discussion, review, and approval.

2.1.1.3 Commencement of the Work

As directed by the Contracting Officer, following approval.

2.1.2 Storm Water Pollution Prevention Plan

The following Pollution Prevention Plan is incorporated into the contract documents as a portion of the construction activities to be undertaken by the Contractor. The plan as outlined below contains the minimum requirements for the work under this contract.

POLLUTION PREVENTION PLAN FOR (PROJECT)

The purpose of this plan is to detail the controls that will be utilized for this construction in order to control sediment in the storm water runoff from the construction site drainage area.

Project Location: Fort Campbell Army Base
Fort Campbell, Kentucky
(PROJECT)
(LOCATION)
Latitude - 36 38'10" North
Longitude - 87 27' 40" East
(Values Approximate for Latitude - Longitude)

Constructed by: U.S. Army Corps of Engineers
Louisville District
P.O. Box 59
Louisville, KY 40201-0059

Description of Site and Construction Activity: This construction is **(INSERT DESCRIPTION)**.

The soil disturbing activity will consist of clearing and grubbing and demolition for the installation of the erosion and sediment control features, grade work, excavation for utilities, and parking lots. The sediment and erosion controls being utilized include straw bale dam, basket curb inlet, stone outlet sediment trap, fabric drop inlet protection, gravel donut inlet protection, construction entrance/exit, silt fence, and silt fence rock overflow, and temporary seeding and mulching. Clearing and grubbing must be held to a minimum necessary for grading and equipment operation.

Temporary seeding and mulching shall be deemed necessary if no construction activity occurs in the disturbed areas for more than fourteen (14) days. Construction must be sequenced to minimize the exposure time of cleared surface areas. Grading activities must be avoided during periods of highly erosive rainfall. Slopes of 2H:1V will be protected using an erosion control blanket. Other slopes that may be seeded and mulched may experience washout problems and require the use of an erosion control blanket. Contractor is to refer to manufacturer's recommendations for the type of erosion control blanket to be used on particular slopes.

Runoff Coefficient: The present runoff coefficient for the site is approximately 0.6 to 0.75. The development of the site will not significantly increase this coefficient. Developed coefficient is approximately **(INSERT COEFFICIENT)**.

Receiving Waters: The water for the disturbed areas will pass through erosion control then into the storm system. The storm system for the majority of the site empties into **(LOCATION)**.

Erosion and Sediment Controls:

STABILIZATION PRACTICES	STRUCTURAL PRACTICES	
Permanent Seeding	Straw Bale Dam	Gravel Donut Inlet
Mulching	Basket Curb Inlet	Protection
	Stone Outlet Sediment	Temporary Construction
	Trap	Entrance/Exit
	Fabric Drop Inlet	Silt Fence
	Protection	Silt Fence Rock Overflow

2.1.2.2 Contracting Officer shall provide Environmental Plan for review to Environmental Division, Pollution Protection Branch.

2.2 ANTICIPATED SEQUENCE OF ACTIVITY:

Place erosion control measures in locations in close proximity to those shown on the drawings. Additional erosion control measures may be required to comply with the NPDES permit once demolition and construction begins.

Surface water flowing toward the construction area will be diverted around the construction area to reduce its erosion potential. Silt fence, sediment traps or straw bale check dams shall be properly constructed to detain runoff and trap sediment.

Construct new site amenities including utilities, buildings, parking areas, and sidewalks after completing the necessary demolition.

Landscape and grade remaining areas according to the drawings.

Upon completion, remove any temporary measures not necessary for future phases of the project after stabilization of the area. Any sediment removed from these measures shall be disposed of at a time and location designated by the Contracting Officer. Any other areas disturbed during the removal of the sediment control structures shall be seeded and mulched within 24 hours.

NOTE: The Contractor controls the actual sequence, however, the sediment control measures must be established prior to initiation of work in any area. Contractors for Phased projects will be required to coordinate this work and interface Pollution Prevention Plans to ensure compliance with the intent of the Pollution Control Plans and to maintain continuous pollution prevention. Construction should be staged or phased for this project. Areas of one phase should be stabilized before other phases are initiated. Stabilization shall be accomplished by temporarily or permanently protecting the disturbed soil surface from rain fall impacts and runoff.

2.3 DEMONSTRATION OF COMPLIANCE WITH FEDERAL, STATE AND LOCAL REGULATIONS.

All activities constructed under this contract will be performed in accordance with Federal, State and Local regulations. The construction contractor's specifications require compliance with all applicable regulations.

2.4 POLLUTION PREVENTION PLAN AND NOTICE OF INTENT

The Contractor will implement the Pollution Prevention Plan (PPP) as shown on the plans and directed in these specifications. This plan must be implemented in accordance with the NPDES permit. A Notice of Intent (NOI) will be prepared by the U.S. Army Corps of Engineers and submitted to the state of Tennessee (KENTUCKY) fourteen (14) days prior to the notice to proceed being issued. The NOI Contractor Consent form for Tennessee (KENTUCKY) must be signed by the Contractor. A blank [Contractor's Signature Form](#) is attached at the end of this section. The Contractor shall maintain a copy of the PPP in their construction trailer. Any changes made to the plan must be documented and approved by the Contracting Officer.

2.5 INVENTORY FOR POLLUTION PREVENTION PLAN

The materials or substances listed below are expected to be present onsite during construction:

These are examples of materials that could be Hazardous Materials and an inventory must be kept using Ft. Campbell's Hazardous Material Form attached. This list is not comprehensive but for illustration only. The Contractor must maintain and update a Hazardous Material list and inventory forms.

Concrete	Fertilizer	Detergents	Paints (Enamel and Latex)
Cleaning Solvents	Wood	Sealants	Metal Rebar/Structural Steel
Concrete Additives	Tar	Asphalt	Petroleum Based Products

2.6 SPILL PREVENTION

The following are the material management practices to reduce the risk of spills or other accidental exposure of materials and substances to storm water runoff.

2.6.1 Good Housekeeping

- a. An effort will be made to store only enough product required to perform the task. Storage shall meet Federal, State and Local regulations to include 150 % containment of bulk storage over 19 liters.

- b. All materials stored onsite will be stored in a neat and orderly manner in their appropriate containers and properly labeled. When possible, material should be stored under a roof or in an enclosed area. If this is not possible, material will be covered with a tarpaulin or suitable replacement to prevent direct contact between storm water and the materials. All runoff from the storage area will be routed through a control structure.
- c. Products will be kept in their original containers with the original manufacturer's label.
- d. Substances will not be mixed with one another unless recommended by the manufacturer.
- e. Whenever possible, all of the product will be used up before disposing of container.
- f. Manufacturer's recommendations for proper use and disposal will be dictated by Federal, State and Local regulations. Manufacturer's recommendations may be followed if as stringent or more than Federal, State and Local.
- g. The contractor will conduct daily inspections to ensure proper use and disposal of materials onsite.

2.6.2 Hazardous Products

These practices are used to reduce the risks associated with hazardous materials and must be incorporated into the Pollution Prevention Plan:

- a. Products will be kept in their original containers unless they are not resealable.
- b. Original labels and material safety data will be retained they contain important product information.
- c. All containers will have the Diamond label affixed per the National Fire Prevention Associations Publication 704.
- d. Disposal of surplus product will be performed as recommended by the manufacturer or as required by State and Local regulations.

2.7 SPILL PREVENTION PRACTICES

In addition to good housekeeping and material management practices discussed in the previous sections of this plan, a Site Specific Spill Contingency Plan must be prepared by the Contractor and submitted to Fort Campbell Environmental Division. The SSSCP must be developed as outlined in the Fort Campbell Environmental Handbook. Guidance and instructions for preparation of the **SITE SPECIFIC SPILL CONTINGENCY PLAN**

(SSSCP) are included at the end of this section. In addition to the requirements of the SSSCP, the following practices must be followed by the Contractor for spill prevention and clean up:

- a. Materials and equipment necessary for cleanup will be kept in the material storage area. There will be enough equipment to supply at least three (3) men. Equipment and materials will include but not be limited to; brooms, dust pans, mops, rags, gloves, goggles, absorbing compound, and plastic and metal trash containers specifically for this purpose.
- b. Manufacturer's recommended methods for spill cleanup will be clearly posted and site personnel will be made aware of the procedures and the location of information and cleanup supplies.
- c. All spills will be cleaned up immediately after discovery. Disposal of the waste from the spill shall be at the Contractor's expense and shall be coordinated with the Pollution Prevention Branch before removal or disposal.
- d. The spill area will be kept well ventilated and personnel will wear appropriate protective clothing to prevent injury from contact with a hazardous substance.
- e. All spills of toxic or hazardous materials will be reported to the Ft. Campbell Fire Department and DPW Environmental through the Contracting Officers Representative who will report to the appropriate State or Local government agency if necessary.
- f. Once a spill has occurred, the spill prevention plan will be adjusted to include measures to prevent this type of spill from recurring with a discussion of the appropriate cleanup for that type of spill. Also, a description of the spill, what cleaned it, and the cleanup measures will be included.
- g. The prime Contractor will be responsible for the day-to-day site operations, including spill prevention and will designate an employee, by name, to be the primary cleanup coordinator. Each subcontractor bringing more than 75 liters or 68 kilograms of a spillable substance shall also designate a cleanup coordinator. The cleanup coordinators will designate three (3) additional site personnel for spill prevention and cleanup.
- h. Everyone will be trained in spill prevention and cleanup and shall know the primary cleanup coordinator and any additional site personnel to contact. Fort Campbell's Environmental Handbook (excerpt included below) will be the basis for spill prevention training.

(TAKEN FROM)

FORT CAMPBELL ENVIRONMENTAL HANDBOOK
Guidance and Instruction

SPILL PLANNING AND RESPONSE

Spill response equipment is a critical component of an effective response to an unexpected release of hazardous materials. Making an inventory of potential spots for emergency releases and having appropriate and sufficient spill response equipment to deal with those potential releases is required for each unit. Attachment 1 provides spill response materials minimum requirements.

SPILL PLANNING AND RESPONSE TRAINING REQUIREMENTS:

1) All personnel involved with the management and handling of oil and hazardous materials must be periodically trained in spill prevention and response. The training will be similar to the Hazardous Communication Program - Worker Right to Know and will include the following key features:

- a) Health effects of exposure to oil or hazardous materials;
- b) Applicable first aid procedures to be used following exposure;
- c) Personal Protective Equipment requirements and procedures for using equipment;
- d) Evacuation procedures;
- e) Spill material combustibility and potential for flash-back along vapor trails;
- f) Fire fighting procedures and special hazards of combustible products;
- g) Reactivity of spill material with common materials including water;
- h) Use and maintenance of all alarms and monitoring equipment associated with spill prevention or response;
- i) Initial Notification procedures;
- j) Site specific contingency plans;
- k) Location of posted Site Specific Spill Contingency Plan;
- l) Immediate spill response actions including location of pump controls and valves to stop spill flow; location and use of fire extinguishers, absorbents, neutralizing agents and other immediate spill response procedures;
- m) Visual inspections requirements of the particular areas; and
- n) Purpose and requirements of good housekeeping.

2) Spill response training exercises will be conducted once per year for personnel working at oil and hazardous material sites. Personnel entering one of these positions will be trained within two weeks after starting work and after any significant changes to the spill plan or training program. Records of the type, extent, and frequency of each individual's training will be maintained until closure of the applicable area or until three years after the date the individual last worked in the area. . Refresher training shall be given with the Toolbox Safety Meetings and documented on the Quality Control Reports. Training shall cover what to do, and who to contact in case of a spill and what emergency action must be taken if any.

SPILL RESPONSE IS HANDLED BY FOUR DISTINCT OPERATIONS:

a) SPILL REPORTING

The first action to be taken in the event of a spill is to report the spill. If you observe a release of a hazardous material, report it to your supervisor and the Fire Department as required below. If the spill is in a Training Area, then the spill will be reported to Range Control, who will then notify the Fire Department. The Fire Department will notify DPW Environmental Division and if required, Installation Safety, Emergency Medical, and Preventative Medicine. The DPW Environmental Division does all reporting to State/Federal Agencies.

The Fire Department (or Range Control) must be promptly notified of any of the following spills:

(1) Any uncontrolled quantity of a hazardous substance, or if assistance is needed by Fire Department or Environmental Division, or as instructed by the MSDS or supervisor's discretion.

(2) Oil and other petroleum products with quantity exceeding 10 gallons or area of spill greater than two feet in any direction or any amount that has spilled into a stream or body of water.

Environmental Division review has determined the material(s) listed requires special reporting at the quantity shown: (To be supplied by environmental staff during plan review.)

b. STOP OR CONTAIN THE SPILL

Assess the situation before attempting to contain any hazardous material spilled and proceed only if it is safe to do so. You must have knowledge of the spilled substance and don any required personal protective equipment. If necessary, make the spill scene off limits to any unauthorized personnel. If situation warrants, evacuate the area.

c. CLEAN UP THE SPILL

Under no circumstances should untrained and/or ill-equipped persons attempt to perform cleanup. In some instances, spill cleanup may require respiratory protection and other personal protective equipment. If it is within the capability of the unit that caused the spill, then that unit is responsible for its cleanup. Environmental Division will make the decision to obtain assistance and coordinate with other units as required. If you handle/work with the hazardous material as part of your job, you are to be trained and qualified to participate in the cleanup of the spill. **All contractors must have an OSHA 1910.120 qualified spill response contractor available to respond to spills in 4 to 6 hours that require heavy equipment to remove contaminated soils/absorbents. Spill that cannot be removed because of response delays may need to be covered with heavy plastic and or secured to prevent further spread of contamination.**

d. DISPOSE OF SPILLED HAZARDOUS MATERIAL.

All spilled material and other contaminated material (soil, gravel, absorbents, etc.) must be properly disposed. It is the responsibility of the contractor that created the spill to properly package, dispose of the waste, and ensure the site is properly cleaned at no cost to the government. Some spill incidents may require cleanup, disposal, soil testing and a site closure report by an approved licensed environmental contractor approved by Fort Campbell. Environmental Division will determine the required cleanup and disposal method.

2.8 PRODUCT SPECIFIC PRACTICES

The following product specific practices will be followed on-site:

- a. Petroleum Products - All vehicles will be periodically inspected for leaks and shall receive regular preventative maintenance to reduce the chance of leaks occurring. Petroleum products will be stored in tightly sealed containers which are clearly labeled. Bulk storage areas will be equipped with secondary containment appropriate for risk of loss from the primary container (s). Storage shall meet Federal, State and Local regulations. Secondary containment shall hold 150 % of the bulk amount stored over 19 liters. The Contractor will maintain a specific spill contingency and countermeasures plan for use in a bulk storage area.
- b. Fertilizer - Fertilizers used will be applied only in the minimum amounts recommended by the manufacturer. Once applied, fertilizer will be worked into the soil to limit exposure to storm water. The contents of any partially used bags of fertilizer will be transferred to a sealable container to avoid spills.
- c. Paints, Solvents, and Sealants - All containers will be tightly sealed and kept in the storage area when not in use. Any excesses of these materials will not be discharged

into the storm sewer system, but will be properly disposed of according to manufacturer's instructions or State and Local regulations.

d. Concrete Trucks - Concrete trucks will be allowed to wash out, discharge surplus concrete and drum wash water only in a designated area. All wash water from the concrete trucks must be retained on-site and treated according to Federal, State and Local regulations. Upon completion of the job, all discharges of surplus concrete and any soil contaminated by the concrete wash water will be removed from the site and taken to an approved disposal area. Water with the potential of entering sink holes or storm sewers will not be allowed to be discharged.

2.9 INSTALLATION/CONSTRUCTION

2.9.1 Inlet Protection

2.9.1.1 Fabric Drop Inlet Protection

- a. Construct a dike on the downslope side of the inlet to prevent runoff from bypassing. Dike should be 150 mm higher than inlet protection.
- b. Cut fabric from a single roll to avoid joints.
- c. Construct the fence as shown on in the drawings.
- d. Space the support posts evenly against the inlet perimeter a maximum of one (1) m apart, and drive them about 0.5 m into the ground.

2.9.1.2 Gravel Donut Inlet Protection

- a. Construct a dike on the downslope side of the inlet to prevent runoff from bypassing. Dike should be 150 mm higher than inlet protection.
- b. Construct as shown in the drawings.

2.9.1.3 Basket Curb Inlet

- a. Install immediately after a new inlet is placed or on existing inlets, before any land disturbing activity.
- b. If necessary, adapt basket dimensions to fit inlet box dimensions, see drawings.
- c. Remove the grate and place basket in the inlet.
- d. Cut and install a piece of filter fabric large enough to line the inside of the basket and extending a minimum of 150 mm beyond the frame.

- e. Replace the inlet grate, which also serves to anchor the fabric.

2.9.2 Silt Fence and Silt Fence Rock Overflow

- a. Construct as shown on the drawings.
- b. Staked and entrenched straw bales must be installed along the base of all fills and cuts and on the downhill sides of stockpiled soil.

2.9.3 Straw Bale Dam

- a. Construct as shown on the drawings.
- b. Staked and entrenched straw bales must be installed along the base of all fills and cuts and on the downhill sides of the stockpiled soil.

2.9.4 Seeding

- a. Test soil to determine its nutrient level or apply a 12-12-12 fertilizer at a rate of 75 to 110 kilograms per hectare.
- b. Work fertilizer into the soil 50 mm - 100 mm deep with a disk or rake operated across the slope.
- c. Select a seed mixture and application rate that best suits the soil type and climate. Also, consult the county soil, water conservation office for assistance.
- d. Apply seed uniformly with a drill or cultipacker seeder, or by broadcasting, and cover to recommended depth.
- e. If drilling or broadcasting, firm the seedbed with a roller or cultipacker.
- f. Mulch seeded area to increase seeding success.

2.9.5 Mulching

- a. Apply at the recommended rate based on the material being used.
- b. Spread uniformly with no more than 25% of the ground surface visible.
- c. If straw or hay is used, it must be anchored immediately.

2.10 INSPECTION AND MAINTENANCE

All measures that are being utilized will be inspected at least once each week and after each storm event. An inspection report shall be written after each inspection and submitted to the Contracting Office representative within 24 hours. Once a problem is found or sediment has reached the clean-out elevation, corrective action shall commence

within 24 hours. Inspections shall continue until the controls are removed or the vegetative cover is firmly established.

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall perform all work in such manner as to minimize the pollution of air, water, or land, and shall, within reasonable limits, control noise and the disposal of solid waste materials, as well as other pollutants. Information contained in the following specifications should also be referenced:

Section 02050	Demolition
Section 02080	Removal and Disposal of Asbestos Containing Materials
Section 02090	Demolition of Buildings with Lead Containing Paint and Disposal of Lead-Based Paint

3.2 IMPLEMENTATION

Within 10 calendar days after Notice to Proceed and prior to commencement of the work at the site, the Contractor shall meet the representatives of the Contracting Officer to review and alter his proposal as needed for compliance with the environmental pollution control program.

3.3 PROTECTION OF LAND AREAS

Except for any work on storage areas and access routes specifically assigned for the use of the Contractor under this contract, the land areas outside the limits of permanent work performed under this contract shall, in accordance with CONTRACT CLAUSE: PROTECTION OF EXISTING VEGETATION, STRUCTURE, UTILITIES AND IMPROVEMENTS, be preserved in their present condition. Contractor shall confine his construction activities to areas defined for work on the plans or specifically assigned for his use. In accordance with CONTRACT CLAUSE: OPERATIONS AND STORAGE AREAS, storage and related areas and access routes required temporarily by the Contractor in the performance of the work will be assigned by the Contracting Officer. No other areas on Government premises shall be used by the Contractor without written consent of the Contracting Officer.

3.4 PROTECTION OF TREES AND SHRUBS

CONTRACT CLAUSE: PROTECTION OF EXISTING VEGETATION, STRUCTURES, UTILITIES AND IMPROVEMENTS, is hereby supplemented as follows: The Contractor shall not deface, injure or destroy trees or shrubs, nor remove or cut them without special authority. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorage.

3.4.1 Tree Protective Structures

Where, in the opinion of the Contracting Officer, trees may possibly be defaced, bruised, injured or otherwise damaged by the Contractor's equipment or by his other operations, he may direct the Contractor to provide temporary protection of such trees by placing boards, plans, or poles around them.

3.4.2 Restoration of Damaged Trees

Any tree scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition at the Contractor's expense. All scars made on trees not designated on the plane to be removed by construction operations shall be coated as soon as possible with an approved tree wound dressing. Trees that are to remain, either within or outside established clearing limits, that are damaged by the Contractor so as to be beyond saving in the opinion of the Contracting Officer, shall be immediately removed, if so directed, and replaced with a nursery-grown tree of the same species and size.

3.5 PROTECTION OF WATER RESOURCES

The Contractor shall control the disposal of fuels, oils, bitumen, calcium chloride, acids, or harmful materials, both on and off the Government premises, and shall comply with applicable Federal, State, County and Municipal laws concerning pollution of rivers and streams while performing work under this contract. The contractor should note that the entire cantonment area is within the delineated Well Head Protection Area for Fort Campbell. This means any release in this area has the potential, due to the installations geological features to impact their drinking water source. For this reason special measures need to be taken to prevent chemicals, fuels, oils, greases, bituminous materials, herbicides and insecticides from entering public waters or potentially migrating via sinkholes or other karst related geologic features to drinking water sources. Special measures will include the generation of a site-specific Spill Prevention Control and Countermeasures Plan. Water used in onsite material processing, concrete curing, foundation and concrete cleanup, and other waste waters shall not be allowed to reenter a stream if an increase in the turbidity of the stream could result there from.

3.6 BURNING

Air pollution restrictions applicable to this project are as follows. Materials shall not be burned on the Government premises. If the Contractor elects to dispose of waste materials off the Government premises, by burning, he shall make his own arrangements for such burning area and shall, as specified in CONTRACT CLAUSE: PERMITS AND RESPONSIBILITIES, conform to all local regulations.

3.7 DUST CONTROL

The Contractor shall maintain all excavations, stockpiles, access roads, waste areas, and all other work areas free from excess dust to such reasonable degree as to avoid causing a hazard or nuisance to the Using Service or to others. Approved temporary methods consisting of sprinkling, chemical treatment, or similar methods will be permitted to control dust. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs.

3.8 EROSION CONTROL

Surface drainage from cuts and fills within the construction limits, whether or not completed, and from borrow and waste disposal areas, shall be graded to control erosion within acceptable limits. Temporary control measures shall be provided and maintained until permanent drainage facilities are completed and operative. The area of bare soil exposed at any one time by construction operations should be held to a minimum.

3.9 CORRECTIVE ACTION

The Contractor shall, upon receipt of a notice in writing of any noncompliance with the foregoing provisions, take immediate corrective action. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs of damages by the Contractor unless it was later determined that the Contractor was in compliance.

3.10 POST-CONSTRUCTION CLEANUP OR OBLITERATION

In accordance with CONTRACT CLAUSE: CLEANING UP, the Contractor shall, unless otherwise instructed in writing by the Contracting Officer, obliterate all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed areas shall be graded and filled and the entire area seeded.

3.11 PAYMENT

No separate payment or direct payment will be made for the cost of the work covered under this section, and such work will be considered as a subsidiary obligation of the Contractor.

-- END OF SECTION --

[Return to designer instructions](#)

Construction Activity Water Permitting Requirements Contractor's Signature Form

State of Tennessee
Department of Environment and Conservation
Rule 1200-4-10.05
Division of Water Pollution Control
NPDS General Permit TNR 100000

To be completed by developer:
NOI Submission Date: _____

Project Name: _____

Project Location: _____
County _____

I have agreed to perform construction-related professional services,
described as:

_____ that will likely impact the nature of storm water runoff from the named
construction activity. Erosion control services involve primarily:

- _____ Prepare erosion control plan
- _____ Inspection of controls
- _____ Install, maintain erosion and sediment controls
- _____ Other

I understand the terms and conditions of Rule 1200-4-10.05 and that I, and my
company, as the case may be, are responsible for the legally liable for
complying with this Rule and the applicable State and Federal Laws. I
understand that State or EPA or private actions may be taken against me if
the terms and conditions of the Rule are not met.

Printed Name: _____ Title: _____

Signature: _____ Date: _____

Company Name: _____

Address: _____

City: _____ State: _____ Phone No. _____

Field Person in charge: _____ Phone No. _____

Owner/Developer: I certify that the above has been retained to perform the
described construction related services noted above and as outlined in the
referenced NOI.

Signature: _____ Date: _____

-- End of form --

[Back to Paragraph 2.4](#)

August 17, 1998

FORT CAMPBELL CONTRACTOR SITE SPECIFIC SPILL
CONTINGENCY PLAN

NAME: _____

CONTRACT NUMBER: _____

GENERAL DISCRIPTION OF WORK: _____

1. RESPONSIBLE PERSONS

A. PRIMARY PERSON

Name: _____ TITLE: _____
Work Phone: _____ Home Phone: _____

B. ALTERNATE PERSON

Name: _____ TITLE: _____
Work Phone: _____ Home Phone: _____

C. SECOND ALTERNATE PERSON

Name: _____ TITLE: _____
Work Phone: _____ Home Phone: _____

2. SPECIAL PRECAUTIONARY MEASURES FOR BUILDING(S) AND ASSOCIATED AREAS

If more than one building, Specify hazardous materials for those buildings.

Building (S) # _____

- A. Avoid contacts with spilled substances.
- B. Refer to Material Safety Data Sheets (MSDS) for particular hazards and precautionary measures for special handling and spill procedures. Flammable materials will be extinguished as to local fire regulations and the material safety data sheets. If needed, list any materials that need special handling, PPE or special precautionary measures.

3. EMERGENCY SPILL EQUIPMENT ON HAND

(For example, sweeping compound and absorbent material, brooms and plastic dust pans, emergency spill kits, non-sparking shovels, other items as needed and required)

BUILDING#: _____ **BUILDING#:** _____

4. HAZARDOUS MATERIAL AND QUANTITY NORMALLY ON HAND

A. Attach a listing of Hazardous Materials on hand, using the FTCKY HAZMAT Inventory Form.

B. Material Safety Data Sheets are readily available and located at (the specific location is required).

Bldg. #: _____

Bldg. #: _____

5. SPILL RESPONSE AND NOTIFICATION PROCEDURES

A. **REPORT THE SPILL.**

The first action in the event of a spill is to report the spill. If you observe a release of a hazardous material, report it to your supervisor and the Fire Department as required below. If the spill is in a Training Area, then the spill will be reported to Range Control, who will then notify the Fire Department. The Fire Department will notify Environmental Division and, if required, Installation Safety, Emergency Medical, and Preventative Medicine. The Environmental Division does all reporting to State/Federal Agencies.

The Fire Department (or Range Control) must be promptly notified of any of the following spills:

- Any uncontrolled quantity of a hazardous substance, or if assistance is needed by Fire Department or Environmental Division, or as instructed by the MSDS or supervisor's discretion:
- Oil and other petroleum products with quantity exceeding 10 gallons or area of spill greater than two feet in any direction or any amount that is spilled into a stream or body of water.
- Environmental Division review has determined the material(s) listed requires special reporting at the quantity shown: (To be supplied by environmental staff during plan review.)

Name: _____ Quantity _____

Name: _____ Quantity _____

Name: _____ Quantity _____

Signature of Environmental Division staff: _____
SUPERVISOR (to notify in case of spill)

NAME: _____ TITLE: _____
WORK PHONE: _____ HOME PHONE: _____

FIRE DEPARTMENT: phone 911
RANGE CONTROL: phone (270) 798-3001 or on radio frequency FM 49.95
ENVIRONMENTAL phone (270) 798-3105

1. If required by your **ORGANIZATION**, additional people to be notified within your chain of command: If not required, fill in N/A.

ALTERNATE PERSON

NAME: _____ RANK: _____
WORK PHONE: _____ HOME PHONE: _____

ALTERNATE PERSON

NAME: _____ RANK: _____
WORK PHONE: _____ HOME PHONE: _____

The spill report must include the following information:

- Name/Phone/Unit of individual reporting the spill; _____
- Spill (Building Location of Number, etc.); _____
- Name of spilled material; _____
- Amount spilled; _____
- Rate currently spilling; _____
- Extent of spill, including drainage features; _____
- Injuries, if any; _____
- Time spill occurred; _____
- Any additional information. _____

B. STOP OR CONTAIN THE SPILL.

Assess the situation before attempting to contain any hazardous material spilled and proceed only if it is safe to do so. You must have knowledge of the spilled substance and don any required personal protective equipment. If necessary, make the spill scene off limits to any unauthorized personnel. If situation warrants, evacuate the area.

C. CLEAN UP THE SPILL.

Under no circumstances should untrained and/or ill-equipped persons attempt to perform cleanup. In some instances, spill cleanup may require respiratory protection and other personal protective equipment. If it is within the capability of the unit that caused the spill, then that unit is responsible for its cleanup. Environmental Division will make the decision to obtain assistance and coordinate with other units as required.

If you handle/work with the hazardous material as part of your job, you are to be trained and qualified to participate in the cleanup of the spill.

D. DISPOSE OF SPILLED HAZARDOUS MATERIAL.

All spilled material and other contaminated material (soil, gravel, absorbents, etc.) must be properly disposed. It is the responsibility of the unit that created the spill to properly package and dispose of the waste. Environmental Division will determine the required disposal method.

Responsible Person Signature and Date

SECTION 01572 - 01670

Construction and Demolition Waste Removal/Diversion Recycle of Recovered Materials

Ft. Campbell Requirements:

Requirements in this section and Appendix A-7. [Solid Waste Disposal/Diversion Practices](#) shall apply to all construction and demolition activities at Fort Campbell. Contract specifications shall require at least a 50% diversion of demolished building materials such as wood, plumbing fixtures, electrical materials (lights and panels), windows, doors, toilet partitions, HVAC equipment, and scrap metals be diverted from the landfill. See Chapter 2, Paragraph 2.1.4 ([Click here](#)). Diversion can be accomplished by deconstructing the wood buildings and components per instructions below or by moving the structure off-post.

Demolition materials shall not be salvaged by the contractor and shall not be removed from the installation. Non salvageable demolition materials shall not to be transported off the installation.

Notify the DPW Environmental Division if unknown waste is discovered during site investigations. Waste could be explosive, hazardous or toxic waste.

Dumpster service for new construction and for demolition is not provided by the installation. The contractor shall arrange for dumpster service at the Contractor's own expense.

In general, utilities are not to be abandoned in place; all abandoned utilities are to be removed. There are circumstances where this requirement does not apply. Abandonment of utilities and removal shall be a topic of discussion at design conferences.

Instructions to Designers:

- 1 Modify UFGS 01572 - 01670 paragraphs to include the building demolition/diversion requirements above and modify contract specifications.
- 2 Construction specifications shall require a Building Materials Diversion Plan to be submitted and approved by DPW.
- 3 When a project requires removal/disposal of environmentally hazardous waste generated at Fort Campbell, the DPW Environmental Division must be involved in the permitting process. Modify project drawings and specifications paragraphs to include each of the above features as they apply to the project. Additional guidance on Environmental Requirements and Hazardous Waste Disposal Practices is contained in [Appendix A](#), and project specifications shall be modified to indicate these requirements.
- 4 For mercury containing light bulb disposal, insert the [Mercury Light Bulb](#) paragraph.

[Return to Division Table of Contents](#)

CHAPTER 3

Technical Requirements and Instructions

Division 02000

Section

02080	<u>Removal and Disposal of Asbestos Containing Materials</u>
02090	<u>Demolition or Buildings with Lead-Based Paint, Removal and Disposal of Lead-Based Paint</u>
02220	<u>Demolition</u>

SECTION 02080

Removal and Disposal of Asbestos Containing Materials

Ft. Campbell Requirements:

Removal and disposal of asbestos containing materials shall be conducted in accordance with Ft. Campbell specification section 02080, Removal and Disposal of Asbestos Containing Materials, which shall be included in all projects containing or possibly containing Asbestos products.

Friable and non-friable asbestos containing materials are to be removed from buildings before demolition. Abatement contractors are to notify the TSCA program in writing at least two days prior to beginning asbestos removal. The point of contact for this notification is Russ Godsave at (270) 798-9637.

Contractors must abide with the asbestos regulations in order for the asbestos to be accepted at the Woodlawn Landfill. These procedures include proper notification, manifesting, documentation, vehicle marking, unloading and PPE.

Many contractors depend on refuse contractors to transport the asbestos waste, and their personnel accompanying the asbestos do not normally have asbestos knowledge or training. Therefore, those delivering the materials to the landfill must have proof of medical surveillance and proper PPE.

Instruction to Designers:

1. Asbestos studies have been completed for numerous existing buildings and facilities at Fort Campbell. Designers shall investigate and review the data as required to insure proper identification and notification of asbestos presence at planned OMA and MILCON projects. These studies are available for inspection at the DPW Maintenance Division. POC is **Audie Hardin** at 270-956-1801.
2. All projects containing or possibly containing Asbestos products shall include [Ft. Campbell specification section 02080, Removal and Disposal of Asbestos Containing Materials](#)
3. Additional Environmental guidance applies. See [Appendix A](#).
4. For electronic copies of the document, contact the PE/A for MILCON and OMA projects by the COE. A-E's directly serving the installation should contact the PM

Ft. Campbell Specification

Section 02080, Removal and Disposal of Asbestos Containing Materials

SECTION 02080

REMOVAL AND DISPOSAL OF ASBESTOS CONTAINING MATERIALS

11/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) PUBLICATIONS:

ANSI Z9.2-79	Fundamentals Governing the Design and Operation of Local Exhaust Systems
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CODE OF FEDERAL REGULATIONS (CFR) PUBLICATIONS:

40 CFR 61, Subpart A	General Provisions
40 CFR 61, Subpart M	National Emission Standard for Asbestos
40 CFR 241	Guidelines for the Land Disposal of Solid Wastes
40 CFR 257	Criteria for Classification of Solid Waste Disposal Facilities and Practices
29 CFR 1926.1101	OSHA Construction Industry Asbestos Standard
29 CFR 1910.120	OSHA Hazardous Waste Emergency Response
29 CFR 1910 subpart I	OSHA Personal Protective Equipment Standard

NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH

Method 7400	Manual of Analytical Methods, 3rd Ed., Vol. 1, Physical and Chemical Analysis Method (P&CAM)Fibers
Method 7402	Asbestos Fibers

UNDERWRITERS LABORATORIES, INC. (UL) PUBLICATIONS

UL 586

1986 High Efficiency Particulate, Air Filter

1.2 DESCRIPTION OF WORK

The work covered by this section includes the handling of friable and nonfriable asbestos containing materials (ACMs) which may be encountered during removal and demolition operations and the incidental procedures and equipment required to protect workers and occupants of the building or area, or both, from contact with airborne asbestos fibers. The work also includes the disposal of the removed asbestos-containing materials. Perform work in accordance with 29 CFR 1926.1101; 40 CFR 61, Subpart A; 40 CFR 61, Subpart M; and the requirements specified herein.

Please refer to pages B20-B38 of the Detail drawings, Volume 1 of 7 for specific locations and quantities of asbestos containing materials.

Please see drawing TU 1.0 for locations of underground chilled water lines, steam lines and condensate lines which are insulated with asbestos containing materials. A total of 6002 linear feet (1850m) are assumed to be present. The breakdown of the piping is as follows:

- 100 mm (4") chilled water supply - 425 m (1361 ft)
- 100 mm (4") chilled water return - 425 m (1361 ft)
- 150 mm (6") steam - 350 m (1148 ft)
- 125 mm (5") steam - 150 m (492 ft)
- 80 mm (3") condensate - 250 m (820 ft)
- 50 mm (2") condensate - 250 m (820 ft)

In addition two cooling towers located at buildings 6775 and 6781 are composed of transite panels and have interiors that contain a honey combed fill material which contains asbestos. An estimated total of 160 square feet of asbestos containing materials are present in each of the two units.

1.2.1 Asbestos Survey

An asbestos Survey was conducted in the contract work area(s) to identify the presence of asbestos containing materials as described in 1.2 above. The data collected is contained in the Asbestos and Lead-Based Paint Survey Report for the Third Brigade Barracks, Fort Campbell, Kentucky, prepared by Gobbel Hays Partners, which is on file at the Fort Campbell PW, Environmental Division. Contact must be made through the Contracting officer.

1.2.2 Unidentified ACM

If suspect ACM not covered by the drawings or the specifications is encountered, the contractor will stop work and immediately notify the contracting officer. Upon direction from the contracting officer, the contractor may be required to conduct sampling and testing of these suspect materials in accordance with the Industrial Hygienist's recommended procedures.

1.3 DEFINITIONS

1.3.1 Aggressive method

Removal or disturbance of building material by sanding, abrading, grinding or other method that breaks, crumbles, or disintegrates intact Asbestos Containing Material (ACM).

1.3.2 Amended Water

Water containing a wetting agent or surfactant.

1.3.3 Area Monitoring

Sampling of asbestos fiber concentrations inside and out of the regulated area, which is representative of the airborne concentrations of asbestos fibers which may reach the breathing zone.

1.3.4 Asbestos

Includes chrysotile, amosite, crocidolite, tremolite, anthophyllite, actinolite, and any of these minerals that have been chemically treated and/or altered. For purposes of this standard, "asbestos" includes PACM, as defined below.

1.3.5 Asbestos Abatement Contractor

A business entity certified, licensed, or accredited by the state in which a response action involving asbestos-containing building material that is friable, or expected to become friable during the response action.

1.3.6 Asbestos Containing Material (ACM)

Any material containing more than one percent asbestos

1.3.7 Asbestos Fibers

Asbestos fibers having a length-to-diameter ratio of at least 3 to 1 and a length of 5 micrometers or longer as counted in the NIOSH Method 7400 or Method 7402 procedure using either phase contrast light microscopy (PCM) or transmission electronic microscopy (TEM).

1.3.8 Asbestos Permissible Exposure Limit (PEL)

Legally enforceable level of asbestos fibers in air set by the Occupational Safety and Health Association (OSHA), as an eight (8) hour time weighted average (TWA) of asbestos fibers not to exceed 0.1 fibers per cubic centimeter of air as set forth in 29 CFR 1926 1101

1.3.9 Authorized Person

Any person authorized and required by work duties to be present in regulated areas.

1.3.10 Breathing Zone

A hemisphere forward of the shoulders with a radius of approximately 6 inches to 9 inches.

1.3.11 Category I Nonfriable ACM

Category I Nonfriable ACM includes asbestos-containing packing, gaskets, resilient floor covering, and asphalt roofing products.

1.3.12 Category II Nonfriable ACM

Category II Nonfriable ACM includes any asbestos-containing material not included in Category I that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.

1.3.13 Certified Asbestos Supervisor

One certified by the State in which work is to be performed and has passed an examination covering "Supervision of Asbestos Abatement Projects" or similar title training. This training must be the equivalent in curriculum, training, method and length to the EPA Model Accreditation Program (MAP) asbestos abatement workers training 40 CFR part 763 subpart E, Appendix C.

1.3.14 Certified Asbestos Worker

One certified by the National Asbestos Council and holds current cards illustrating the board number.

1.3.15 Certified Licensed Contractor

A Contractor who has been trained at an EPA approved course and certified/accredited by the state for which the work is to be performed in.

1.3.16 Certified Industrial Hygienist (CIH)

One certified in the comprehensive practice of industrial hygiene by the American Board of Industrial Hygiene.

1.3.17 Class I Asbestos Work

Activities involving the removal of Thermal System Insulation (TSI) and surfacing ACM and PACM.

1.3.18 Class II Asbestos Work

Activities involving the removal of ACM which is not thermal system insulation or surfacing material. This includes, but is not limited to, the removal of asbestos-containing wallboard, floor tile, sheeting, roofing, siding shingles, and construction mastics.

1.3.19 Class III Asbestos Work

Repair and maintenance operations, where "ACM," including thermal system insulation and surfacing material, is likely to be disturbed.

1.3.20 Clean Room

An uncontaminated, transitional room having facilities for storage of employees' street clothing and uncontaminated materials and equipment.

1.3.21 Competent Person

In addition to the definition in 29 CFR 1926.32(f), one who is capable of identifying existing asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure and has the authority to take prompt corrective measures to eliminate them, as specified in 29 CFR 1926.32 (f); in addition, for Class I and Class II work, one who is specially trained in a training course which meets the criteria of EPA's Model Accreditation Plan (40 CFR 763) for project designer or

supervisor, or its equivalent and, for Class II who is trained in an operations and maintenance (O&M) course developed by EPA (40 CFR 763 . 92 (a)(2)).

1.3.21 Critical Barrier

One or more layers of plastic sealed over all openings into a work area or any other similarly placed physical barrier sufficient to prevent airborne asbestos in work area from migrating to an adjacent area.

1.3.23 Decontamination Area

An enclosed area adjacent and connected to the regulated area and consisting of an equipment room, shower area, and clean room which is used for the decontamination of workers, materials and equipment contaminated with asbestos.

1.3.24 Demolition

The wrecking or taking out of any load-supporting structural member and any related razing, removing, or stripping of asbestos products.

1.3.25 Disturbances

Contact which releases fibers from ACM or PACM or debris containing ACM or PACM. This term includes activities that disrupt the matrix of ACM or PACM, render ACM or PACM friable, or generate visible debris. Disturbance includes cutting away small amounts of ACM and PACM, no greater than the amount which can be contained in one standard sized glove bag or waste bag in order to access a building component. In no event will the amount of ACM or PACM so disturbed exceed that which can be contained in one glove bag or waste bag which will not exceed 60 inches in length and width.

1.3.26 Employee Exposure

That exposure to airborne asbestos fibers that would occur if the employee were not using respiratory protective equipment.

1.3.27 Encapsulant

A liquid material which can be applied to ACM which controls the possible release of asbestos fibers from the material either by creating a membrane over the surface (bridging encapsulant) or by penetrating into the material and binding its components together (penetrating encapsulant).

1.3.28 Encapsulate

The process where by an encapsulant is applied to ACM to control the release of asbestos fibers into the air.

1.3.29 Equipment Room (Change Room)

A contaminated room located within the decontamination area that is supplied with impermeable bags or containers for the disposal of contaminated protective clothing and equipment.

1.3.30 Excursion Limit

The contractor will ensure that no employee is exposed to an airborne concentration of asbestos in excess 1.0 fibers per cubic centimeter of air (1.0 f/cc) as averaged over a sampling period of 30 minutes.

1.3.31 Fiber

A particulate form of asbestos, 5 micrometers or longer, with a length-to-diameter ratio of at least 3 to 1.

1.3.32 Friable Asbestos Material

Material that contains more than one percent asbestos by weight which can be crumbled, pulverized, or reduced to powder by hand pressure when dry.

1.3.33 Glovebag Technique

A method with limited applications for removing small sections of asbestos-containing material from HVAC ducts, short piping runs, valves, joints, elbows, and other nonplanar surfaces in a noncontained regulated area. The glovebag is constructed and installed in such a manner that it surrounds the object or material to be removed and contains all asbestos fibers released during the removal process. All workers who are permitted to use the glovebag technique must be highly trained, experienced and skilled in this method. Glovebag techniques must be performed in accordance with 29 CFR 1926.1101 which require at least two persons perform class I removals. Glovebags may not be moved along a piece of pipe.

1.3.34 Glovebag

An impervious plastic bag-like enclosure affixed around an asbestos-containing material, with glove-like appendages through which material and tools may be handled. Glovebags will be made of 6 mil thick plastic and will be seamless at the bottom. Glovebags are for single use and must be smoke tested for leaks prior to usage.

1.3.35 HEPA Filter Equipment

High-efficiency particulate air (HEPA) filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining at least 99.97 percent of all mono-dispersed particles of 0.3 micrometer diameter or larger.

1.3.36 Homogeneous Area

An area of surfacing material or thermal system insulation that is uniform in color and texture.

1.3.37 Intact

ACM which has not been crumbled, pulverized, or otherwise deteriorated so that it is no longer likely to be bound with its matrix.

1.3.38 Negative Initial Exposure Assessment

A demonstration based by the contractor, which complies with the criteria in paragraph (f)(2)(iii) of 29 CFR 1926.1101, that employee exposures during an operation are expected to be consistently below the PELs.

1.3.39 Nonfriable Asbestos Material

Material that contains asbestos in which the fibers have been locked in by a bonding agent, coating, binder, or other material so that the asbestos is well bound and may not release fibers in excess of the action level during any appropriate use, handling, storage, transportation, or processing. Nonfriable asbestos containing material must be removed prior to demolition/renovation. Nonfriable asbestos containing materials are to be disposed as special waste at a state permitted subtitle D landfill approved to accept asbestos..

1.3.40 Presumed Asbestos Containing Material (PACM)

Thermal system insulation and surfacing material found in buildings constructed no later than 1980.

1.3.41 Personal Monitoring

Sampling of airborne asbestos fiber concentrations within the breathing zone of an employee.

1.3.42 Prior Experience

Experience required of the contractor, his employees, and his Industrial Hygienist on asbestos projects of similar nature and scope to insure capability of performing the asbestos removal in a satisfactory manner. Similarities will be in areas related to material composition, project size, number of employees and the engineering work practice and personal protection controls required.

1.3.43 Regulated Areas

Areas established to demarcate where Class I, II and III asbestos work is conducted, and any adjoining area where debris and waste from such asbestos work may accumulate; and a work area within which airborne concentrations of asbestos, exceed or there is a reasonable possibility they may exceed the permissible exposure limit.

1.3.43.1 Enclosed Regulated Area

A regulated area which has been isolated by physical boundaries and maintained under negative pressure to prevent the spread of asbestos dust, fibers, or debris. A local HEPA filtered exhaust system is required.

1.3.44 Regulated Asbestos-Containing Material (RACM) for abatement at Fort Campbell will include the following:

- (a) Friable asbestos containing material
- (b) All category I nonfriable ACM
- (c) All category II nonfriable ACM

1.3.45 Thermal System Insulation (TSI)

ACM applied to pipes, fittings, boilers, breeching, tanks, ducts or other structural components to prevent heat loss or gain.

1.3.46 Thermal System Insulation ACM

Thermal system insulation which contains more than 1 percent asbestos.

1.3.47 Time Weighted Average (TWA)

The TWA is an individual's 8-hour time weighted average of airborne concentration of fibers per cubic centimeter of air.

1.4 SUBMITTALS

The following will be submitted in accordance with Section 01300 SUBMITTALS to and approved by the contracting officer prior to commencing work involving asbestos materials:

1.4.1 SD-01, Data

1.4.1.1 Local Exhaust Equipment;

1.4.1.2 HEPA Vacuum Equipment;

1.4.1.3 Respirators; including fit test records

1.4.1.4 Pressure Differential Monitor;

1.4.1.5 Hazardous Communication Plan (if hazardous materials will be brought onto site)

1.4.1.6 Training Data

Submit signed and dated certificates for each employee that has received training for the appropriate task(s) assigned and the required amount of hours for the proper handling of materials that contain asbestos, that the employee understands the health implications and risks involved, including the illnesses possible from exposure to airborne asbestos fibers; understands the use and limitations of the respiratory equipment to be used; understands the results of monitoring of airborne quantities of asbestos as related to health and respiratory equipment; and understands engineering and other hazard control techniques and procedures.

1.4.2 SD-08 Statements

1.4.2.1 Testing Laboratory;

Submit the name, address, and telephone number of the testing laboratory selected to perform the monitoring, testing, and reporting of airborne concentrations of asbestos fibers. The laboratory will be approved by the American Industrial Hygiene Association

(AIHA) to participate in the AAR program. Submit proof that persons reading the samples have been judged proficient by successful participation within the last year in the National Institute for Occupational Safety and Health (NIOSH) Proficiency Analytical Testing (PAT) Program or proof that the individuals reading the air samples are current participants in the Asbestos Analysts Registry (AAR). If bulk sample analysis is necessary the testing laboratory will have to submit their certification of National Laboratory Accreditation Program (NVLAP) participation.

1.4.2.2 Industrial Hygienist;

Submit the name, address, and telephone number of the Industrial Hygienist selected to prepare the asbestos plan, direct monitoring and perform training, and a certification that the Industrial Hygienist is certified by the American Board of Industrial Hygiene, including certification number, and date, and their previous experience in asbestos removal activities. For the purposes of this specification the terms industrial hygienist, Certified Industrial Hygienist and CIH are synonymous. The industrial hygienist will be contracted by the abatement firm performing the work. In addition to being a CIH, the individual must be accredited in the discipline he is performing. The Industrial Hygienist must be an accredited building inspector if he is to collect samples or an accredited designer if he is to perform asbestos design specifications.

1.4.2.3 Prior Experience;

As evidence that the asbestos removal effort will be accomplished by trained and competent personnel totally familiar with safe and legal asbestos working practices, the contractor will furnish for Government approval (for himself or for his selected asbestos removal subcontractor) written documentation of successfully completed asbestos abatement projects of similar nature and scope. A short summary of three (3) asbestos abatement projects performed will include:

a. The name, address, and telephone number of the contact person (someone specifically familiar with the contractor's work). If available, include copies of letters of reference from previous users of the contractor's service.

b. A short description of the type of removal (e.g. pipe lagging, sprayed girders and/or ceilings, transite siding, etc.), its extent (square feet, linear feet), and days to complete (scheduled and actual).

c. Documentation of any licenses or certifications as an asbestos abatement Contractor in the jurisdiction covered. If none, a negative response is required.

d. The contractor will certify that the firm and its employees are familiar with regulations of the Occupational Safety and Health Administration (OSHA) and the U.S.

Environmental Protection Agency (EPA)cited in the project specification and related to asbestos abatement.

e. The contractor will further document that no RACM will be stripped, removed , or otherwise be handled or disturbed unless at least one on-site representative, such as a foreman, management level, or other authorized representative trained in the provisions of this regulation and the means of complying with them, is present. Annually the trained on-site individual will receive refresher training in the provisions of this regulation. The required training will include as a minimum: applicability; notifications; material identification; control procedures for removals including, at least, wetting, local exhaust ventilation, negative pressure enclosures, glove-bag procedures, and High Efficiency Particulate Air (HEPA) filters; waste disposal work practices; reporting and record keeping; and asbestos hazards and worker protection. Evidence that the required training has been completed will be posted and made available for inspection by the NESHAP administering agency at the demolition or renovation site.

f. A notarized statement, signed by an officer of the asbestos abatement company, containing the following information: (If none, a negative reply is required.)

(1) A record of any citations issued by Federal, State or local: regulatory agencies relating to asbestos abatement activity. Include projects, dates and resolutions.

(2) A list of penalties incurred through noncompliance with asbestos abatement project specifications including liquidated damages, overruns in scheduled time limitations and resolutions

(3) Situations in which an asbestos related contract has been terminated including projects, dates and reasons for terminations.

(4) A listing of any asbestos-related legal proceedings/claims which the contractor (or employees Scheduled to participated in this project) has participated or is currently involved. Include descriptions of role, issue and resolution to date.

1.4.2.4 Asbestos Plan;

Submit a detailed Plan of the work procedures to be used in the removal and disposal of materials containing asbestos. Include in the Plan an explanation of Initial Exposure Assessment. The Plan will be prepared, signed, and sealed, including certification number and date, by the contractor's Certified Industrial Hygienist. Such Plan will include a sketch showing the location, size, and details of regulated areas, location and details of the decontamination area, layout of decontamination area, and locations of local exhaust equipment. The Plan will also include interface of trades involved in the construction, sequencing of asbestos-related work, disposal plan, type of wetting agent

to be used, air monitoring, respirators, protective equipment, pressure differential monitoring device, and a detailed description of the method employed in order to control ambient air conditions within the regulated area. All milestones and schedules will be included within this Plan. The Plan will be approved by the contracting officer prior to the start of any asbestos work. Prior to beginning work, the contractor will meet with the contracting officer to discuss in detail the Asbestos Plan, including work procedures and safety precautions.

1.4.2.5 Notification Requirements;

a. Initial Notification

At least 10 working days before asbestos stripping or removal work or any other activity begins such as site preparation that would break up, dislodge or similarly disturb asbestos containing materials.

The contractor will:

(1) Provide the U.S. Environmental Protection Agency (EPA) Regional NESHAP administering agency with the required notice of intention to demolish or renovate. If work is performed in Tennessee, notification shall be in accordance with State of Tennessee regulation Ch 1200-3-11 and Code of Federal Regulations 40 CFR 61, Subpart M. The contractor will send notification forms to:

Department of Environment and Conservation-Division of Air Pollution Control
9th Floor, L&C Annex
401 Church Street
Nashville, Tennessee 37243-1531.

If the work is performed in Kentucky, the NESHAP notification forms are to be sent to the:

Kentucky Division for Air Quality
Asbestos Branch, Paducah Region
4500 Clarks River Road
Paducah, Kentucky 42003

Forms are located at the end of this section. Work will not commence on any dates other than those stated in the notification without re-notification of all parties. Delivery of the notice by U.S. Postal Service, commercial delivery service, or hand delivery is acceptable. The contractor will also provide the Contracting Office representative copies of all notifications and re-notifications.

(2) Update notice, as necessary, including when the amount of asbestos affected changes by at least 20 percent.

(3) The contractor will submit to the Contracting Administrator (CA) a copy of the NESHAP notification on the same day it is sent to the administering agency (state).

The CA will, in-turn, forward a copy of the NESHAP notification to the Directorate of Public Works/Environmental Division/Compliance Branch, Building 2182, 13 ½ Street, IMSE-CAM-PWE, Fort Campbell, KY 42223-5130. The contractor will provide the Contracting Officer Representative (COR) and Environmental Division notification 48 hours prior to the start of removal or disturbance of Asbestos Containing Material (ACM). If the contractor was not required by the state to submit a NESHAP notification, the contractor shall submit to the Contracting Officer Representative (COR) 48 hour electronic notification of intent to start removal of asbestos containing material. Such notification shall include the following:

- Building number
- Anticipated start and end dates
- Description of material being disturbed or abated
- Quantity of material being disturbed or abated including units (SF, LF, CY)
- Description of approximate location of work (e.g. latrines, NW corner of building, 2nd floor, etc.)

The COR will in turn forward a copy of the notification to the DPW Environmental Division

b. Re-notification

For asbestos stripping or removal work in a demolition or renovation operation that will begin on a date other than the one contained in the original notice, notice of the new start date must be provided to the NESHAP-administering agency as follows:

(1) When the asbestos stripping or removal operation or demolition operation covered by this paragraph will begin after the date contained in the notice,

(a) Notify the NESHAP administering agency of the new start date by telephone as soon as possible before the original start date, and

(b) Provide the NESHAP administering agency with a written notice of the new start date as soon as possible before, and no later than, the original start date. Delivery of the updated notice by the U.S. Postal Service commercial delivery service, or hand delivery is acceptable.

(2) When the asbestos stripping and removal operation or demolition operation covered by this paragraph will begin earlier than the original start date, provide the NESHAP administering agency with a written notice of the new start date at least 10 working days before asbestos stripping or removal work begins.

(3) In no event will an operation covered by this paragraph begin on a date other than the date contained in the written notice of the new start date.

c. Notification Information

The following will be included in the notice:

- (1) An indication of whether the notice is the original or a revised notification.
- (2) Name, address, and telephone number of both the facility owner and operator and the asbestos removal contractor.
- (3) Type of operation: demolition or renovation.
- (4) Address including specific building number and description of the facility or affected part of the facility including the size (square meters/square feet and number of floors), age, and prior use of the facility.
- (5) Procedure, including analytical methods, employed to detect the presence of RACM and Category I and Category II nonfriable ACM.
- (6) Estimate of the approximate amount of RACM to be removed from the facility in terms of length of pipe in linear meters (linear feet), surface area in square meters (square feet) on other facility components, or volume in cubic meters (cubic feet).
- (7) Location of the facility being demolished or renovated.
- (8) Scheduled start and completion dates of demolition or renovation.
- (9) Description of planned demolition or renovation work to be performed and method(s) to be employed, including demolition or renovation techniques to be used and description of affected facility components.
- (10) Description of work practices and engineering controls to be used to comply with the requirements of this subpart, including asbestos removal and waste-handling emission control procedures.
- (11) Name and location of the waste disposal site where the asbestos-containing material will be deposited.
- (12) A certification that at least one person trained as required by paragraph (e) of 1.4.2.3 of this section will supervise the stripping and removal described by this notification.
- (13) Description of procedures to be followed in the event that unexpected ACMs are encountered.
- (14) Name, address, and telephone number of the waste transporter.

d. Demolition

Refer to Appendix A-10 for demolition NESHAP requirements.

1.4.3 SD-09, Reports

1.4.3.1 Monitoring Results;

Fiber counting will be completed and results reviewed by the Certified Industrial Hygienist within 16 hours. The CIH will notify the contractor and the contracting officer immediately of any exposures to fibers in excess of the acceptable limits. Submit monitoring results to the contracting officer within 3 working days, signed by the testing laboratory, the employee performing air monitoring and the CIH.

1.4.3.2 Local Exhaust System;

Local exhaust systems must be installed and operated in accordance with ANSI Z9.2-79. The local HEPA filtered exhaust system will be operated continuously, 24 hours a day, to maintain the enclosure under negative pressure until the enclosure of the regulated area is removed. Pressure differential recordings for each workday will be reviewed by the Industrial Hygienist and submitted to the contracting officer within 24 hours from the end of each workday. The contractor will notify the contracting officer immediately of any variance in the pressure differential which could cause exposure of adjacent unsealed areas to asbestos fiber concentrations.

1.4.3.3 Job Progress Report;

During abatement activities, the Industrial Hygienist will submit a weekly job progress report to the contracting officer detailing abatement activities. Include review of progress with respect to Asbestos Plan, milestones and schedules, major problems and actions taken, injury reports, equipment breakdowns and a compilation of the weeks bulk material and air sampling results conducted by the contractor's Industrial Hygienist or air sampling professional. Submission of individual monitoring results will be as dictated by SD-09, Reports. The progress report will be signed by the contractor, asbestos abatement subcontractor and the Industrial Hygienist.

1.4.3.4 Within 48 hours after removal of asbestos containing material (ACM), the contractor will provide the Contract Administrator (CA) a copy of the asbestos survey drawings that annotates in blue or red ink the ACM(s) that have been removed as a result of the project. A copy of the building asbestos survey drawings may be obtained at the DPW Environmental Division. The CA will in-turn forward a copy of the survey annotation to the Directorate of Public Works / Environmental Division / Compliance

Branch, Building 2182, 13 ½ Street, IMSE-CAM-PWE, Fort Campbell, Kentucky 42223-5130.

1.4.4 SD-13, Certificates

1.4.4.1 Local exhaust and HEPA vacuum filters;

Local exhaust and HEPA vacuum filters need to be maintained as per manufacturers specifications. Asbestos prefilters need to be replaced daily and HEPA filters changed based upon daily readings of the manometer as described in section 2.7 of this specification.

1.4.4.2 Respirators;

Respiratory protection will be provided by the contractor according to 29 CFR 1926.1101 and the requirements specified in section 2.2 of this specification. The contractor will have developed and implemented a respiratory protection program meeting all the requirements of 29 CFR 1910.134 OSHA's Respiratory Protection Standard.

1.4.5 SD-18, Records

1.4.5.1 Landfill Delivery Records;

Submit written evidence that the contractor plans to use the [Woodlawn](#) Landfill for disposal and will follow all approved procedures for asbestos disposal issued by the EPA, state and local regulatory agencies. Submit copies of all waste shipment records and resulting correspondence. An asbestos waste shipment record appears [at the end of this specification](#).

1.5 TITLE TO MATERIALS

Materials resulting from demolition work, except as specified otherwise, will become the responsibility of the contractor and will be disposed of as specified herein.

1.6 PROTECTION OF EXISTING WORK TO REMAIN

Perform demolition work without damage or contamination of adjacent work. Where such work is damaged or contaminated, restore work to the original condition at no additional cost to the government.

1.7 SEQUENCE OF WORK

No other work shall be performed in the asbestos regulated area prior to completion and certification of the asbestos abatement work.

1.8 PERMISSIBLE EXPOSURE LIMITS (PELS)

a. Time-weighted average limit (TWA). Ensure that no employee is exposed to an airborne concentration of asbestos in excess of 0.1 fiber per cubic centimeter of air as an eight (8) hour time-weighted average (TWA).

b. Excursion limit. Ensure that no employee is exposed to an airborne concentration of asbestos in excess of 1.0 fiber per cubic centimeter of air (1.0 f/cc) as averaged over a sampling period of thirty (30) minutes.

1.9 MEDICAL SURVEILLANCE 29 CFR 1926.1101(m)

1.9.1 Medical examinations

Submit evidence of a medical surveillance program for all employees who for a combined total of 30 or more days per year are engaged in Class I, II and III work or are exposed at or above the permissible exposure limit or excursion limit, and for employees who wear negative pressure respirators. The content of the examination shall be consistent with 29 CFR 1926.1101 (m). This examination is not required if adequate records show the employee has been examined as required by 29 CFR 1926.1101 (m) within the past year. The same medical examination shall be given on an annual basis to employees engaged in an occupation involving asbestos fibers and within 30 calendar days before or after the termination of employment in such occupation.

1.9.2 Medical Records

Maintain complete and accurate records as required by 29 CFR 1926.1101(n) employees' medical examinations for a period of at least 40 years after termination of employment and make records of the required medical examinations available for inspection and copying to: The Assistant Secretary of Labor for Occupational Safety and Health, The Director of the National Institute for Occupational Safety and Health (NIOSH), authorized representatives of either, and an employee's physician upon the request of the employee or former employee.

I.10 TRAINING

All workers must receive training specific to the tasks performed on the project. In addition, each employee must have received an equivalent level of training within 3

months prior to assignment to asbestos work or shall be instructed for a minimum of 8 hours by the CIH with regard to the methods of recognizing asbestos; the health effects associated with asbestos; the relationship between smoking and asbestos in producing lung cancer; its purposes, proper use, fitting instructions, and limitations of respirators; the nature of operations that could result in exposure to asbestos, the importance of necessary protective controls to minimize exposure and any necessary instructions in the use of these controls and procedures; the appropriate work practices for performing the asbestos removal job; medical surveillance program requirements; and a review of 29 CFR 1926.1101 safety and health precautions and the use and requirements for protective clothing and equipment including respirators. Fully cover engineering and other hazard control techniques and procedures. Maintain complete and accurate records of training for each employee. Records shall be maintained for one year beyond the last date of employment.

Employees who perform Class I or Class II removals will have received the EPA worker 4-day course. Supervisors will have received the EPA 5-day Competent person training.

1.12 PERMITS

Obtain necessary permits in conjunction with this project for the abatement, demolition, transportation and disposal of asbestos containing materials, and provide timely notification of such actions as may be required by Federal, State, regional, and local authorities. Refer, also, to SD-18, Records (Landfill Delivery Records) for additional requirements.

1.13 SAFETY AND HEALTH COMPLIANCE

In addition to detailed requirements of this specifications, comply with laws, ordinances, rules, and regulations of Federal, State, regional, and local authorities regarding handling, storing, transporting, and disposing of asbestos waste materials. Comply with the applicable requirements of the current issue of 29 CFR 1926.1101 and 40 CFR 61, Subpart A and 40 CFR 61, Subpart M. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work. Where specification requirements and referenced documents vary, the most stringent requirements will apply.

PART 2 PRODUCTS

2.1 EQUIPMENT AND MATERIAL USED IN REMOVAL OPERATIONS

Furnish the contracting officer with two complete sets of personal protective equipment, as required herein, for each entry into and inspection of the regulated area.

2.2 RESPIRATORS

The contractor will provide respirators , and ensure they are used in the following circumstances. Respiratory protection is required on all asbestos abatement jobs.

- a. During all class I removal jobs.
- b. During all class II work where the ACM is not removed in a substantially intact state.
- c. During all Class II and III work which is not performed using wet methods, provided, however that respirators need not be worn during removal of sloped roofs when a negative exposure assessment has been made and the ACM is removed in an intact state.
- d. During all Class II and III asbestos jobs where the contractor does not produce a “negative exposure assessment.”
- e. During all Class III jobs where TSI or surfacing ACM or PACM is to be disturbed.
- f. During all Class IV work performed in regulated areas where employees performing other work are required to wear respirators.
- g. During all work where employees are exposed above the PEL or the excursion limit.
- h. During emergencies.

Select respirators approved by the Mine Safety and Health Administration (MSHA) and the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services, for use in atmospheres containing asbestos fibers according to the table below. During the performance of work when removal or demolition of asbestos materials is not underway and after the TWA and ceiling limits have been established, the contractor shall provide respirators as required in 29 CFR 1926.1101(h). The contractor shall establish a respirator program as required by ANSI Z88.2-80 and 29 CFR 1910.134.

RESPIRATORY PROTECTION FOR ASBESTOS FIBERS

<u>Airborne concentration of asbestos or condition of use</u>	<u>Required respirator</u>
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Not in excess of 1 f/cc (10XPEL), or Half-mask air purifying respirator otherwise as required independent other than a disposable, equipped of exposure with high efficiency filters.

Not in excess of 5 f/cc (50XPEL). Full-face piece air purifying respirator equipped with high efficiency filters.

Not in excess of 10 f/cc (100XPEL). Any powered air-purifying respirator equipped with high efficiency filters or any supplied air respirator operated in continuous flow mode.

Not in excess of 100 f/cc (100XPEL) Full-face piece supplied - air respirator operated in pressure demand mode.

Greater than 100 f/cc Full-face piece supplied air (1,000XPEL), or unknown concentration. respirator operated in pressure demand mode, equipped with an auxiliary positive pressure self contained breathing apparatus.

*Airborne concentrations are based upon the 8 hour TWA - PEL

*A high efficiency filter means a filter that is at least 99.97 percent efficient against mono-dispersed particles of 0.3 micrometers in diameter or larger.

*Air purifying respirators must be equipped with high-efficiency particulate air (HEPA) filters. The HEPA filters are not reusable.

In addition to the above selection criteria the contractor will provide tight fitting powered air purifying respirators equipped with high efficiency filters or a full face piece supplied air respirator operated in the pressure demand mode equipped with HEPA egress cartridges or an auxiliary positive pressure self contained breathing apparatus for all employees within the regulated area where Class I work is being performed for which a negative exposure assessment has not been produced and the exposure assessment indicates the level will not exceed 1 f/cc as an 8- hour time weighted average. A full face piece supplied air respirator operated in the pressure demand mode equipped with an auxiliary positive pressure self-contained breathing apparatus shall be provided under such conditions, if the exposure assessment indicates exposure levels above 1.0 f/cc as an 8-hour time weighted average.

2.3 SPECIAL CLOTHING

2.3.1 Protective Clothing

Protective clothing shall be coveralls or similar whole-body clothing, head coverings, gloves, and foot coverings.

2.3.2 Work Clothing

Provide boot covers and cloth work clothes to be worn under the protective coveralls.

2.4 HYGIENE FACILITIES

A decontamination area shall consist of an equipment room, shower area, and clean room in series. The equipment room shall be supplied with impermeable, labeled bags and containers for the containment and disposal of contaminated protective equipment. Shower facilities shall be provided which comply with 29 CFR 1910.14(d)(3). The clean change room shall be equipped with a locker or appropriate storage container for each employee's use.

2.5 EYE PROTECTION

Provide goggles for personnel engaged in asbestos operations when the use of a full face respirator is not required.

Eye protection will be provided as per 29 CFR 1910.133 OSHA's Eye and Face Protection Standard.

2.6 WARNING SIGNS AND LABELS

2.6.1 Warning Signs

Warning signs must be of sufficient size to be clearly legible and display the following information:

DANGER

ASBESTOS

CANCER AND LUNG DISEASE HAZARD

AUTHORIZED PERSONNEL ONLY

RESPIRATORS AND PROTECTIVE CLOTHING ARE REQUIRED IN THIS AREA

2.6.2 Warning Labels

Labels must be of sufficient size to be clearly legible, printed in large, bold letters on a contrasting background, and displaying the following legend:

DANGER

CONTAINS ASBESTOS FIBERS

AVOID CREATING DUST

CANCER AND LUNG DISEASE HAZARD

2.7 LOCAL EXHAUST SYSTEM

Provide a local exhaust system in the enclosed regulated areas. Filters on vacuums and exhaust equipment will be UL 586-labeled HEPA filters. Local exhaust equipment shall be sufficient to maintain a minimum pressure differential of minus 0.02 inches of water column relative to adjacent, unsealed areas. The local exhaust system must be equipped with a manometer-type negative pressure differential monitor with minor scale division of 0.02 inches of water and accuracy within plus or minus 10 percent. The manometer must be calibrated daily as recommended by the manufacturer. Provide manually recorded manometer readings of the pressure differential between the enclosed regulated area and adjacent unsealed areas at the beginning of each workday and every 2 working hours thereafter. The local exhaust system will be operated continuously, 24 hours per day, until the regulated area enclosure is removed. Replace filters as required to maintain the efficiency of the system. The building heating, ventilating, and air-conditioning (HVAC) system will not be used as the local exhaust system for the enclosed regulated area.

2.8 TOOLS AND MISCELLANEOUS EQUIPMENT

2.8.1 Airless Sprayer

An airless sprayer, suitable for application of sealing material, will be used.

2.8.2 Scaffolding

Scaffolding, as required to accomplish the specified work, shall meet all applicable safety regulations.

2.8.3 Transportation Equipment

Transportation equipment, as required, will be suitable for loading, temporary storage, transporting, and unloading of contaminated waste without exposure to persons or property.

2.8.4 Vacuum Equipment

All vacuum equipment utilized in the work area will utilize HEPA filtration systems.

2.8.5 Water Sprayer

The water sprayer will be an airless or other low pressure sprayer for amended water application.

2.8.6 Other Tools and Equipment

The contractor shall provide other suitable tools for the stripping, removal, encapsulation and disposal activities including but not limited to: knives, stiff nylon brushes, sponges, rounded edge shovels, brooms, and carts.

2.9 MATERIALS

2.9.1 Lockdown Sealant

The sealing agent will be penetrating sealants and will meet the following criteria:

- a. They will withstand most impact or abrasion and protect the surface.
- b. Sealants selected for use by the contractor will be one of those demonstrating probable effective performance under the tests conducted by an independent testing laboratory and are approved by the contracting officer.
- c. They will have high flame retardant characteristics, and a low toxic fume and smoke emission rating.
- d. They will not be noxious or toxic to application workers, or subsequent workers in the area.
- e. They will have some permeability to water vapor to prevent condensation accumulation, and resist solution by common cleaning agents. They will be water insoluble when cured.
- f. They will be acceptable weathering and aging characteristics.

- g. They will be acceptable by architectural standards.
- h. They will be compatible with all insulating material likely to be applied to the stripped surfaces.
- i. They will be demonstrably capable of adhering to the surfaces of the substrate.
- j. They must contain a light blue or red paint tint. (Food coloring is not acceptable.)

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Respirator Program.

Submit evidence of a respirator program as required by ANSI Z88.2 and 29 CFR 1910.134.

3.1.2 Protective Clothing

Provide and require the use of protective clothing for any employee exposed to airborne concentrations of asbestos that exceed the TWA and/or excursion limit, or for which a required negative exposure assessment is not produced, and for any employee performing Class I and II operations (other than roofing felts and mastics) which involve the removal of over 25 linear or 10 square feet of TSI or surfacing ACM and PACM.

3.1.3 Hygiene Facilities

For employees performing Class I work involving over 25 linear or 10 square feet of TSI or surfacing ACM and PACM, establish a decontamination area that consists of an equipment room, shower area, and clean room in series. Ensure that employees enter and exit the regulated area through the decontamination area. Where it is demonstrated that it is not feasible to locate the shower between the equipment room and the clean room, or where work is performed outdoors, ensure that employees remove asbestos contamination from their work suits in the equipment room using a HEPA vacuum before proceeding to a shower.

3.1.4 Warning Signs and Labels

Provide warning signs at approaches to regulated areas containing airborne asbestos fibers. Locate signs at such a distance that personnel may read the sign and take the

necessary protective steps required before entering the area. Provide labels and affix to asbestos materials, scrap, waste, debris, and other products contaminated with asbestos.

3.1.5 Accessibility of Work Areas

The Government will rearrange areas to the extent of providing a reasonable, direct, and an unobstructed path to the work sites. During asbestos removal, the Contractor will confine his equipment and employee pattern to these designated areas. Where the building is still occupied during the removal operations, interference with the functional operation of the building occupants outside these areas will not be permitted. Where conflicts arise due to Contractor's operations, the decision of the Contracting officer or his authorized representative will be final.

3.1.6 Preparation for Removal

3.1.6.1 Movable Furnishings

Movable furnishings, equipment and fixtures in the work area will be pre-cleaned and removed from the area of work by the Government before asbestos work begins.

3.1.6.2 Pre-Cleaning

All wall and floor surface areas, other than those from which asbestos is to be removed, and all non-movable furnishings, equipment, and fixtures remaining in the work area will be pre-cleaned with a HEPA filter equipped vacuuming device or wet cleaning methods prior to sealing with plastic sheeting. Do not use any methods which would raise dust such as dry sweeping or vacuuming with equipment not equipped with HEPA filters. After pre-cleaning, enclose fixed objects in 6-mil polyethylene sheeting, label, and seal securely with tape, objects which must remain in the work area and that require special ventilation or enclosure requirements will be suitably protected as approved by the contracting officer. Items in the work area which may require access by user during abatement will be designated during the pre-abatement walkthrough and enclosures constructed with access flaps sealed with waterproof tape.

3.1.7 Regulated Areas

All Class I, II, and III asbestos work will be conducted within regulated areas. The regulated area will be demarcated in any manner that minimizes the number of persons within the area and protects persons outside the area from exposure to airborne concentrations of asbestos. Where critical barriers or negative pressure enclosures are used, demarcate the regulated area. Signs will be provided and displayed pursuant to 29 CFR 1026.1101(k)(6). Access to regulated areas will be limited to authorized persons. All persons entering a regulated area where employees are required to wear

respirators, will be supplied with a respirator. All asbestos work performed within regulated areas will be supervised by a competent person.

3.1.7.1 Enclosed (Critical Barrier) Regulated Area Requirements

Seal openings in areas where the release of airborne asbestos fibers is expected. Establish a regulated area with the use of curtains, portable partitions, or other enclosures in order to prevent the escape of asbestos fibers from the contaminated area. The established regulated area will be provided with protective covering of walls and ceilings with a continuous membrane of two layers of minimum 6-mil plastic sheeting sealed with tape to prevent water or other damage and two layers of 6-mil plastic sheeting over floors extending a minimum of 24 inches up walls. All penetrations of the floor, walls, and ceiling will be sealed with 6-mil polyethylene plastic and duct tape. Seal joints using spray adhesive and duct tape. Openings will be allowed in enclosures of regulated areas for the supply and exhaust of air for the local exhaust system.

3.2 ASBESTOS ABATEMENT PROCEDURES

3.2.1 Initial Exposure Assessment

Ensure that a "competent person" conducts an exposure assessment immediately before or at the initiation of the operation to ascertain expected exposures during that operation or workplace. The assessment must be completed in time to comply with requirements which are triggered by exposure data or the lack of a "negative exposure assessment," and to provide information necessary to assure that all control systems planned are appropriate for that operation and will work properly.

An Initial Exposure Assessment will be conducted in accordance with 29 CFR 1926.1101

For Class I asbestos work, until exposure monitoring is conducted, and is documented that employees on the job will not be exposed in excess of the PELs, or otherwise makes a negative exposure assessment, it is presumed that employees are exposed in excess of the TWA and excursion limit. A negative exposure assessment can only be obtained by demonstrating requirements contained in 29 CFR 1926.1101.

3.2.2 Monitoring Requirements

Perform exposure monitoring as required to determine accurately the airborne concentrations of asbestos to which employees are exposed. Determinations of employee exposure will be made from breathing zone air samples that are representative of the 8-hour TWA and 30-minute short-term exposures of each

employee. Representative 8-hour TWA employee exposure will be determined on the basis of one or more samples representing full-shift exposure for employees in each work area. Representative 30-minute short-term employee exposures will be determined on the basis of one or more samples representing 30-minute exposures associated with operations that are most likely to produce exposures above the excursion limit for employees in each work area.

3.2.2.1 Monitoring Prior to Asbestos Work

Provide area monitoring and establish the reference TWA 1 day prior to the masking and sealing operations for each asbestos removal site. The reference TWA is determined by taking at least three general area air samples in each asbestos regulated area.

3.2.2.2 Periodic monitoring

Conduct daily monitoring that is representative of the exposure of each employee who is assigned to work within a regulated area who is performing Class I or II work unless a negative exposure assessment for the entire operation has been made. Conduct periodic monitoring of all work where exposures are expected to exceed a PEL at intervals sufficient to document the validity of the exposure prediction. When all employees required to be monitored daily are equipped with supplied-air respirators operated in the positive-pressure mode, daily monitoring is not required. However employees performing Class I work using a control method which is not listed in Class I Requirements paragraph, will continue to be monitored daily even if they are equipped with supplied-air respirators.

3.2.2.3 Monitoring Adjacent Areas Prior to Asbestos Work

Provide area monitoring and establish the reference TWA inside the building outside the enclosed regulated area 1 day prior to beginning asbestos work.

3.2.2.4 Termination of Monitoring

If the periodic monitoring reveals that employee exposures, as indicated by statistically reliable measurement, are below the PEL and excursion limit, monitoring may be discontinued for those employees whose exposures are represented by such monitoring. Institute additional monitoring whenever there has been a change in process, control equipment, personnel or work practices that may result in new or additional exposures above the PEL and/or excursion limit.

3.2.3 Respiratory Protection

Respirators will be provided and used according to the requirements of 29 CFR 1926.1101 and section 2.2 of this specification.

3.2.4 Controls and Work Practices

The following controls and work practices will be used in all classes of work regardless of levels of exposure:

- a. Vacuum cleaners equipped with HEPA filters to collect all debris and dust containing ACM or PACM;
- b. Wet methods, or wetting agents, to control employee exposures during asbestos handling, mixing, removal, cutting, application, and cleanup, except where demonstrated that the use of wet methods are infeasible;
- c. Prompt clean-up and disposal of wastes and debris contaminated with asbestos in leak-tight container;
- d. Local exhaust ventilation equipped with HEPA filter dust collection systems;
- e. Enclosure or isolation of processes producing asbestos dust;
- f. Ventilation of the regulated area to move contaminated air away from the breathing zone and toward a filtration or a collection device equipped with a HEPA filter.

The following work practices and controls will not be used for work related to asbestos or the work which disturbs ACM or PACM, regardless of measured levels of asbestos exposure or results of the initial exposure assessments:

- a. High-speed abrasive disc saws that are not equipped with point of cut ventilator or enclosures with HEPA filters exhaust air;
- b. Compressed air used to remove asbestos, or ACM, unless the compressed air is used in conjunction with an enclosed ventilation system designed to capture the dust cloud created by the compressed air;
- c. Dry sweeping, shoveling or other dry clean-up and debris containing ACM and PACM;
- d. Employee rotation as a means of reducing employee exposure to asbestos.

3.2.5 Class I Abatement Requirements

In addition to all provisions required in control and work methods above, the following controls and work practices will be used for all Class I work.

a. Installation and operation of the control systems, will be supervised by a competent person.

b. Work involving the removal of more than 25 linear or 10 square feet of thermal system insulation or surfacing material; for all other Class I jobs, where a negative exposure assessment, or where employees are working in areas adjacent to the regulated area, while the Class I work is being performed, use one of the following methods to ensure that airborne asbestos does not migrate from the regulated areas:

(1) Critical barriers will be placed over all openings to the regulated area;

(2) Use another barrier or isolation method which prevents the migration of airborne asbestos from the regulated area, as verified by perimeter area surveillance during each work shift at each boundary of the regulated area, showing no visible asbestos dust; and perimeter area monitoring showing that clearance levels contained in 40 CFR Part 763, Subpart 3, or that perimeter area levels are no more than background levels representing the same area before the asbestos work began.

c. HVAC systems will be isolated in the regulated area by sealing with a double layer of 6 mil plastic or the equivalent;

d. Impermeable drop cloths will be placed on surfaces beneath all removal activity;

e. All objects within the regulated area will be cleaned out and covered with impermeable drop cloths or plastic sheeting which is secured by duct tape or an equivalent.

f. Where a negative exposure assessment cannot be produced, or where exposure monitoring shows that a PEL is exceeded, ventilate the regulated area to move contaminated air away from the breathing zone of employees toward a HEPA filtration or collection device.

3.2.5.1.1 Vinyl and Asphalt Flooring Materials

For removing vinyl and asphalt flooring materials which contain ACM in buildings constructed no later than 1980:

a. Flooring or its backing will not be sanded.

b. Vacuums equipped with HEPA filter, disposable dust bag, and metal floor tool (no brush) will be used to clean floors.

- c. Resilient sheeting will be removed by cutting with wetting of the snip point and wetting during delamination. Rip-up of resilient sheet floor material is prohibited.
- d. All scraping of residual adhesive and/or backing will be performed using wet methods.
- e. Dry sweeping is prohibited.
- f. Mechanical chipping is prohibited unless performed in a negative pressure enclosure which meets the requirement of this section.
- g. Tiles will be removed intact, unless it is demonstrated that intact removal is not possible.
- h. When tiles are heated and can be removed intact, wetting may be omitted.
- I. Resilient flooring material including associated mastic and backing will be assumed to be asbestos-containing materials unless an industrial hygienist determines them to be non asbestos containing materials using recognized analytical techniques.
- J. Splash guards consisting of 6 mil polyethylene sheeting will be utilized when chemical strippers are used . Splash guards will extend along the wall from the floor to a height of 4 feet.

3.2.5.1.2 Any other Removal of ACM

- a. The material will be thoroughly wetted with amended water prior and during its removal.
- b. The material will be removed in an intact state unless the employer demonstrates that intact removal is not possible.
- c. Cutting, abrading, or breaking the material will be prohibited unless the employer can demonstrate that methods less likely to result in asbestos fiber release are not feasible.
- d. ACM removed will be immediately bagged or wrapped, or kept wetted until transferred to a closed receptacle, no later than the end of the work shift.

3.2.5.3 Asbestos Contaminated Soil

Any area of contaminated soil is to be removed of by the following procedures:

- a. Before the soil removal commences, mark the wall in the area(s) at the existing ground elevation.
- b. Using small shovels, all loose soil will be removed to a minimum depth of 3 inches.
- c. Verification of the depth will be made by measurement from the excavation floor to the bottom of the original ground elevation mark or the wall.

3.3 COLLECTION

3.3.1 Nonfriable Non-Regulated Asbestos Containing Material (Non-RACM)

The non-friable ACM found in this project will be handled as RACM and will require special collection action as detailed in Para. 3.3.2.

The notification requirements of Para. 1.4.2 also are applicable to Non-RACM.

3.3.2 Regulated Asbestos Containing Material (RACM)

All asbestos containing materials for this project will be treated as RACM due to the nature of the materials present. Asbestos containing material will be removed in manageable sections and maintained in a wet condition. Material should be containerized upon removal and before being moved to any new location.

Maintain surfaces of the regulated area free of accumulations of asbestos fibers. Restrict the spread of dust and debris; keep waste from being distributed over the general area. Do not dry sweep or blow down the space with compressed air.

Collect asbestos waste, scrap, debris, bags, containers, equipment, and asbestos-contaminated clothing which may produce airborne concentrations of asbestos fibers; place in sealed impermeable bags imprinted with a caution label (Para. 2.6.2) and label with the name of the contractor and the location at which the waste was generated. The sealed bags will then be placed in a second sealed impermeable bag also imprinted with the warning label. Bags will be placed in asbestos roll off boxes for shipment to the landfill.

3.3.2.1 Removing Material Intact

Asbestos containing materials should be removed intact whenever possible (removal of pipe and pipe insulation by wrapping, sealing the insulation and cutting the uninsulated ends of the pipe). Asbestos containing materials will not be dropped or thrown to the ground. Materials between 15 and 50 feet above the ground may be containerized at elevated levels or placed into inclined chutes or scaffolding for subsequent collection

and containerization. Asbestos materials in open containers will be kept wet at all times.

3.3.2.2 Containers

Containers (drums or 6-mil polyethylene bags) will be sealed when full. Wet material will be heavy and double bagging of waste material is required. Bags, if used, will not be overfilled. They should be securely sealed to prevent accidental opening and leakage by tying the tops of the bags in an overhand knot or by taping in goose neck fashion. Do not seal bags with wire or cord. Bags may be placed in drums for staging and transportation to the landfill. Bags will be decontaminated on exterior surfaces by wet cleaning before being placed in clean drums and sealed with locking ring tops. Where unusual circumstances prohibit use of plastic disposal bags or drums, the contractor will submit, in the asbestos plan, an alternate proposal for removal, containerizing, and disposal of the asbestos containing materials.

3.3.2.3 Sharp Edged Components

Asbestos containing or contaminated waste with sharp edged components (e.g. nails, screws, metal lath, tin sheeting) that could otherwise tear polyethylene bags will be placed into drums for disposal.

3.3.2.4 Asbestos Contaminated Soil

Any removed soil will be placed in 6-mil plastic bags, sealed and then placed in approved containers such as fiber waste drums for disposal. Do not overfill plastic bags.

3.3.2.5 Wastewater

a. Pre-filtering. Any water produced by the decontamination of either equipment or persons will be (1) collected, (2) filtered through a system capable of trapping particles 5 microns and larger, specifically designed to remove asbestos fibers, and (3) filtrate disposed into a local sanitary sewer system.

b. Filter System. The filtration system will contain a series of several filters with progressively smaller pore sizes to avoid rapid clogging of the system by large particles. Disposable filters will be treated as asbestos waste.

3.4 DISPOSAL OF ACM

3.4.1 All Asbestos Containing Materials

3.4.1.1. Prior to delivery of asbestos containing materials at the Woodlawn Landfill the contractor will provide Fort Campbell, DPW Roads and Grounds at least 24 hours notice of when ACM is to be disposed.

3.4.2. Once drums, bags and otherwise containerized asbestos containing materials have been removed from the work area, they will be loaded into an enclosed truck for transportation to the Woodlawn landfill. Asbestos waste will not be allowed to be placed in trucks with non-asbestos waste. All bags utilized will be of 6-mil polyethylene and must be double lined.

3.4.3. All containers will be labeled according to the requirements of 29 CFR 1910.1200 OSHA Hazardous Communication Standard and will contain the following:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD

3.4.4. The enclosed cargo area of the truck will be free of debris and lined with 6-mil polyethylene sheeting to prevent contamination from leaking or spilled containers. Floor sheeting will be installed first and extend up the sidewalls. Wall sheeting will be overlapped and taped into place so that no materials may escape to the environment.

3.4.5. Drums will be placed on level surfaces in the cargo area and packed tightly together to prevent shifting and tipping. Do not throw containers into the cargo area.

3.4.6. Personnel loading asbestos containing waste will be protected by disposable clothing including head, body and foot protection and at a minimum, half-face piece, air purifying, dual cartridge respirators equipped with high efficiency particulate air (HEPA) filters.

3.4.7. Large steel dumpsters (roll-off boxes) may be used for asbestos waste disposal. These should be lined with polyethylene and should have doors, tops or covers that can be closed to prevent vandalism or other disturbance of the containerized asbestos debris and wind dispersion of asbestos fibers. Uncontainerized asbestos materials will not be placed in these type dumpsters, nor will they be used for non-asbestos waste. Bags will be placed, not thrown, into these containers to avoid splitting.

3.4.8. Disposal of waste asbestos material at Woodlawn Landfill. Contact Fort Campbell-DPW, Environmental Division through the Contracting Officers representative.

3.4.9. For temporary storage, store sealed impermeable bags in asbestos waste drums. If temporary storage is within regulated areas and under negative pressure drums are not required. An area for interim storage of asbestos waste-containing

drums will be assigned by the contracting officer or by an authorized representative. This area must be secure. No ACM wastes, except those properly labeled and properly containerized and physically located in the assigned holding area will be allowed to remain at the site overnight.

3.4.10. Procedures for hauling and disposing will comply with 40 CFR 61 Subpart M, 40 CFR 241, 40 CFR 257, and State, regional and local standards. Vehicles used to transport asbestos containing waste material must be clearly marked. The markings must:

(i) Be displayed in such a manner and location that a person can easily read the legend.

(ii) Conform to the requirements for 51 cm x 36 cm (20 in. x 14 in.) upright format signs specified in 29 CFR 1910.145(d)(4) and this paragraph; and

(iii) Display the following legend in the lower panel with letter sizes and styles of a visibility at least equal to those specified in this paragraph.

Legend

DANGER
ASBESTOS DUST HAZARD
CANCER AND LUNG DISEASE HAZARD
Authorized Personnel only

Notation

2.5 cm (1 inch) Sans Serif, Gothic or Block
2.5 cm (1 inch) Sans Serif, Gothic or Block
1.9 cm (3/4 inch) Sans Serif, Gothic or Block
14 Point Gothic

Spacing between any two lines must be at least equal to the height of the upper of the two lines.

3.4.11. Upon reaching the landfill, trucks are to approach the dump location as closely as possible for unloading of the asbestos containing waste.

3.4.12. Bags, drums and components will be inspected as they are off loaded at the disposal site. Material in damaged containers will be repacked in empty drums or bags as necessary. Uncontaminated drums may be recycled.

3.4.13. Waste containers will be placed on the ground at the disposal site, not pushed or thrown out of trucks since the weight of wet material could rupture containers.

3.4.14. Personnel off-loading containers at the disposal site will wear protective equipment consisting of disposable head, body and foot protection and, at a minimum, half-face piece, air-purifying, dual cartridge respirators equipped with high efficiency particulate air (HEPA) filters. Following the removal of all containerized waste, the truck cargo area will be decontaminated to meet the no visible residue criteria. Polyethylene sheeting will be removed and discarded along with contaminated cleaning materials and protective clothing, in bags or drums at the disposal site. If landfill personnel have not been provided with personal protective equipment for the compaction operation by the landfill operator, the contractor will supply protective clothing and respiratory protection for the duration of this operation.

3.4.15. Shipment Records

a. Maintain waste shipment records, using copies of the [form located at the end of this section](#) and include the following information:

(i) The name, address, and telephone number of the waste generator.

(ii) The name and address of the local, State, or EPA Regional office responsible for administering the asbestos NESHAP program.

(iii) The approximate quantity in cubic meters (cubic feet).

(iv) The name and telephone number of the disposal site operator.

(v) The name and physical site location of the disposal site.

(vi) The date transported.

(vii) The name, address, and telephone number of the transporter(s).

(viii) A certification that the contents of this consignment are fully and accurately described by proper shipping name and are classified, packed, marked, labeled, and are in all respects in proper condition for transport by highway according to applicable international and government regulations.

b. Provide a copy of the waste shipment record, described above to the disposal site owners or operators at the same time as the asbestos-containing waste material is delivered to the disposal site.

c. For waste shipments where a copy of the waste shipment record, signed by the owner or operator of the designated disposal site, is not received by the contractor within 35 days of the date the waste was transported, contact the owner or operator of

the designated disposal site to determine the status of the waste shipment. The contractor will report in writing to the NESHAP administering agency if a copy of the waste shipment record, signed by the owner or operator of the designated waste disposal site, is not received by the contractor within 45 days of the date the waste was transported. Include in the report the following information:

(i) A copy of the waste shipment record for which a confirmation of delivery was not received, and

(ii) A cover letter explaining the efforts taken to locate the asbestos waste shipment and the results of those efforts.

d. Retain a copy of all waste shipment records, including a copy of the waste shipment record signed by the owner or operator of the designated waste disposal site, for at least 2 years.

e. Provide to the contracting officer within 3 working days following delivery of asbestos containing waste material copies of all waste shipment records. Also within 3 working days of initiation, provide to the contracting officer copies of any correspondence with the NESHAP administering agency.

Furnish upon request, and make available for inspection by the NESHAP administering agency, all records under this section.

3.4.16 Wastewater

It is the contractor's responsibility to comply with any local wastewater systems' regulations or policy regarding the disposal of wastewater from asbestos abatement activities.

3.5 CLEANUP AND FINAL CLEARANCE

3.5.1 Cleanup

Clean all surfaces in the work area and other contaminated areas with water and/or HEPA vacuum equipment. After cleaning the work area, allow 24 hours for settlement of dust and wet clean or clean with HEPA vacuum equipment all surfaces in the work area. When asbestos removal, disposal, and cleanup are complete, the contractor will certify, in writing, that the area is free of any asbestos material or debris.

3.5.2 Visual Inspection After Cleanup

Prior to the performance of final air monitoring, the contractor and the contracting officer or his representative will perform a visual inspection for asbestos dust/residue. If

residue is found, additional wipedown/vacuuuming will be performed to the satisfaction of the contracting officer. If recleaning is required, monitor the airborne fiber concentration after recleaning.

3.5.3 Monitoring After Final Cleanup

After the removal site has passed the visual inspection, provide area monitoring of fibers (at least 5 samples per removal site) under aggressive conditions. Collect and analyze the samples to establish airborne asbestos fiber concentration within the area after final cleanup but before removal of the enclosure of the regulated area. The fiber counts from the samples will be less than 0.01 fibers (longer than 5 micrometers) per cubic centimeter of air or not be greater than the levels referenced as background before the work was initiated, whichever is less. Should any of the final sampling indicate a higher value, the contractor will take appropriate actions to reclean the area and will repeat the monitoring.

3.5.4 Sampling

Sampling under aggressive conditions will include the following procedures:

- a. Before starting the sampling pumps, direct the exhaust from forced air equipment (such as a 1 horsepower leaf blower) against all walls, ceiling, floors, ledges and other surfaces in the room. This should take at least 5 minutes per 1000 sq. ft. of floor.
- b. Place a 20-inch fan in the center of the room. (Use one fan per 10,000 cubic feet of room space.) Place the fan on low speed and point it toward the ceiling.
- c. Start the sampling pumps and sample for the required time.
- d. Turn off the pump and then the fan(s) when sampling is complete.

3.5.5 Air Clearance Failure

Should clearance sampling results fail to meet the final cleanup requirements, the contractor will take appropriate action at no additional cost to the Government, to reclean, resample, and analyze data until final cleanup requirements are met.

3.5.6 Site Inspection

While performing asbestos removal work, the contractor will be subject to onsite inspection by the contracting officer who may be assisted by safety or health personnel. If the work is in violation of specification requirements, the contracting officer will issue a stop work order to be in effect immediately and until the violation is resolved. Standby time and expenses required to resolve the violation will be at the contractor's expense.

3.5.7 Sealing Permanent Exposed Surfaces (RACM)

After the asbestos material has been removed and HEPA vacuumed to the greatest extent possible, all permanent asbestos exposed interior surfaces will be coated with an approved lockdown sealant to permanently bind any remaining fibers in place. Sealant will be applied by airless sprayers and in accordance with the sealant manufacturers recommendations.

3.5.8 Sealant Tint

The sealant will have an adequate tint to easily distinguish between sections sealed and sections not sealed.

3.5.9 Reestablishment of the Work Area

Reestablishment of the work area will occur only after the completion of the following to the contracting officers satisfaction: performance of clean-up procedures and the successful achievement/ documentation of clearance air monitoring values.

3.5.10 Visual Inspection

The contractor and contracting officer will visually inspect the work area for any remaining visible residue. Evidence of asbestos materials will necessitate additional cleaning requirements.

3.5.11 Clearance of Work Area

Following satisfactory clearance of the work area, remaining barriers may be removed and disposed of as asbestos contaminated waste.

3.5.12 Remaining Building Demolition Procedures

Contractor may proceed with remaining building demolition procedures as described in SECTION 02050: DEMOLITION.

End of Section

[Return to Designer Instructions](#)

ASBESTOS WASTE SHIPMENT RECORD

Department of Environment
and Conservation
Division of Air Pollution Control



9th Floor, L & C Annex
401 Church Street
Nashville, TN 37243-1531
(615) 532-0554

ASBESTOS WASTE SHIPMENT RECORD

GENERATOR		
1. Work site name and mailing address	Owner's name	Owner's telephone no. ()
2. Operator's name and address		Operator's telephone no. ()
3. Waste disposal site (WDS) name, mailing address, physical site location and disposal facility permit number		WDS phone no. ()
		Permit no.
4. Name and address of responsible agency		
5. Description of materials	6. Containers No. Type	7. Total quantity m ³ yd ³
8. Special handling instructions and additional information		
9. OPERATOR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and government regulations.		
Print/type name & title	Signature	Month Day Year
TRANSPORTER		
10. Transporter 1 (acknowledgement of receipt of materials)		
Print/type name & title	Signature	Month Day Year
Address		() Telephone No.
11. Transporter 2 (acknowledgement of receipt of materials)		
Print/type name & title	Signature	Month Day Year
Address		() Telephone No.
DISPOSAL SITE		
12. Discrepancy indication space		
13. Waste disposal site Owner or operator: Certification of receipt of asbestos materials covered by this manifest except as noted in item 12.		
Print/type name & title	Signature	Month Day Year

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(Instructions on Reverse)

INSTRUCTIONSWaste Generator Section (Items 1-9)

1. Enter the name of the facility at which asbestos waste is generated and the address where the facility is located. In the appropriate spaces, also enter the name of the owner of the facility and the owner's phone number.
2. If a demolition or renovation, enter the name and address of the company and authorized agent responsible for performing the asbestos removal. In the appropriate spaces, also enter the phone number of the operator.
3. Enter the name, address, and physical site location of the waste disposal site (WDS) that will be receiving the asbestos materials. In the appropriate spaces, also enter the phone number of the WDS. Enter "on-site" if the waste will be disposed of on the generator's property.
4. Provide the name and address of the local, State, or EPA Regional office responsible for administering the asbestos NESHAP program.
5. Indicate the types of asbestos waste materials generated. If from a demolition or renovation, indicate the amount of asbestos that is
 - Friable asbestos material
 - Nonfriable asbestos material
6. Enter the number of containers used to transport the asbestos materials listed in item 5. Also enter one of the following container codes used in transporting each type of asbestos material (specify any other type of container used if not listed below):
 - DM - Metal drums, barrels
 - DP - Plastic drums, barrels
 - BA - 6 mil plastic bags or wrapping
7. Enter the quantities of each type of asbestos material removed in units of cubic meters (cubic yards).
8. Use this space to indicate special transportation, treatment, storage or disposal or Bill of Lading information. If an alternate waste disposal site is designated, note it here. Emergency response telephone numbers or similar information may be included here.
9. The authorized agent of the waste generator must read and then sign and date this certification. The date is the date of receipt by transporter.

NOTE: The waste generator must retain a copy of this form.

Transporter Section (Items 10 & 11)

10. & 11. Enter name, address, and telephone number of each transporter used, if applicable. Print or type the full name and title of person accepting responsibility and acknowledging receipt of materials as listed on this waste shipment record for transport. Enter date of receipt and signature.

NOTE: The transporter must retain a copy of this form.

Disposal Site Section (Items 12 & 13)

12. The authorized representative of the WDS must note in this space any discrepancy between waste described on this manifest and waste actually received as well as any improperly enclosed or contained waste. Any rejected materials should be listed and destination of those materials provided. A site that converts asbestos-containing waste material to nonasbestos material is considered a WDS.
13. The signature (by hand) of the authorized WDS agent indicates acceptance and agreement with statements on this manifest except as noted in item 12. The date is the date of signature and receipt of shipment.

NOTE: The WDS must retain a completed copy of this form. The WDS must also send a completed copy to the operator listed in item 2.

[Back to Shipment Records Paragraph 1.4.5.1](#)
[Back to Shipment Records Paragraph 15](#)

NOTIFICATION OF ASBESTOS DEMOLITION OR RENOVATION FORM



DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF AIR POLLUTION CONTROL

NOTIFICATION OF ASBESTOS DEMOLITION OR RENOVATION

Operator Project #	Postmark	Date Received	Notification #	
I. Type of Notification (O-Orig., R-Revised, C-Cancelled)				
II. Facility Information (Identify Owner, Removal Contractor, Operator)				
Owner Name:				
Address:				
City:	State:	Zip:		
Contact:	Telephone: ()			
Removal Contractor:				
Address:				
City:	State:	Zip:		
Contact:	Telephone: ()			
Other Operator (If Different From Owner):				
Address:				
City:	State:	Zip:		
Contact:	Telephone: ()			
III. Type of Operation (D-Demo., O-Ordered Demo., R-Renov., E-Emer. Renov.)				
IV. Is Asbestos Present? (Yes/No)				
V. Facility Description (Include Building Name, Number and Floor or Room Number)				
Building Name:				
Address:				
City:	State:	Zip:		
Site Location:				
Building Site Total Sq. Ft.:	# of Floors:	Age in Years:		
Present Use:	Prior Use:			
VI. Procedure and Analytical Method Used to Detect the Presence of Asbestos Material				
VII. Approximate Amount of Asbestos in Work Area Including				
1. Regulated ACM to be Removed	RACM To Be Removed	Nonfriable Asbestos Material		Units of Measurement
2. Category I ACM Not Removed		Not To Be Removed	To Be Removed	
3. Category II ACM Not Removed		Cat I	Cat II	
Pipes				LnFT Ln m
Surface Area				SqFt Sq m
Vol. RACM Off Facility Components				CuFT Cu m
VIII. Scheduled Dates for Asbestos Removal		Start:	Complete:	
Scheduled Dates of Preparation		Start:	Complete:	
Days of Week: (circle) ALL Sun Mon Tue Wed Thu Fri Sat		Hours of Day:		
IX. Scheduled Dates for Demo./Renovation		Start:	Complete:	
X. Description of Planned Demolition or Renovation Work, Method(s) to be Used:				
XI. Description of Work Practices and Engineering Controls to be used to Prevent Emissions of Asbestos at the Demolition and Renovation Site:				

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RDA 1298

XII. Waste Transporter #1		
Name:		
Address:		
City:	State:	Zip:
Contact Person:	Telephone: ()	
Waste Transporter #2		
Name:		
Address:		
City:	State:	Zip:
Contact Person:	Telephone: ()	
XIII. Waste Disposal Site		
Name:		
Location:		
City:	State:	Zip:
Telephone:		
XIV. If Demolition Ordered by a Government Agency, Please Identify Below:		
Name:	Title:	
Authority:	Date Ordered to Begin (mm/dd/yy)	
Date of Order (mm/dd/yy):		
XV. For Emergency Renovations		
Date and Hour of Emergency (mm/dd/yy):		
Description of the Sudden, Unexpected Event:		
Explanation of How the Event Caused Unsafe Conditions or Would Cause Equipment Damage or an Unreasonable Financial Burden:		
XVI. Description of Procedures to be Followed in the Event Asbestos is Found or Previously Nonfriable Asbestos Material Becomes Crumbled, Pulverized, or Reduced to Powder.		
XVII. I Certify That an Individual Trained in the Provisions of this Regulation (40 CFR Part 61, Subpart M) Will be On-Site During the Demolition or Renovation and Evidence That Required Training has Been Accomplished by This Person Will be Available for Inspection During Normal Business Hours. (REQUIRED AFTER NOVEMBER 20, 1991)		
_____ (Signature of Owner/Operator)		_____ (Date)
XVIII. I Certify That the Above Information is Correct.		
_____ (Signature of Owner/Operator)		_____ (Date)

Submit Completed Form by U.S. Postal Service / Commercial Delivery Service or Hand Deliver to:

Department of Environment and Conservation
 Division of Air Pollution Control
 9th Floor, L & C Annex
 401 Church Street
 Nashville, TN 37243-1531
 (615) 532-0554

[Back to Notification Requirements Paragraph 1.4.2.5](#)

WOODLAWN LANDFILL ASBESTOS POLICY

MEMORANDUM OF UNDERSTANDING

WOODLAWN ROAD LANDFILL
FORT CAMPBELL, KENTUCKY

ASBESTOS POLICY

Woodlawn Landfill is operated under a permit issued by the Division of Solid Waste Management, Department of Conservation, State of Tennessee and in accordance with Federal, State and Local Regulations. A special waste permit was issued by the State of Tennessee for the landfill to accept Asbestos Containing Waste, but only with certain stipulations.

Haulers bringing asbestos waste to the landfill must comply with the Federal, State and Local Regulations and with state permit requirements. The following is a list of some of those requirements:

1. Any vehicle hauling asbestos containing waste must be marked with signs in accordance with APC rule 1200-3-11-02(2)(k)4 providing warning that the vehicle contains asbestos. Improperly marked vehicles will not be accepted at the landfill.
2. Any vehicle hauling asbestos containing waste must be enclosed or in a covered 39-14-503 cartier as described in Tennessee Code Annotated. Vehicles not meeting this requirement will not be accepted at the landfill.
3. The vehicle driver and any passengers must have fit tested respirators to be present or within 100 meters during unloading operations at the landfill. Facial hair that would interfere with a proper air seal around the respirator is not allowed on personnel wearing respirators unless the respirator has been specifically approved for that purpose. Failure to comply with the requirement will bar that individual from future entry into the landfill. A copy of the fit test certificate will be presented to the landfill operator when requested.
4. Asbestos waste will be placed in the area designated by the landfill personnel. The materials will be carefully unloaded to prevent spillage or puncture of the containers. Improper handling of the asbestos waste will prohibit that person from future asbestos operations at the landfill.
5. Asbestos waste will be accepted at the landfill only after receiving a 24 hour notice. A time will be designated for receiving the asbestos waste. Shipments arriving at the landfill more than thirty minutes from that time may be refused entry.
6. The shipper must furnish a copy of the NESHAP 10 day notice and an asbestos waste manifest to the landfill personnel before being accepted. Improperly completed information will be grounds to reject the acceptance of the asbestos waste.

I have read and understand the above requirements. I understand that failure to observe that regulations and requirements will cause me not to be allowed to deliver and dispose of asbestos containing waste at the Woodlawn Road Landfill.

Signature: _____

Employer: _____

Date: _____

Approved respirator fit test date: _____

[Back to Shipment Records Paragraph 1.4.5.1](#)

[Back to Instructions to Designers](#)

SECTION 02090 Demolition or Buildings with Lead-Based Paint, Removal and Disposal of Lead –Based Paint

Ft. Campbell Requirements:

Removal and disposal of lead-based paint materials shall be conducted in accordance with Ft. Campbell specification section 02090, Demolition or Buildings with Lead-Based Paint, Removal and Disposal of Lead–Based Paint, which shall be included in all projects containing or possibly containing lead-based products.

Lead-based paint materials shall be removed before demolition of buildings.

Instruction to Designers:

1. All projects containing or possibly containing lead products shall include Ft. Campbell specification section [02090, Removal and Disposal of Lead-Based Materials](#).
2. Additional Environmental guidance applies. See [Appendix A](#).

02090 Removal and Disposal of Lead- Based Materials

ous waste drums in interim storage longer than 90 calendar days from the date affixed to each drum.

- c. Handle, store, transport, and dispose lead or lead-contaminated waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, and 40 CFR 265. Comply with land disposal restriction notification requirements as required by 40 CFR 268.

3.5.4.1 Disposal Documentation

Submit written evidence that the hazardous waste treatment, storage, or disposal facility (TSD) is approved for lead disposal by the EPA and state or local regulatory agencies. Submit one copy of the completed manifest, signed and dated by the initial transporter in accordance with 40 CFR 262. **Manifest must be signed by the HW manager as well as transporter before leaving the installation.**

3.5.5 Disposal of Lead Contaminated Non-Hazardous Waste

Any portion of the segregated waste products which does not test as hazardous by the testing requirements stated above, may be disposed at the Woodlawn Landfill.

3.5.6 Payment for Hazardous Waste Disposal

Payment for disposal of hazardous waste will not be made until a signed copy of the manifest from the treatment or disposal facility certifying the amount of lead-containing materials delivered is returned and a copy is furnished to the Government.

SECTION 02220

Demolition

Ft. Campbell Requirements:

Requirements in this section and Appendix A-7. [Solid Waste Disposal/Diversion Practices](#) shall apply to all construction and demolition activities at Fort Campbell. Contract specifications shall require at least a 50% diversion (by weight) of demolished building materials such as wood, plumbing fixtures, electrical materials (lights and panels), windows, doors, toilet partitions, HVAC equipment, and scrap metals be diverted from the landfill (See Chapter 2, para 2.1.4 ([Click here](#))). Diversion can be accomplished by deconstructing the wood buildings and components per instructions below or by moving the structure off-post.

Requirements in this section and Appendix A-10. [National emission standards for hazardous air pollutants \(NESHAP\)](#) regulatory requirements for demolition apply .

Demolition materials shall not be salvaged by the contractor and shall not be removed from the installation. Non-salvageable demolition materials shall not to be transported off the installation.

Notify the DPW Environmental Division if unknown waste is discovered during site investigations. Waste could be explosive, hazardous or toxic waste.

Dumpster service for new construction and for demolition is not provided by the installation. The contractor shall arrange for dumpster service at the Contractor's own expense.

In general, utilities are not to be abandoned in place; all abandoned utilities are to be removed. There are circumstances where this requirement does not apply. Abandonment of utilities and removal shall be a topic of discussion at design conferences.

Instructions to Designers:

- 1 Modify UFGS 02220 paragraphs to include the building demolition/diversion requirements above and modify contract specifications.
- 2 Construction specifications shall be modified to require a Building Materials Diversion Plan to be submitted and approved by DPW.
- 3 When a project requires removal/disposal of environmentally hazardous waste generated at Fort Campbell, the DPW Environmental Division must be involved in the permitting process. Modify project drawings and specifications paragraphs to

include each of the above features as they apply to the project. Additional guidance on Environmental Requirements and Hazardous Waste Disposal Practices is contained in [Appendix A](#), and project specifications shall be modified to indicate these requirements.

- 4 National emission standards for hazardous air pollutants (NESHAP) regulatory requirements for demolition apply for asbestos abatement and most people understand that. However, in addition [NESHAP](#) notification is also required even if the operation involves removal of "non-regulated" ACM only in any amount, OR even if the operation involves no asbestos removal whatsoever. See this [EPA site](#) for specific items covered. When NESHAP items are encountered, project demolition specifications shall be modified to include the requirements identified in Appendix A.
- 5 For mercury containing light bulb disposal, insert the [Mercury Light Bulb](#) paragraph.

[Return to Division Table of Contents](#)

The following Mercury Containing Bulbs paragraph shall be included in Spec Section 02220, Demolition in all projects:

"[3.4.?](#) Mercury Containing Light Bulbs: Mercury containing light bulbs such as mercury vapor, metal halide, high pressure sodium, and fluorescent light bulbs, or any other mercury-containing light bulbs shall be considered and handled as hazardous waste for recycle.. The contractor shall collect these old/used bulbs or tubes and very carefully deliver them to the DPW-PPOC yard before the time of demolition of old buildings or a section of a building. For disposal and recycling of these bulbs, have the Contracting Officer's representative contact the DPW-PPOC yard hazardous waste supervisor before delivery to the yard so that packaging requirements for transport of the bulbs can be determined."

[Return to Designer Instructions](#)

Appendix A

Environmental Requirements

PARAGRAPH

- A-1 [Occupational Health Considerations](#)
- A-2 [Clean Air Act](#)
- A-3 [Clean Water Act](#)
- A-4 [Safe Drinking Water Act](#)
- A-5 [TSCA](#)
- A-6 [FIFRA](#)
- A-7 [Solid Waste Disposal Practices](#)
- A-8 [Hazardous Waste Disposal Practices](#)
- A-9 [Emergency Planning and Community Right-To-Know Act](#)
- A-10 [National emission standards for hazardous air pollutants \(NESHAP\)](#)

A-1. Occupational Health Considerations

Ft. Campbell has design Standard Operating Procedures for the following items and they shall be used in preparation of a design:

Confined Spaces:

Contractor shall observe OSHA Regulation 29 CFR Part 1910.146 regarding permitting, entry and working within confined spaces. Contractor is required to submit a work plan to the Contracting Officer's representative prior to entering any confined space.

Hazard Communication Program:

Contractor shall observe OSHA Regulation 29 CFR Part 1910.1200 regarding a written hazard communication program for describing how requirements for labels and other forms of warning, material safety data sheets, and employee information and training will be met. The program will also include a list of the hazardous chemicals known to be present and the methods used to inform employees of the hazards of non-routine tasks.

Lock Out, Tag Out Procedures:

Contractor shall observe OSHA Regulation 29 CFR Part 1910.147 regarding the control of hazardous energy (lock-out/tag-out).

Lock-out/Tag-out for Safety: The Contractor shall use a locking device that secures a valve or lever in the "off" position when a repair, inspection, or construction or new installation is required and also to clean or move any equipment. Making any exception to this rule could result in serious injury and death.

Lock-out: Blocking the flow of energy from the power source to the equipment - and keeping it blocked out - is called a lock-out system. A locking device is usually a key or combination lock arrangement.

Tag-out: Tag-out means placing a tag on the power source to warn co-workers or others not to turn the power on. The information on the tag shall include the name of personnel who put it there, the date, time the work begins, and type of work to be performed.

Basic Rules: Before shut down, the Contractor shall ensure that authorized employees know the type, magnitude, and hazards of the energy to be controlled; and shall verify the method or means of the system. He shall inform all affected employees of the lockout. The equipment shall be turned off, and the Contractor shall lockout energy sources and tag-out at the disconnect point. Any stored or residual energy may be released at that time so the equipment can be tested. The Contractor shall restore energy safely.

[Return to Chapter 2](#)

[Return to Appendix A](#)

A-2 Clean Air Act:

A-2.1 Fort Campbell has specific Environmental points of contact, and requirements. These are available at the following Internet site:

[**http://www.campbell.army.mil/envdiv/cleanairact.html**](http://www.campbell.army.mil/envdiv/cleanairact.html)

A-2.2 Ft. Campbell is a major source for criteria air pollutants and has an Operating permit for both Kentucky and Tennessee. Permitted air sources include boilers, spray booths, aggregate storage piles, etc. Air permit information is to be provided by designers to Ft. Campbell Environmental Division, Air Quality, prior to construction start. If required, construction and operating permits will be obtained by the Air Quality office. Construction permits are based on design while Operating permits are based on actual installation. Data needed for the permit application are on the **Control Device/Technique Checklist** and **Vent/Stack Checklist** that are included at the end of this Appendix for designers' use. If required, permits can take 3-6 months to obtain so as much of a lead time will be necessary.

A-2.3 Class 1 ozone depleting substances (CFC's, Halon) shall not be used on any project. Class 2 refrigerants (HCFC's) are close to being phased out of production so Class III refrigerants (HFC's) are preferred.

A-2.4 Emergency generator data must be obtained to determine compliance with new regulations. Please contact the Air Quality office if a new emergency generator is going to be installed.

A-2.5 Ft. Campbell has been designated as an "Attainment - Maintenance" area for ozone. A General Conformity Rule (GCR) analysis will be required for all projects that have the potential to impede the continuation of the attainment status for ozone and to ensure that the action does not hinder air pollution control efforts in the ozone "maintenance" area. The contractor performing the work on a project must provide information as requested on the **General Conformity Rule Checklist** included at the end of this Appendix and turned into the Air Quality office prior to commencement of construction.

A-2.6 Ft. Campbell Air Quality POC is Patty Lockard, 270.798.9603

**FORT CAMPBELL ENVIRONMENTAL DIVISION – AIR QUALITY PROGRAM
CONTROL DEVICE/TECHNIQUE CHECKLIST**

Date: _____

Organizational Owner/Operator: _____

Interviewer: _____

Facility: _____ Contact: _____

Phone: _____

Bldg. No.: _____ Room No.: _____

Source No.: _____

1. Control(s) for (describe source): _____

2. Type of controls (check all that apply): equipment technique/strategy
(If technique only, describe in comments)

3. Control for: PM VOC HAP Other (describe) _____

4. Monitoring for: PM VOC HAP Other (describe) _____

5. Type of controls/monitors:

No.	Description	Pollutant	% Control Equip. Eff	Tested? (y/n)	Test date	Cost Equip.
_____	_____ for _____	_____	_____	_____	_____	_____
_____	_____ for _____	_____	_____	_____	_____	_____
_____	_____ for _____	_____	_____	_____	_____	_____
_____	_____ for _____	_____	_____	_____	_____	_____
_____	_____ for _____	_____	_____	_____	_____	_____

(If necessary, continue on additional sheets and attach.)

6. Control Equipment Information:

No.	Equipment Manufacturer	Model No.	Serial No.
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

7. Obtain copy of technical specifications and attach (includes specifications for panel filter products)

8. Obtain copy of test results and attach

9. Complete applicable control equipment form(s) and attach

10. If answer to No. 9 is "yes", list the control devices for which capture efficiency tests have been completed _____

FORT CAMPBELL ENVIRONMENTAL DIVISION – AIR QUALITY PROGRAM VENT/STACK CHECKLIST

Date: _____

Organizational Owner/Operator: _____

Interviewer: _____

Facility: _____ Contact: _____

Phone: _____

Bldg. No.: _____ Room No.: _____

Source No.: _____

1. Description of emission (particulate matter, gaseous, mix, species name, etc.)

2. Identify source(s) served _____

3. Are criteria air pollutants emitted? (check one) Yes No

4. Are hazardous air pollutants emitted? (check one) Yes No

5. Does the source also have the potential for fugitive emissions? (check one)
(If yes, describe nature of fugitive emissions in the comment section.) Yes No

6. Has there been a stack test for this source? (check one)
(If yes, attach copy of stack test documents to this form) Yes No

7. Has there been a surrogate stack test for this source? (check one)
(If yes, attach copy of stack test documents to this form) Yes No

Pick-up Duct Data (Not applicable if spray booth exhaust panel(s) are part of design)

1. Hood Type _____

2. Hood Dimensions: Slot Length _____

Slot Width _____

Distance from Hood Face to Contaminant _____

Hood Face Area (Calculated) _____

Measured Air Flow at Hood _____

Measured Face Velocity _____

Hood Static Pressure _____

Duct ID _____

Duct Length to Bldg. Exit _____

Contaminant Capture Temp. _____

Vent Information

1. Inside diameter (ID) at exit _____ (inches; ft - check one)

2. Vent height: a. Above ground _____ (ft)

General Conformity Rule Checklist
General Information

Name of Project: _____

Construction Company: _____

POC Name: _____

Phone Number/Email: _____

Anticipated Start Date: _____ Anticipated End Date: _____

Construction Equipment Listing

Equipment Type	Qty	Hours of Operation	Miles	Fuel Type
Bulldozer				
Grader				
Excavator				
Backhoe				
Dump Truck				
Fuel/Service Trucks				
Tractors				
Pug Mills (on site)				
Concrete Batch Plant (on site)				
Scraper				
Ready-Mix Truck				
Screed, Concrete				
Portable Paint Sprayer				
Air Compressor				
Lay Down Machines				
Rollers				
Compactors				
Water Trucks				
Pavement Stripping Machines				
Traffic Road Striping				
Loaders				

Generators				
Compactors				
Curb and Gutter Pavers				
Other: _____				
Other: _____				

Emergency Generator Information

(This information will be needed for all stationary emergency generators associated with the project, attach a sheet if necessary)

Manufacturer: _____

Model Number: _____

Horsepower: _____

Max. Fuel consumption (gal/hr): _____

Fuel Type: _____

Serial number if currently available: _____

Stationary Fuel Burning Equipment

(This information will be needed for all stationary sources such as boilers, hot water heaters, etc that will be installed attach a sheet if necessary)

Type: _____

Manufacturer: _____

Model Number: _____

BTU Value: _____

Fuel Type: _____

Serial number if currently available: _____

Personal Occupancy Vehicle Information

Vehicle Type	Qty	Miles driven on Post	Fuel Type
Light Duty Truck			
Heavy Duty Truck			
Car/SUV/Van			

Submitted by: _____ **Date:** _____

ISSUE	STATEMENT TO BE INCLUDED
GENERAL CONFORMITY RULE (GCR)	<p><u>OZONE:</u> The current status for Fort Campbell is that the installation has been designated an ozone " maintenance" area in 2005 . The maintenance plan requirements will be designed to maintain the average ozone concentration levels at or below the maximum allowed to sustain compliance with the National Ambient Air Quality Standards. The redesignation as an "attainment maintenance area" will be in effect for 12 years. During this time Fort Campbell Air Quality will have to establish that all construction activities will not impede the continuation of the attainment status and ensure the action does not impede Kentucky or Tennessee air pollution control efforts in ozone "attainment maintenance areas". This is referred to as the General Conformity Rule (GCR). The rule requires that an analysis and other procedures (if required as a result of the analysis) be completed prior to the commencement of any of the project activities. In order to make the determination, the Air Quality Program will need to gather information from the contractor concerning equipment types, hours of operation, number of personnel, etc. and then do calculations for estimated emissions. This process needs to be started as soon as the contractor is known, because it is required to be completed prior to groundbreaking. Once awarded, please have the contractor contact the Air Quality office at (270) 798-9598 or (270) 798-9603.</p> <p><u>PM2.5:</u> Nonattainment designations for particulate matter (PM) are based on 3- year averages of either each years' annual average concentration (annual average) or on a 24 hour average basis (a rolling 24 hour avg.). Exceeding either standard can result in an area being classified as nonattainment. Trends indicate that within the next few years Fort Campbell has a strong possibility of being designated nonattainment for PM2.5. If that should occur, PM2.5 will be considered and added to the GCR process as stated above.</p>
Fuel Burning Equipment (Natural Gas and/or Fuel Oil)	Boilers \geq 10 MBTU or any boiler that uses fuel oil, contact the Air Quality Program with specifications for boilers. Hot Water Heaters \geq 120 gallons, contact the Air Quality Program with specifications for hot water heaters. The Air Quality Program will submit the Boiler NESHAP Notification to EPA.
Concrete/ Asphalt	Recommend that document include requirements concerning whether operations of concrete batch plant/asphalt plant (including any use of a pug mill) will be on or off post. If on post, need capacity and other design data to determine if air permits would be required and to determine other CAA related compliance issues. Approximately 120 day lead time to obtain state operating permit.
Debris Burning	Recommend inserting the statement "air pollution restrictions applicable to this project do not allow materials to be burned on the Government premises."
Debris Disposal	Recommend that document include requirements concerning disposal of debris. If the debris is to be sent to a grinder for recycling, need to know if the grinding equipment will be on or off post and if on-post, will need to obtain grinder capacity (tons/hour) and design in order to determine if air permitting and other CAA related compliance issues apply. Approximately 120 day lead time to obtain state operating permit.
Dust	Recommend inserting the statement "maintain all excavations, stockpiles, access roads, waste areas, and all other work areas free from excess dust to such a reasonable degree as to avoid causing a hazard or nuisance".
Ozone Depleting Chemicals	Recommend inserting a statement requiring any refrigerants to have an ozone depleting potential (ODP) of 0.05 or less.

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A-3 Clean Water Act:

A-3.1 Ft. Campbell POC is Dan Etson at 270-798-9784.

A-3.2 Ft. Campbell averages 3 million gallons per day. The high has been 13 million gallons. The desire is to not exceed this.

A-3.3 Water volume calculations need to be submitted. There is a two to three month review time by State. Can walk permit through. Storm water shall not discharge into sanitary sewer.

A-3.4 When sinkholes are encountered close them, and route water to natural storm drainage patterns. Must have permit from Tennessee to close sinkhole. Double sandbag or hay bales if sinkhole is part of the drainage pattern on a construction site.

A-3.5 If water is discharged into Kentucky, then Kentucky permit will be required.

A-3.6 If oil/water separators are used then design shall be the open top type. Ft. Campbell Environmental Division will provide oil/water separator design.

A-3.7 Specifications and sizing data for construction of the grease interceptor are available to the design team. Designer will contact Gary Sewell for this information. State of Tennessee has sizing criteria. Grease interceptors shall be located for ease of access for cleaning by pumper truck.

A-3.8 Pollution prevention plan must be maintained during construction. Notice-of-intent is required prior to moving any earth.

A-3.9 See Specification [Section 01560, Environment Protection](#). Specifications must address spill containment for contractor and should contain language for servicing of construction vehicles. Five copies of Spill Contingency Plans shall be specified. The Contractor shall be required to mail or submit one copy of a Spill Contingency Plan to:

Wayne Lee
Environmental Division, DPW
Building 2186, 13-1/2 Street

Ft. Campbell, KY 42223

And, four copies to the Contacting Officer. The Contractor shall not start work until the Spill Contingency Plan is approved by the Contracting Officer. If the contract does not require any plan for a specific project, he shall apply for an exception to the Contracting Officer with a copy to Mr. Lee, Environmental Division at address indicated above. For further information or guidelines in order to prepare Spill Plan contact Environmental Division, DPW at 270-798-9641.

A-3.10 Dumping of any liquids on the ground will be considered a release.

A-3.11 Floor drains are not to be provided except where required. They will be provided in a judicious manner, only where necessary. Old sewage system cannot take load. Shower drains are okay but wash-down drains are not acceptable. Mud Rooms must go to sanitary sewer. Discharge cannot adversely affect waste treatment. Biggest concern is volume. Ft. Campbell treatment facility almost maxed out. This is the reason shop wash down is not allowed. Must adhere to approved provisions for washing tents or vehicles. Washing must occur on grass areas.

A-3.12 Must pretreat boiler blow down before discharge due to base sewer toxicity levels being a noted problem.

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A-4 Safe Drinking Water Act:

A-4.1 Dead end water lines shall not be installed. Lines must be looped and disinfected. POC is Audie Hardin at 270-956-1801.

A-4.2 Backflow prevention is required on domestic water only and must be approved by state of Tennessee.

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A-5 Toxic Substances Control Act (TSCA):

A-5.1 Lead paint:

A-5.1.1 Lead-based paint and lead containing paint protection required for working personnel in accordance with OSHA requirements. Lead exposure for air quality will be tested by an exposure assessment for the first building demolished; this data can then be used for the remainder of buildings. If test results indicate that airborne lead levels have not exceeded standards as established by the Clean Air Act, additional testing is not required.

A-5.1.2 Lead-Based Paint Notification Requirements for Work in Family Housing:

A-5.1.2.1 There is a new Federal requirement to notify family housing occupants when work in their quarters will disturb known or suspected lead-based paint (LBP). This requirement became effective 1 June 1999 and will affect all Army Family housing built prior to 1978. This final rule is issued under the authority of section 406(b) of the Toxic Substance Control Act (TSCA), 15 U.S.C. 2686(b) as amended by the Residential Lead-Based Paint Hazard Reduction Act of 1992 to add Title IV, entitled Lead Exposure Reduction. The Residential Lead-Based Paint Hazard Reduction Act is also referred to as Title X of the Housing and Community Development Act of 1992, Public Law 102-550. A copy of this requirement can be found in the Federal Register, 1 Jun 98, at <http://www.epa.gov/fedrgstr/EPA-TOX/1998/June/Day-01/t14437.htm>.

A-5.1.2.2 The requirement is that whenever maintenance, repair, or renovation is performed in or on an occupied unit and LBP is disturbed (resulting in flaking or dust) that the worker (both in-house and contractor) must provide the occupant a copy of the pamphlet, "Protect Your Family from Lead in Your Home". The Pamphlet can be obtained at <http://www.hud.gov/lea/leadhelp.html>. This is the same pamphlet that is required to be given to occupants by the housing office when they are assigned to quarters containing lead-based paint (per ACSIM Memo, Subject: Disclosure Requirements for Lead-Based Paint Hazards in Army Family Housing, dated 24 Jul 96). The worker must also attempt to obtain from the occupant a written acknowledgment that the occupant has received the pamphlet (sample language on the above web site). These records must be kept for three years. This requirement also applies when work is done in common areas of occupied multi-unit family housing. The Garrison commander (or designated representative, such as the housing manager), as the owner's representative, must also be notified.

A-5.1.2.3 Contractors working in occupied AFH are also required to issue this pamphlet and this should be verified by the Government inspector. Current contracts should be modified as necessary to comply with this new requirement. Pre-1978 AFH units that are certified as free of lead-based paint and units that are vacant due to major renovation or between occupancy are exempt from this requirement. This requirement does not apply to minor repair and maintenance activities (including minor electrical work and plumbing) that disrupt 2 square feet or less of painted surface per component.

A-5.1.2.4 PAINTER-L is a computerized tool currently available to help manage the presence of LBP and LBP hazards. For more information on this system contact Dr. Ashok Kumar, CERL, at 1-800-USA-CERL.

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A-5.2 Radon:

A-5.1.1 Building design must have Radon protection features. In the specifications, Contractor is to be required to test the building for radon after construction is complete. Also refer to Section 01560, Paragraph 2.1.1g.

Radon mitigation design and testing: All construction performed at Fort Campbell must have passive radon mitigation features implemented into the design. The contractor will install preliminary features as per drawings. The contractor will hire an independent testing company to perform radon monitoring prior to habitation of the building(s). The testing firm must be EPA accredited and approved to perform work in the State of Tennessee (Kentucky). A list of accredited testing firms in the state of TN (KY) can be obtained through the state Radon Program Coordinator (TN 615-532-0733) (KY 502-). In the event radon concentrations greater than 4 pCi/l (pico curries per liter) are revealed, consult Fort Campbell DPW through the Contracting Officer's Representative for guidance pertaining to retesting. If upon further testing unacceptable levels are present, additional mitigation features will be installed followed by more testing. The buildings will not be inhabited until levels of less than 4 pCi/l have been achieved.

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A-6 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA):

A-6.1 Fort Campbell has an approved insecticide and pesticide list contained in the Installation Pest Management Plan (IPMP). The current IPMP's approved list of pesticides will be used in the preparation of the appropriate contract documents. All insecticide and pesticide work on Fort Campbell must comply with the IPMP.

A-6.2 Contractors will submit a report of the pesticides used, type and amounts, on Ft Campbell to the FIFRA program manager. Applicators of pesticides on Ft. Campbell must be licensed in Kentucky and Tennessee.

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A-7 Solid Waste Disposal/Diversion Practices:

A-7.1 In the interest of reducing waste, Fort Campbell is actively recycling and reducing waste in all operations to meet the installation's 25 year sustainability goals. Contractors are required to participate in on-post programs. They are encouraged to find ways of reducing waste. Recycling shall be practiced to the maximum extent possible. Refuse materials shall be separated in accordance with installation policies and practices.

A-7.2 Dumpster service is not provided by the installation. Contractors shall arrange for dumpster service at their own expense.

A-7.3 Landfill:

A-7.3.1 Contract specifications shall include contract performance requirements for a 50% minimum diversion of construction and demolition (C&D) waste by weight, from

landfill disposal. Contract specifications will include submission of a contractor's C&D Waste Management Plan to be submitted and approved by DPW, preferably prior to the start of a site clearance.

A-7.3.2 Point of contact for landfill issues is DPW Environmental Division at 270-798-9769.

A-7.3.3 Landfill Access:

- Upon award of a contract the name of the contractor, the contract number, project name and the completion date of the contract is furnished to the Directorate of Public Works Environmental Division, which will in turn furnish landfill access passes for the contractor's use in delivering C&D debris materials to the Woodlawn Rd. C&D landfill.
- All loads of debris will be weighed and recorded in the landfill data base. Scales are available at the landfill. Each month, tabulation (by contract number) will be furnished to contracting office indicating the amount of debris generated by that contract, if requested. Trucks and/or trailers shall be weighed coming in and going out of the landfill. The vehicle operator shall have a landfill access pass from the contractor to obtain entrance into the landfill. Other information that will be recorded includes whether the load contained asbestos or any other authorized special waste and whether the load contained recyclable materials.

A-7.4 Materials Handling:

A-7.4.1 Demolition and removal Activities:

- Contract specifications shall require at least a 50% diversion (by weight) of C & D waste materials such as wood, plumbing fixtures, electrical materials (lights and panels), windows, doors, toilet partitions, HVAC equipment, and scrap metals be diverted from the landfill. Diversion can be accomplished by deconstructing the wood buildings and components per instructions below or by moving the structure off-post. Construction specifications shall require a C & D Waste Management Plan to be submitted and approved by DPW.

A-7.4.1 (a) Salvageable materials shall not to be transported off the installation. Government salvage requirements shall be evaluated on a project by project basis and salvage rights automatically apply for the following equipment:

- Transformers
- Cut-outs
- Capacitors
- Circuit Breakers
- Voltage Regulators
- Line hardware
- Utility Poles

Salvageable metals that are recovered as a result of grinding shall be separated for sale as scrap metal.

- All salvageable materials removed from the project site shall be delivered to DRMO for selling as scrap metal. The Contractor must properly complete the turn in document, DD Form 1348-1a and ensure Fort Campbell funding code (21F3875 1111 76 C S15056 AC 9921) is utilized when materials are turned into DRMO.

A-7.4.1 (b) Nonsalvageable materials shall not be removed from the installation. They shall be taken to the landfill or diverted for recycle as recovered materials.

- Street surfacing (asphalt/concrete), sidewalks, curbs & gutters, etc., and building related concrete and masonry materials shall be ground up at the construction site and transported to an offsite location designated by the COR. Materials to be ground up shall not have foreign items (doors, windows, piping, PVC items, toilet partitions, plumbing fixtures, etc) included that will render the ground products un-useable.
- These materials may also be transported and stockpiled at the Woodlawn C/D landfill for future grinding. However, Ft. Campbell has placed limits on the size of materials (specifically concrete and asphalt pavement) that can be placed in the landfill. These materials shall not exceed more than 2 feet by 3 feet and shall be no thicker than 18 inches.
- Bricks may be delivered whole and recycled to meet diversion goals.
- **Land clearing waste (trees, stumps, etc.) shall be mulched at the Bi-County Landfill. Logs cannot exceed a maximum length of 12' and 20" in diameter.**

A-7.4.2 New Construction Activities and Contracts:

- It is the contractor's responsibility to insure that all new construction C & D materials disposal meets the 50% diversion criteria. Waste recyclable materials, such as cardboard, paper, scrap metals, pallets, etc., shall be recycled and not landfilled. Evidence that this diversion criteria is met shall be maintained in a data log for the duration of the project by the contractor and provided to the project COR or the project engineer. Assistance in identifying recycler outlets can be obtained from DPW Environmental Division.

A-7.5 Construction projects requiring soil borrow material should be coordinated with DPW Engineering Division at 270-798-3113.

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A-8 Hazardous Waste Disposal Practices:

A-8.1 Mercury containing light bulbs such as fluorescent tubes, mercury vapor, metallic halide, and high-pressure sodium lamps shall be considered hazardous wastes and require special handling. Fluorescent, mercury vapor, metallic halide, and high pressure sodium light bulbs, while not a listed hazardous waste, may be a characteristic hazardous waste and therefore subject to testing and proper disposal as per RCRA. These lamps are a concern at Fort Campbell in regard to their disposal. Disposal of these materials resulting from demolition or other DPW related activities, shall be coordinated with the DPW Environmental Quality Officer for the policy contained in Section 11 of the EQP Handbook.

A-8.2 Low-pressure sodium lamps are not listed hazardous wastes but require special handling.

A-8.3 Refrigerant in air conditioning equipment being demolished must be recovered and transported to the Environmental Division Pollution Prevention Operations Center for reclaiming.

A-8.4 PCB's is a concern for HVAC/Electrical and capacitors. Capacitors in existing air conditioning equipment may contain polychlorinated biphenyl's (PCB's).

A-8.5 Fluorescent ballast in buildings to be demolished may contain PCB's.

A-8.6 Transformers as well as all fluorescent ballasts and HVAC/Electrical capacitors to be removed may contain PCB's. Transformers shall be turned over to DRMO.

A-8.7 Lighting ballast and capacitors are to be placed in 55-gallon drum and delivered to the Environmental Division Pollution Prevention Operations Center..

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A-9 Emergency Planning and Community Right-To-Know Act (EPCRA):

A-9.1 Ft. Campbell is required by Executive Order 12856, "Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements", to comply with the requirements of the Emergency Planning and Community Right-to-Know Act (EPCRA). EPCRA requires Ft. Campbell to identify the amounts of chemicals present on, or released from its facilities, understand the potential problems that hazardous materials pose to the surrounding communities and environment, and provide information to the public and local emergency planning organizations. To comply with EPCRA requirements, Ft. Campbell must track and be accountable for hazardous materials (HM) used throughout the installation. The Contractor must submit information describing hazardous materials (paint, solvents, adhesives, treated lumber, etc) on

FTCKY HAZMAT INVENTORY FORM to the Environmental Division Pollution Prevention Branch. The Contractor will account for the quantity of HM brought to the post, the quantity used or expended during the job, and the leftover quantity to be removed from the installation. This information will be provided on a calendar year basis and must be submitted by the end of January following the year reported. Tracking of hazardous materials used by the Contractor shall be required by the contract.

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CHECKLIST FOR NON-PROCESS SOURCE

Organizational Owner/Operator: _____
Date: _____ Interviewer: _____
Facility: _____ Contact: _____ Phone: _____
Bldg. No.: _____ Room No.: _____ Source No.: _____

FOR DPW-E USE ONLY
Permit Status: [] Required [] Not Required
Permit Type: [] Operating [] Construction [] Relocation [] Modification

General

- 1. Description and designation of source (Boiler #1, Hot Water Heater #1, etc.)
2. Construction date (manufactured) _____ Date commenced operations _____
Installation date (at site) _____
3. Manufacturer _____
Model No. _____ Serial No. _____
4. Normal operating hours _____ hrs/day, _____ days/week, _____ weeks/yr.
5. % operating (time) by calendar year per quarter
_____ 1st _____ 2nd _____ 3rd _____ 4th.
6. Maximum (potential) operating hours
_____ hrs/day, _____ days/week, _____ weeks/yr.
7. Fuel type: Primary fuel _____ Standby fuel (if any) _____
BTU values of fuels: Primary fuel _____ Standby fuel (if any) _____
8. Primary use of heat source _____
Secondary use of heat source (if any) _____
9. If coal burner, type of firing? _____
10. Maximum rated boiler horsepower (BHP) _____
Heat input capacity (MMBtu/hr) _____
Maximum rated electrical Output (kw) _____ (if applicable)
11. Average % load _____ or actual maximum heat input value used _____ MMBtu/hr
12. For fuels other than natural or liquified gases:

CHECKLIST FOR NON-PROCESS SOURCE (continued)

% Sulfur content _____
% Ash _____ (if solid fossil fuel)

13. Average annual fuel consumption: Primary _____ (ft³ gal - check one)
Secondary _____ (ft³ gal - check one)

14. Emissions monitoring equipment installed? Yes No

(If yes, describe above)

[ATTACH COMPLETED CONTROL DEVICE(S)/TECHNIQUE(S) CHECKLIST(S)]

15. Is the source operated under a current operating or construction permit? Yes No
(If yes, obtain copy of permit and attach to this checklist)

16. If fuel oil is used, is the unit served by a fuel storage tank? (check one) Yes No
(If yes, complete and attach Storage Tank Checklist)

17. Is a fuel flow meter installed for
a. Natural gas (check one): Yes No
b. Other fuel (check one): Yes No

[ATTACH COMPLETED STACK/VENT CHECKLIST FOR NON-PROCESS OPERATION]

Comments

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VENT/STACK CHECKLIST

Organizational Owner/Operator: _____
Date: _____ Interviewer: _____ Initials: _____
Facility: _____ Contact: _____ Phone: _____
Bldg. No.: _____ Address: _____ Permit No.: _____

General

- 1. Description of emission (particulate matter, gaseous, mix, species name, etc.)
2. Identify source(s) served
3. Are the emissions air contaminants? (check one)
4. Does the source also have the potential for fugitive emissions? (check one)
5. Has there been a stack test for this source? (check one)
6. Has there been a surrogate stack test for this source? (check one)

Pick-up Duct Data

- 1. Hood Type
2. Hood Dimensions Slot Length Slot Width
Distance from Hood Face to Contaminant
Hood Face Area
Measured Air Flow at Hood
Measured Face Velocity
Hood Static Pressure
Duct ID
Duct Length to Bldg. Exit
Contaminant Capture Temp.
3. Contaminant Data
Name Constituency Portion
(list measurement units)

VENT/STACK CHECKLIST (continued)Vent Information

1. Inside diameter (ID) at exit _____ (ft)
2. Vent height:
 - a. Above ground _____ (ft)
 - b. Above roof level _____ (ft)
3. Gas stream exhaust exit temp _____ (°F)
4. Exit velocity _____ (ft/sec), at _____ °F, _____ (air pressure - note measurement units) and standard conditions (68 °F and 1 atm) _____ (ft/sec)
5. Exit flow at exit conditions _____ (ft³/min)
 Obtained from (check one): calculations test data
 Exit flow at standard conditions _____ (dscfm)
6. Stack gas moisture percent at exit conditions _____ % By Weight Grains Per Dry Standard Cubic Foot (gr/dscf)
7. Exit plume direction (check one): Up Down Horizontal
8. Exhaust fan data: horsepower _____ RPM _____ volume rate _____ (ft³/min)
9. Air pollution controls installed? (check one) yes no
 (If yes, complete and attach Control Device/Technique Checklist)
10. Is there a Bypass Stack? Y or N
 If so, describe and complete vent/stack form for the Bypass Stack.
11. Is this stack equipped with continuous Pollutant Monitoring equipment? Y or N
 If yes, what Pollutants are monitored.

Attach drawing of emission source showing air contaminant flow from process to atmosphere.
 Complete the additional applicable process or non-process checklists.

Comments

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A-10. National emission standards for hazardous air pollutants (NESHAP)

Ft. Campbell has design Standard Operating Procedures for the NESHAP items and they shall be used in preparation of a design:

State of Kentucky and Tennessee NESHAP Reporting Requirements for Demolition (Defined as the demolition of a building or demolition of a load supporting structure such as a load-bearing wall) shall be followed:

1. In the case of demolition only, the contractor will mail and be postmarked, fax and follow-up with a mailing, or deliver the NESHAP notice 10 working days before demolition begins even if the operation involves removal of “non-regulated” ACM only in any amount, OR even if the operation involves no ACM removal whatsoever!
2. In the case of demolition where asbestos abatement is also involved, the contractor will send in a separate notice for the abatement as required in paragraphs 2.a. through 2.d. below. The abatement notice may also be included on the demolition notice, so that only one notice may be sent. In this case, include the additional notice lead times as identified in paragraphs 2.a. through 2.d.
 - a. The Contractor is requested by the state to telephone at least 24 hours beforehand if the operation involves RACM that is below 260 LF, 160 SF, or 35 CF. This only applies in the contractor has sent a long-term NESHAP notification to the State.
 - b. The Contractor will mail and be postmarked, fax and follow-up with a mailing, or deliver the NESHAP notice 10 working days beforehand if the operation involves RACM that is below 260 LF, 160 SF, or 35 CF (and if the contractor has not sent a long-term NESHAP notification to the State).
 - c. The Contractor is requested (not a regulatory requirement) by the State to mail, fax, deliver a notice, or phone in the notice so that it is received at least 24 hours beforehand if the operation involves non-regulated ACM in any amount. (In any case, the government “project designer” may still specify that the contractor does a NESHAP notice for any asbestos removal actions. This would be advantages to the government.)
 - d. The Contractor will mail and be postmarked, fax and follow-up with a mailing, or deliver the NESHAP notice at least 10 working days before abatement begins if the operation involves RACM that is at least 260 LF, 160 SF, or 35 CF.

3. All Kentucky notifications are sent to:

Rebecca Bohannon
Kentucky Division for Air Quality
Asbestos Branch, Paducah Region
4500 Clarks River Road
Paducah, Kentucky 42003
(270) 898-8468 Office
(270) 898-8640 Fax

All Tennessee notifications are sent to:

Mr. Randal Harrison
Tennessee Division Air Pollution Control
9th Floor, L & C Annex, 401 Church St.
Nashville, Tennessee 37243-1531
(615) 532-0554 Office
(615) 532-0614 Fax

[Return to Appendix A](#)

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APPENDIX B

State Water/Sewer Submittals

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APPENDIX C

Digging / Excavation Permits

See [CAM Regulation 420-3](#). This regulation establishes policies, procedures, and guidance for requesting utility locates associated with digging activities and excavation of soil to ensure protection of underground utilities (water/sewer, electric, gas, phone, steam/chill water, control cables, petroleum/POL, cable TV) and environmental/historical sensitive areas (archeological sites, former solid waste disposal sites).

Fort Campbell has stopped using dig permits. Currently, Tennessee One Call is being used to notify utility providers of the need to locate buried utilities prior to digging/excavation. One week prior to beginning digging/excavation, call 800-351-1111 with the following information:

- a. Address
- b. Phone number
- c. Start date – when digging/excavation to begin
- d. Start time – time digging/excavation to begin
- e. Town – Fort Campbell
- f. Dig Street & Number
- g. Nearest Intersecting Road

The proposed area of excavation shall be designated by the person responsible for the excavation by marking such area with safety white color coded stakes or white paint.

The underground utilities will be marked within 3 days as follows:

- a. Safety Red – electric power distribution and transmission facilities
- b. High Visibility Safety Yellow – gas and oil distribution and transmission facilities
- c. Safety Alert Orange – telephone, telegraph, cable, television, video and other telecommunications facilities
- d. Safety Precaution Blue – water system facilities
- e. Safety Green – sewer system facilities
- f. Safety Purple – reclaimed water, irrigation and slurry lines

If the start date and time arrives and one or more members has failed to mark the facilities, and there is clear evidence of the presence of an unmarked utility, you MUST call Tennessee One-Call with a Second Request.

If, during the course of excavation an underground facility has been damaged, notify the facility owner immediately of the location and nature of the damage. Do not try to repair the facility yourself or to cover up the damage.

A locate request has an expiration date. It is 15 calendar days from the date and time specified the dig is to begin.

The above information was taken from the "Tennessee Excavation Guide, April 2007" available from Tennessee One-Call System, Inc. (phone: 615-367-1110, email: tnocs@tncall.com)

[Return to Chapter 2](#)

APPENDIX KK
Geothermal Conductivity Test Report

JACKSON ENTERPRISES, INC.

204 S. Maple St., Lebanon, TN 37087

P.O. Box 1280, Lebanon, TN 37088

615-444-4545, Fax 615-444-4549

leannmorrison@ymail.com

Date and Time:	Tuesday, September 06, 2011 12:01 PM
To:	Jason Starner, PE
Company:	Barge Waggoner Sumner & Cannon, Inc
Fax No.:	(937) 438-0379
From:	Perry Ingram by lm
No. of Pages:	25, including cover

Message:

It has been a pleasure working with you on the Geothermal Project at Ft. Campbell. As we have completed the scope of work, per specifications, I am forwarding you the following documentation.

- * Drilling Logs
- * Grouting Logs
- * Geothermal Conductivity Test and Data Analysis

If I may be of further assistance, please feel free to contact me.

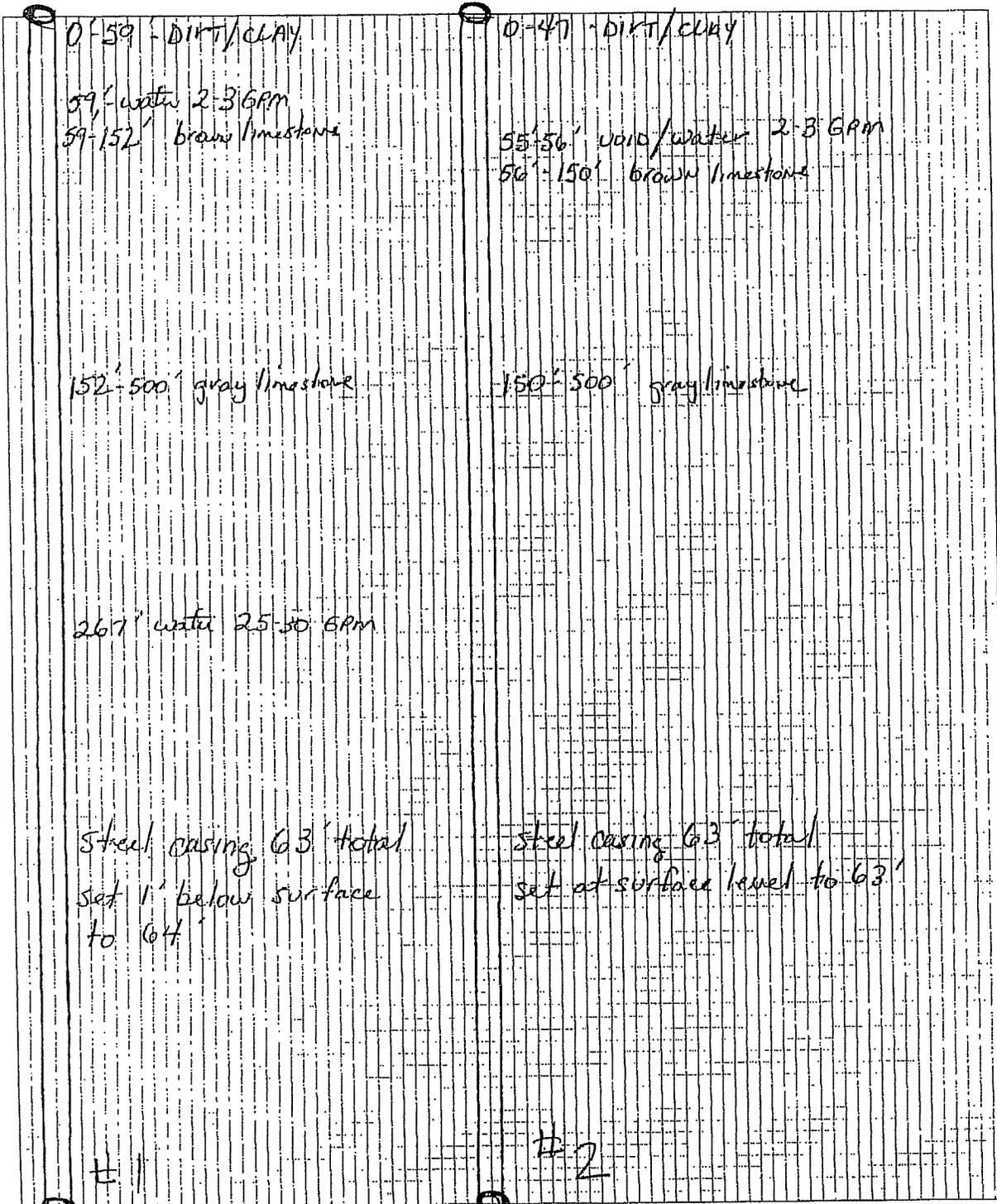
Shot Report
JACKSON ENTERPRISES

4654

615-444-4545

Location Ft. Campbell, KY
Date of Completion 8-17-11
Driller C. Daniel
Total Footage Drilled 1,000'
Scale _____

Total # of Holes 2
Average Depth of Holes 500'
Average Spacing of Pattern _____
*If Holes are varying Depths, the depth of each hole will be shown below on the diagram.



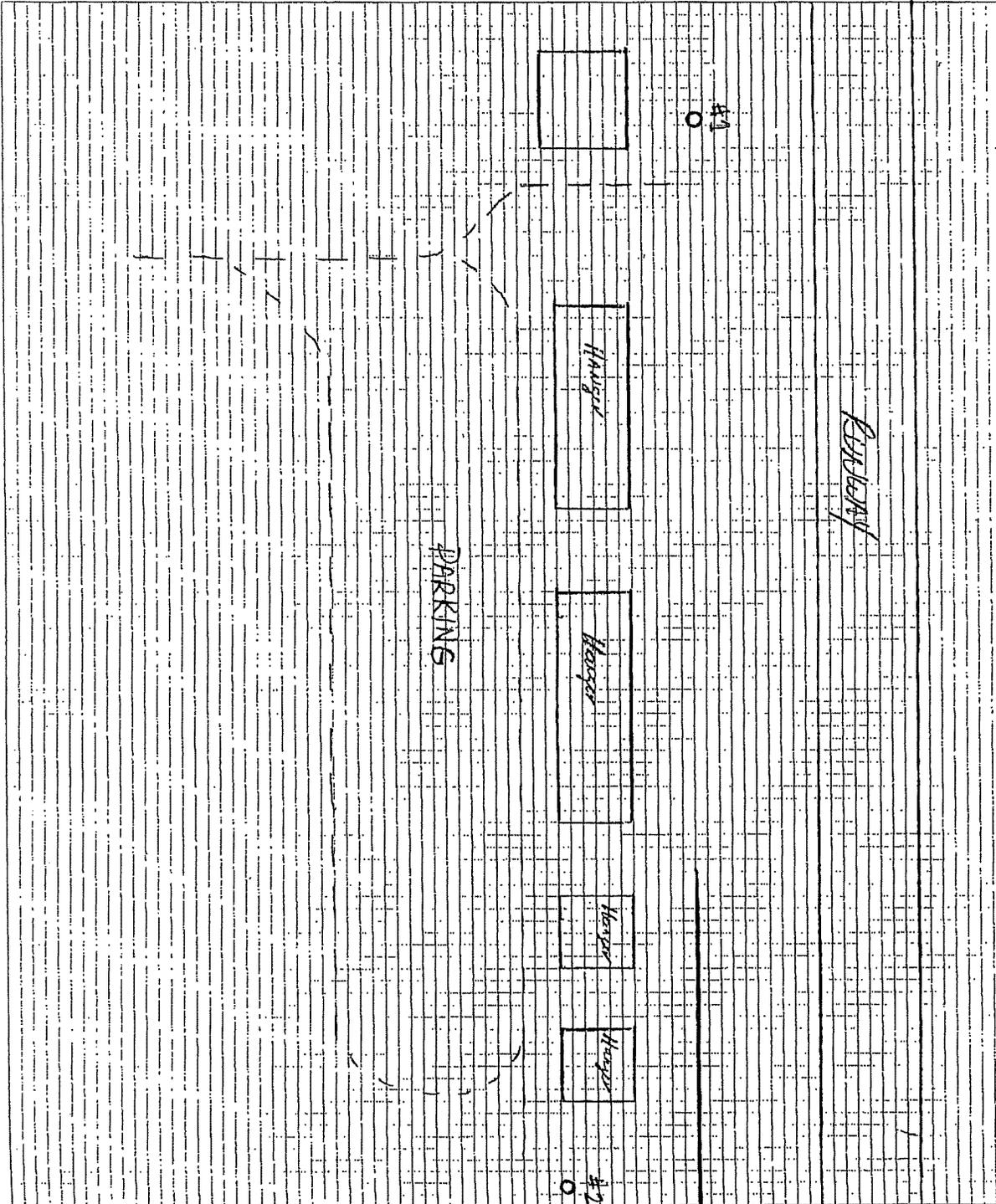
Special Notes: _____

Shot Report
JACKSON ENTERPRISES
615-444-4545

4655

Location _____
Date of Completion _____
Driller _____
Total Footage Drilled _____
Scale _____

Total # of Holes _____
Average Depth of Holes _____
Average Spacing of Pattern _____
*If Holes are varying Depths, the depth of each
hole will be shown below on the diagram.



Special Notes: _____

Fence

Fence

JOB TICKET

Jackson Enterprises, Inc.

No 9340

P.O. BOX 1240 • PHONE: 615-444-4545 • FAX: 615-444-4549 • LEBANON, TN 37088

DATE <i>8-17-11</i>	CUSTOMER'S ORDER NO.	DRILLER <i>C. Hamel</i>	RIG NO. <i>11A</i>
------------------------	----------------------	----------------------------	-----------------------

CHARGE TO _____ COUNTY _____

QUANTITY	HOLE DIA.	DESCRIPTION	TOTAL FT.	UNIT PRICE	AMOUNT
<i>2</i>	<i>5 1/2"</i>	<i>holes 500 ft.</i>	<i>1,000 ft.</i>		
<i>6</i>	<i>6 5/8"</i>	<i>steel casing joints 21 ft.</i>	<i>126 ft.</i>		

FUEL _____

Received By _____



JACKSON ENTERPRISES INC.

Drilling Contractors

WEEK ENDING _____

JOB LOG

	CODE	FROM:	TO:	TIME	JOB LOCATION	FOOTAGE	TRAVEL	EXPLANATION
8/15		600	900	-	prep - drive to Ft. Campbell			
		900	1140	-	get on base / repair work - visit both work sites			
		1140	530	-	set 63' casing - drill 300'			
		530	730	-	off base - home			
		TOTAL HRS.						
8/16		500	800	-	prep - 2 Ft Campbell - 2 drill			
		800	200	-	drill 200' - trip out - drop loop - move to #2			
		200	530	-	set 63' casing - drill 200'			
		530	730	-	off base / home			
		TOTAL HRS.						
8/17		500	800	-	prep - 2 job - 2 drill			
		800	700	-	drill 300' - trip out - drop loop			
		100	230	-	clean up - load + strap			
		230	500	-	set off base - 2 shop			
		TOTAL HRS.						
THUR.								
		TOTAL HRS.						
FRI.								
		TOTAL HRS.						
SAT.								
		TOTAL HRS.						
SUN.								
		TOTAL HRS.						

CODES

(A) DAILY MAINTENANCE (B) MOBILE TIME (TO/FROM) (C) DRILLING TIME (PROD.) (D) RIG REPAIRS (E) SHOP TIME

SIGNATURE _____

E

Page 1555 of 1714
Hole # 1

Formation Thermal Conductivity Test Report

Date August 20, 2011
Location Fort Campbell, KY / 160th Hangar
North of Hangar by Helicopters
Undisturbed Formation Temperature N/A

Borehole Data – As Provided by Jackson Enterprises

Borehole Diameter
Drill Log

Grout performed by Precision Air, Inc. (License #833)

U-bend size 1.25 inch HDPE SDR-11
U-bend length 500 feet
Grout Type Therm-Ex
Grouted Portion Entire bore
Batches of Grout 19

Notes: Found water seam at 130 ft.; added 10 cu.ft. of rock to bridge void; was able to grout to surface; re-checked bore one week later, grout level still at surface.

Hole # 2

Formation Thermal Conductivity Test Report

Date August 22, 2011
Location Fort Campbell, KY / 160th Hangar
South End of Runway by Storage
Undisturbed Formation Temperature N/A

Borehole Data – As Provided by Jackson Enterprises

Borehole Diameter
Drill Log

Grout performed by Precision Air, Inc. (License #833)

U-bend size 1.25 inch HDPE SDR-11
U-bend length 500 feet
Grout Type Therm-Ex
Grouted Portion Entire bore
Batches of Grout 18

Notes: Found water seam at 128 ft.; added 8 cu.ft. of rock to bridge void; was able to grout to surface; re-checked bore one week later, grout level still at surface.

Frequently Asked Questions (FAQ's) Regarding FTC Testing

- Q:** Thermally-enhanced grout is specified for the final loop field design. The test bore was grouted with a low conductivity, 20% solids, bentonite grout. How do I adjust the thermal conductivity value to account for this?
- A:** While the conductivity of the grout is important for the loop field design, it is not important for determining formation thermal conductivity. We use the "line source" method to analyze data, which assumes an infinitely thin line rejecting heat at a constant rate into an infinite medium. The initial ten hours, which is influenced by the bore dimensions and grout conductivity, is ignored in the analysis. However, once the heat has penetrated into the formation, the temperature rise of the formation approaches steady-state. It is the slope of the temperature rise that is used in the analysis. Hence, no adjustment to the reported formation thermal conductivity is required.
- Q:** The software I use to design the loop field requires that I input a value for "soil conductivity". Is this the same as formation thermal conductivity?
- A:** Absolutely. Formation, soil, and ground are all used interchangeably to describe the conditions in which the u-bends will be installed. The use of the word "formation" simply implies that the installation conditions may be soil, rock, or some combination of the two.
- Q:** I've just received your report. I have a formation conductivity of 1.54 Btu/hr.ft. °F. How do I translate that into a loop length requirement, in terms of bore depth (in feet) per ton?
- A:** The formation thermal conductivity test provides values for three key parameters required for the ground loop design. These are the "Undisturbed Formation Temperature, Formation Thermal Conductivity, and Formation Thermal Diffusivity." These parameters, along with many others, are inputs to commercially available loop design software (e.g. GchpCalc, available at GeoKiss.com/software). The software uses all of the inputs to determine the required loop length in bore depth per ton.
- Q:** Is the "Undisturbed Formation Temperature" listed in the report the temperature that I enter into my loop design software where it calls for the "Deep-Earth Temperature"?
- A:** Generally, yes. The "Undisturbed Formation Temperature" is the constant temperature of the formation. We attempt to determine this value by measuring the temperature of the water entering the test unit at the beginning of the test. However, the value we measure and report may be inaccurate if the test is initiated too quickly after the installation of the test bore, or if the testing operator failed to activate the data acquisition unit prior to energizing the heating elements. If you suspect the temperature we are reporting to be too high or too low, we recommend that you investigate further through other sources.

September 2, 2011

GRTI
FTC Test and Data Analysis
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**Geothermal
Resource
Technologies, Inc.**

MAIN OFFICE:

P.O. Box 150
BOWIE, TX 76230
(940) 872-2222
Fax: (940) 872-3678

REGIONAL OFFICES:

ELKTON, SD
(605) 692-9089
Fax: (605) 692-2604

ASHEVILLE, NC
(828) 225-9166
Fax: (828) 281-4139

WEB SITE:

www.GRTI.com

FORMATION THERMAL CONDUCTIVITY TEST AND DATA ANALYSIS

Analysis for:

**Jackson Enterprises, Inc.
204 South Maple Street
Lebanon, TN 37087
Phone: (615) 444-4545
Fax: (615) 444-4549**

Test location:

**Test Well #1
Hanger 160
Fort Campbell, KY**

Report Date:

September 2, 2011

Test Performed by:

Mid-South Geothermal, LLC

Executive Summary

A formation thermal conductivity test was performed on Test Well #1 at the Hanger 160 site at Fort Campbell, Kentucky. The vertical bore was completed on August 17, 2011 by Jackson Enterprises, Inc. GRTI's test unit was attached to the vertical bore on the afternoon of August 25, 2011. Geothermal Resource Technologies, Inc. analyzed the collected data using the "line source" method.

This report provides a general overview of the test and procedures that were used to perform the thermal conductivity test along with a plot of the data in real time and in a form used to calculate the formation thermal conductivity. The following average formation thermal conductivity was found from the data analysis.

⇒ Formation Thermal Conductivity = 1.61 Btu/hr-ft-°F

Due to the necessity of a thermal diffusivity value in the design calculation process, an estimate of the average thermal diffusivity was made for the encountered formation.

⇒ Formation Thermal Diffusivity = 1.07 ft²/day

An estimate of the undisturbed formation temperature was determined from the initial temperature data at startup.

⇒ Undisturbed Formation Temperature = 58.6-59.3°F

A copy of the original collected data is available either in a hard copy or an electronic format upon request.

September 2, 2011

GRTI
FTC Test and Data Analysis
Page 2 of 9

Test Procedures

The American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) has published a set of recommended procedures for performing formation thermal conductivity tests for geothermal applications. GRTI is committed to adhering to ASHRAE recommendations. Some of these recommended procedures are listed below:

- (1) Required Test Duration – A minimum test duration of 36 hours is recommended, with a preference toward 48 hours.
- (2) Power Quality – The standard deviation of the power should be less than or equal to 1.5% of the average power, with maximum power variation of less or equal to 10% of the average power. The heat flux rate should be 51 Btu/hr (15 W) to 85 Btu/hr (25 W) per foot of borehole depth to best simulate the expected peak loads on the u-bend.
- (3) Undisturbed Soil Temperature Measurement – The undisturbed soil temperature should be determined by recording the minimum loop temperature as the water returns from the u-bend at test startup.
- (4) Installation Procedures for Test Loops – The bore diameter is to be no larger than 6 inches, with 4.5 inches being the target diameter. To ensure against bridging and voids, the bore annulus is to be uniformly grouted from the bottom to the top using a tremie pipe.
- (5) Time Between Loop Installation and Testing – A minimum delay of five days between loop installation and test startup is recommended if the formation is expected to have a low thermal conductivity or if low conductivity grouts ($< 0.75 \text{ Btu/hr}\cdot\text{ft}\cdot^\circ\text{F}$) are used. A minimum delay of three days is recommended for all other conditions.

GRTI's testing procedures deviate slightly from those above with regard to item (5). While item (5) bases the delay between installation and testing on the expected formation conductivity, GRTI bases its delay on the type of drilling used in the installation. When air drilling is required, a five-day delay is recommended to allow the bore to return to its undisturbed temperature. For mud rotary drilling, a minimum waiting period of two days is sufficient.

For a complete list of recommended procedures, refer to the ASHRAE 2007 HVAC Applications handbook, pages 32.12-32.13.

September 2, 2011

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Data Analysis

Geothermal Resource Technologies, Inc. uses the "line source" method of data analysis. The line source equation used is not valid for early test times. Also, the line source method assumes an infinitely thin line source of heat in a continuous medium. If a u-bend grouted in a borehole is used to inject heat into the ground at a constant rate in order to determine the average formation thermal conductivity, the test must be run long enough to allow the finite dimensions of the u-bend pipes and the grout to become insignificant. Experience has shown that the amount of time required to allow early test time error and finite borehole dimension effects to become insignificant is approximately ten hours.

In order to analyze real data from a formation thermal conductivity test, the temperature of the water entering and exiting the u-bend heat exchanger is plotted versus the natural log of time. Using the Method of Least Squares, the linear equation coefficients are then calculated that produce a line that fits the data. This procedure is normally repeated for various time intervals to ensure that variations in the power or other effects are not producing erroneous results.

Through the analysis process, the collected raw data is converted to spreadsheet format (Microsoft Excel®) for final analysis. A copy of this data can be obtained either in a hard copy or electronic copy format at any time. If desired, please contact Geothermal Resource Technologies, Inc. and provide a ship-to address or e-mail address at one of the following:

Contact: Chad Martin
Phone: (828) 225-9166
Fax: (828) 281-4139
E-mail: cmartin@grti.com

September 2, 2011

GRTI
FTC Test and Data Analysis
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Formation Thermal Conductivity Test Report

Date August 25-27, 2011
 Location Fort Campbell, KY
 Undisturbed Formation Temperature Approx. 58.6-59.3°F

Borehole Data – As Provided by Mid-South Geothermal, LLC

Borehole Diameter 5 3/4 inches

Note: 63 ft of steel casing was installed.

Drill Log	Clay	0'-59'
	Brown limestone	59'-152'
	Gray limestone	152'-500'

Note: Bore produced 2-3 gpm water at 59-152 ft; 25-50 gpm at 267 ft.

U-bend Size 1 1/4 inch HDPE
 U-Bend Length 500 ft
 Grout Type Wyo-Ben Therm-Ex
 Grout Solids 67%
 Grouted Portion Entire bore

Test Data for Analysis Time Period

Test Duration 43.0 hrs
 Average Voltage 244.9 V
 Average Heat Input Rate 28,984 Btu/hr
 Calculated Circulator Flow Rate 8.5 gpm
 Standard Deviation of Power 0.11%
 Maximum Variation in Power 0.22%

September 2, 2011

GRTI
 FTC Test and Data Analysis
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Test Well #1, Hanger 160, Fort Campbell August 25-27, 2011

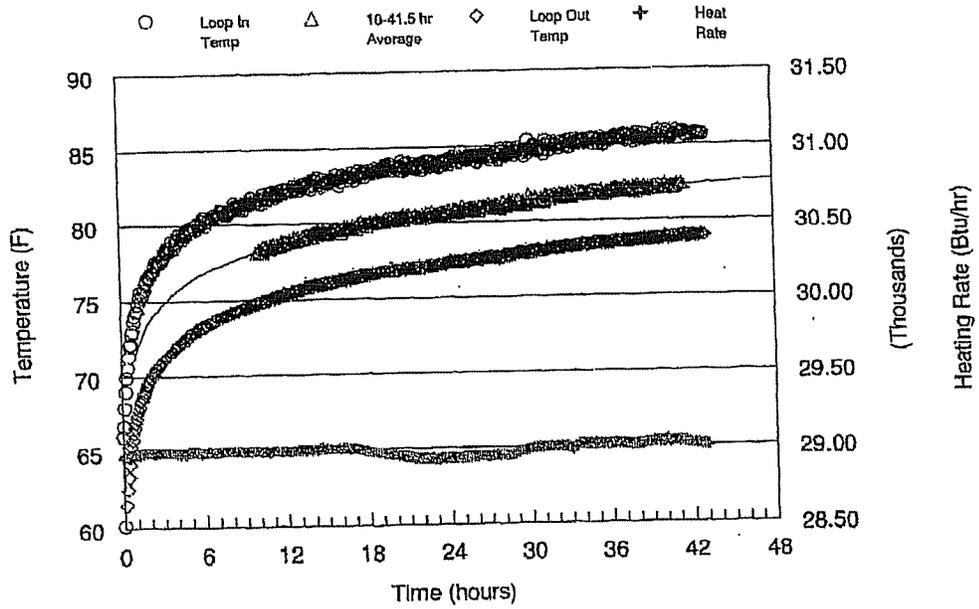


Figure 1: Temperature versus Time Data

September 2, 2011

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FTC Test and Data Analysis
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Line Source Data Analysis

**Test Well #1, Hanger 160, Fort Campbell
August 25-27, 2011**

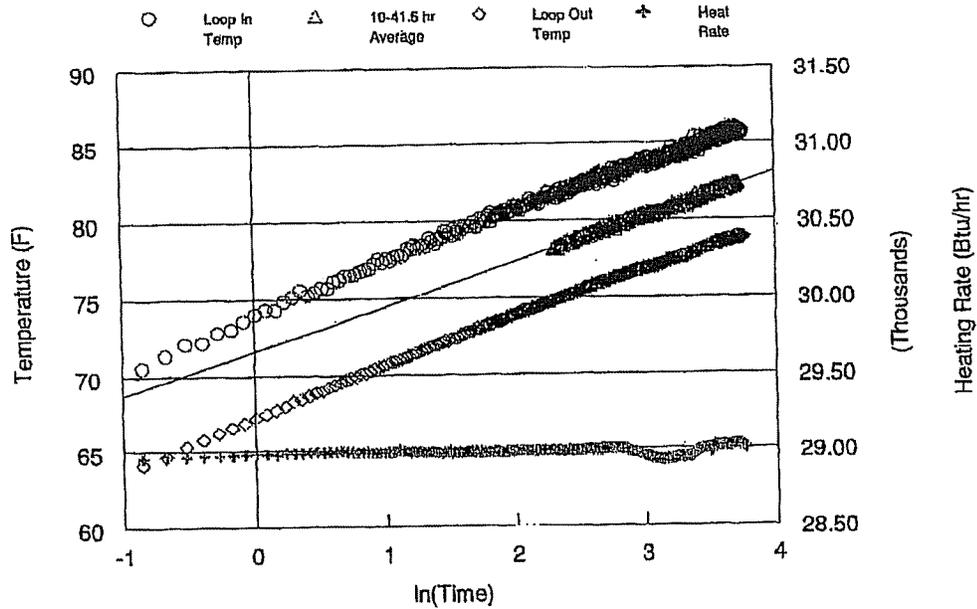


Figure 2: Temperature versus Natural Log of Time

Time Period	Slope: a_1	Average Heat Input (Btu/hr-ft)	(W/ft)	Thermal Conductivity (Btu/hr-ft-°F)
10 - 41.5 hrs	2.87	58.0	17.0	1.61

The temperature versus time data was analyzed using the line source analysis for the time period shown above. An average linear curve fit was applied to the data between 10 and 41.5 hours. The slope of the curve (a_1) was found to be 2.87. The resulting thermal conductivity was found to be 1.61 Btu/hr-ft-°F.

September 2, 2011

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FTC Test and Data Analysis
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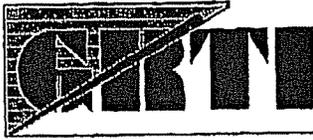
Estimated Thermal Diffusivity

The reported drilling log for this test borehole indicated that the formation consisted of clay and limestone. A heat capacity value for limestone was calculated from specific heat and density values listed by Kavanaugh and Rafferty (Ground-Source Heat Pumps - Design of Geothermal Systems for Commercial and Institutional Buildings, ASHRAE, 1997). A weighted average of heat capacity values based on the indicated formation was used to develop an average heat capacity for the formation. An estimated diffusivity value was then found using the calculated formation thermal conductivity and the estimated heat capacity. The thermal diffusivity for this formation was estimated to be 1.07 ft²/day.

Est. Average Heat Capacity (Btu/ft ³ °F)	Thermal Conductivity (Btu/hr-ft-°F)	Est. Thermal Diffusivity (ft ² /day)
36.1	1.61	1.07

September 2, 2011

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FTC Test and Data Analysis
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**Geothermal
Resource
Technologies, Inc.**

MAIN OFFICE:
P.O. Box 150
BOWIE, TX 76230
(940) 872-2222
Fax: (940) 872-3678

REGIONAL OFFICES:
ELKTON, SD
(605) 692-9069
Fax: (605) 692-2604

ASHEVILLE, NC
(828) 225-9166
Fax: (828) 281-4139

WEB SITE:
www.GRTI.com

FORMATION THERMAL CONDUCTIVITY TEST AND DATA ANALYSIS

Analysis for: **Jackson Enterprises, Inc.**
204 South Maple Street
Lebanon, TN 37087
Phone: (615) 444-4545
Fax: (615) 444-4549

Test location: **Test Well #2**
Hanger 160
Fort Campbell, KY

Report Date: **September 2, 2011**

Test Performed by: **Mid-South Geothermal, LLC**

Executive Summary

A formation thermal conductivity test was performed on Test Well #2 at the Hanger 160 site at Fort Campbell, Kentucky. The vertical bore was completed on August 17, 2011 by Jackson Enterprises, Inc. GRTI's test unit was attached to the vertical bore on the afternoon of August 29, 2011. Geothermal Resource Technologies, Inc. analyzed the collected data using the "line source" method.

This report provides a general overview of the test and procedures that were used to perform the thermal conductivity test along with a plot of the data in real time and in a form used to calculate the formation thermal conductivity. The following average formation thermal conductivity was found from the data analysis.

⇒ Formation Thermal Conductivity = 1.61 Btu/hr-ft-°F

Due to the necessity of a thermal diffusivity value in the design calculation process, an estimate of the average thermal diffusivity was made for the encountered formation.

⇒ Formation Thermal Diffusivity ≈ 1.07 ft²/day

An estimate of the undisturbed formation temperature was determined from the initial temperature data at startup.

⇒ Undisturbed Formation Temperature ≈ 59.0-59.7°F

A copy of the original collected data is available either in a hard copy or an electronic format upon request.

September 2, 2011

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Test Procedures

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- (3) **Undisturbed Soil Temperature Measurement** – The undisturbed soil temperature should be determined by recording the minimum loop temperature as the water returns from the u-bend at test startup.
- (4) **Installation Procedures for Test Loops** – The bore diameter is to be no larger than 6 inches, with 4.5 inches being the target diameter. To ensure against bridging and voids, the bore annulus is to be uniformly grouted from the bottom to the top using a tremie pipe.
- (5) **Time Between Loop Installation and Testing** – A minimum delay of five days between loop installation and test startup is recommended if the formation is expected to have a low thermal conductivity or if low conductivity grouts ($< 0.75 \text{ Btu/hr}\cdot\text{ft}\cdot^\circ\text{F}$) are used. A minimum delay of three days is recommended for all other conditions.

GRTI's testing procedures deviate slightly from those above with regard to item (5). While item (5) bases the delay between installation and testing on the expected formation conductivity, GRTI bases its delay on the type of drilling used in the installation. When air drilling is required, a five-day delay is recommended to allow the bore to return to its undisturbed temperature. For mud rotary drilling, a minimum waiting period of two days is sufficient.

For a complete list of recommended procedures, refer to the ASHRAE 2007 HVAC Applications handbook, pages 32.12-32.13.

September 2, 2011

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FTC Test and Data Analysis
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Data Analysis

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In order to analyze real data from a formation thermal conductivity test, the temperature of the water entering and exiting the u-bend heat exchanger is plotted versus the natural log of time. Using the Method of Least Squares, the linear equation coefficients are then calculated that produce a line that fits the data. This procedure is normally repeated for various time intervals to ensure that variations in the power or other effects are not producing erroneous results.

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Fax: (828) 281-4139
E-mail: cmartin@grti.com

September 2, 2011

GRTI
FTC Test and Data Analysis
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Formation Thermal Conductivity Test Report

Date August 29-31, 2011
Location Fort Campbell, KY
Undisturbed Formation Temperature Approx. 59.0-59.7°F

Borehole Data – As Provided by Mid-South Geothermal, LLC

Borehole Diameter 5 3/4 inches

Note: 63 ft of steel casing was installed.

Drill Log	Clay	0'-55'
	Void/water	55'-56'
	Brown limestone	56'-150'
	Gray limestone	150'-500'

Note: Bore produced 2-3 gpm water at 55-56 ft.

U-bend Size 1 1/4 inch HDPE
U-Bend Length 500 ft
Grout Type Wyo-Ben Therm-Ex
Grout Solids 67%
Grouted Portion Entire bore

Test Data for Analysis Time Period

Test Duration 45.5 hrs
Average Voltage 244.9 V
Average Heat Input Rate 28,986 Btu/hr
Calculated Circulator Flow Rate 8.5 gpm
Standard Deviation of Power 0.08%
Maximum Variation in Power 0.16%

September 2, 2011

GRTI
FTC Test and Data Analysis
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Test Well #2, Hanger 160, Fort Campbell August 29-31, 2011

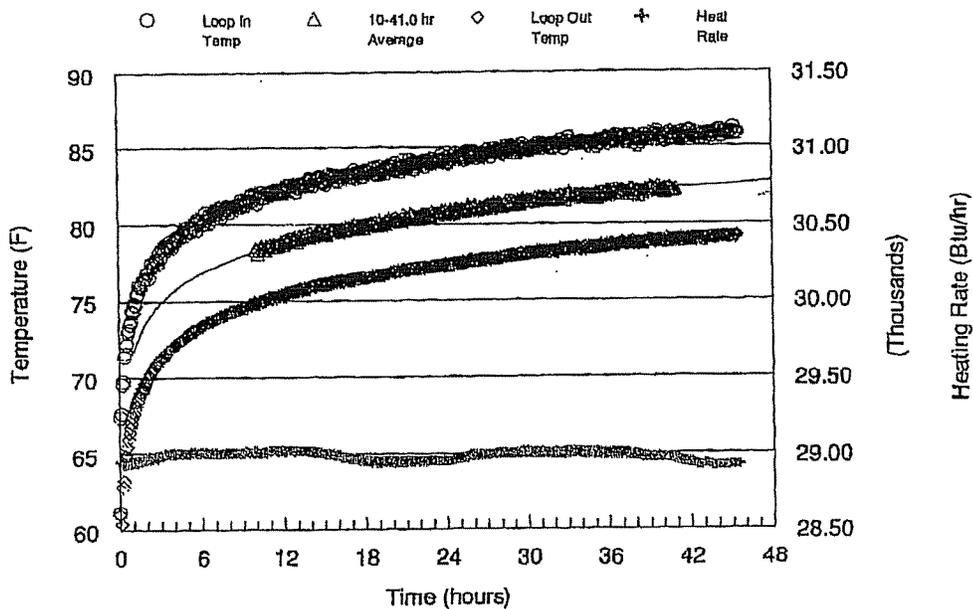


Figure 1: Temperature versus Time Data

September 2, 2011

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FTC Test and Data Analysis
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Line Source Data Analysis

**Test Well #2, Hanger 160, Fort Campbell
August 29-31, 2011**

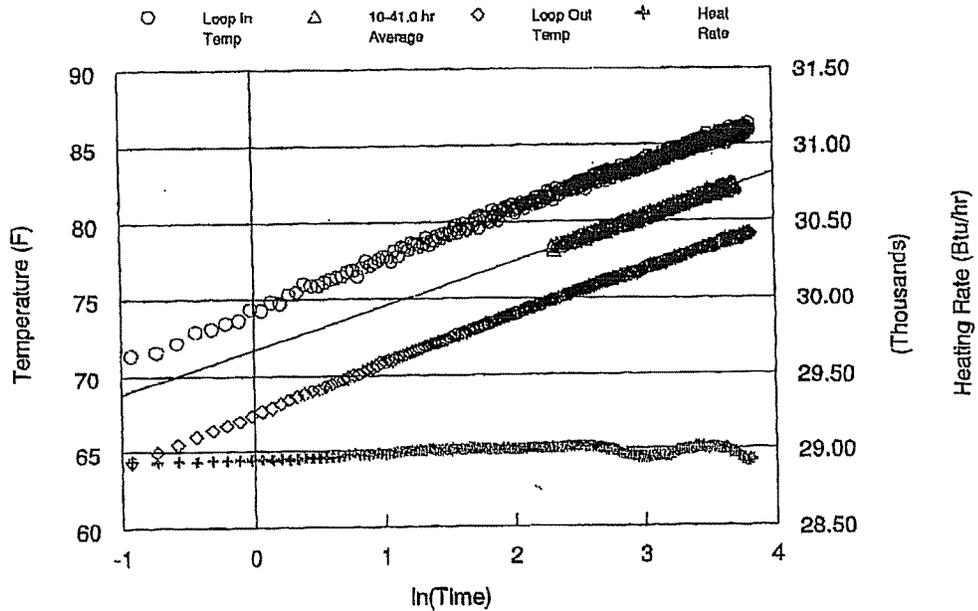


Figure 2: Temperature versus Natural Log of Time

Time Period	Slope: a_1	Average Heat Input (Btu/hr-ft)	(W/ft)	Thermal Conductivity (Btu/hr-ft-°F)
10 - 41.0 hrs	2.86	58.0	17.0	1.61

The temperature versus time data was analyzed using the line source analysis for the time period shown above. An average linear curve fit was applied to the data between 10 and 41.0 hours. The slope of the curve (a_1) was found to be 2.86. The resulting thermal conductivity was found to be 1.61 Btu/hr-ft-°F.

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Estimated Thermal Diffusivity

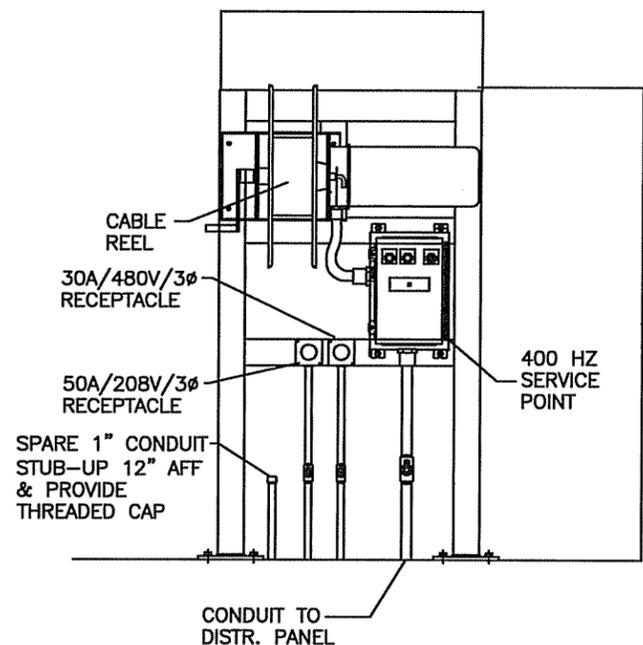
The reported drilling log for this test borehole indicated that the formation consisted of clay and limestone. A heat capacity value for limestone was calculated from specific heat and density values listed by Kavanaugh and Rafferty (Ground-Source Heat Pumps - Design of Geothermal Systems for Commercial and Institutional Buildings, ASHRAE, 1997). A weighted average of heat capacity values based on the indicated formation was used to develop an average heat capacity for the formation. An estimated diffusivity value was then found using the calculated formation thermal conductivity and the estimated heat capacity. The thermal diffusivity for this formation was estimated to be 1.07 ft²/day.

Est. Average Heat Capacity (Btu/ft ³ °F)	Thermal Conductivity (Btu/hr-ft-°F)	Est. Thermal Diffusivity (ft ² /day)
36.0	1.61	1.07

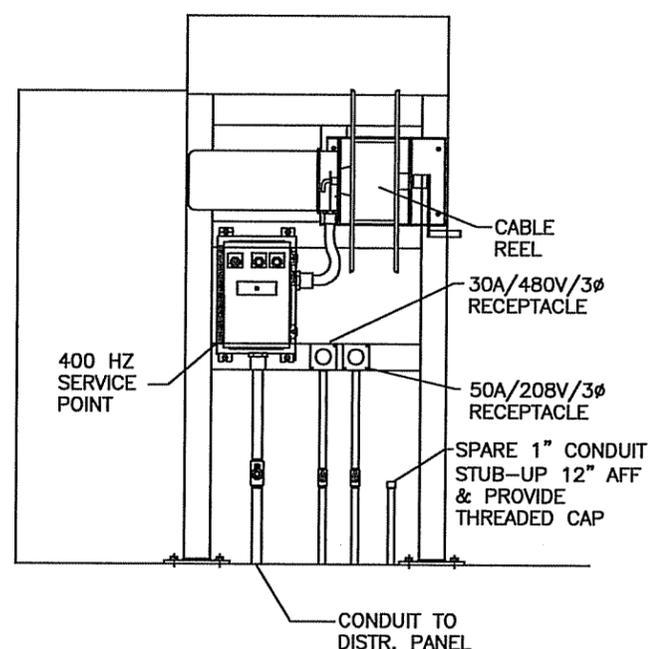
September 2, 2011

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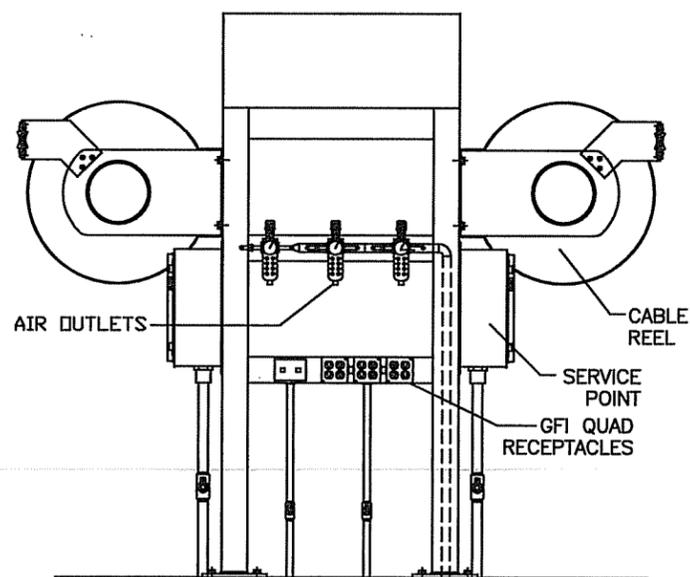
APPENDIX LL
Standard Utility Pedestals



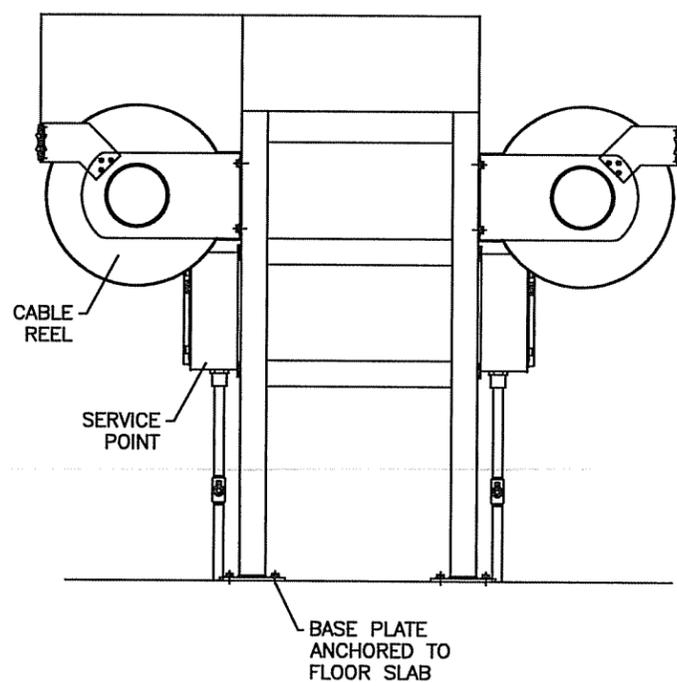
LEFT ELEVATION



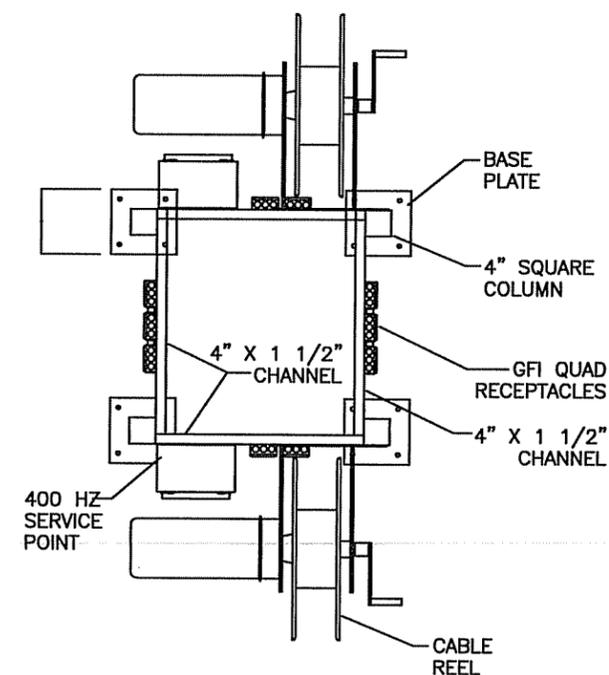
RIGHT ELEVATION



FRONT ELEVATION



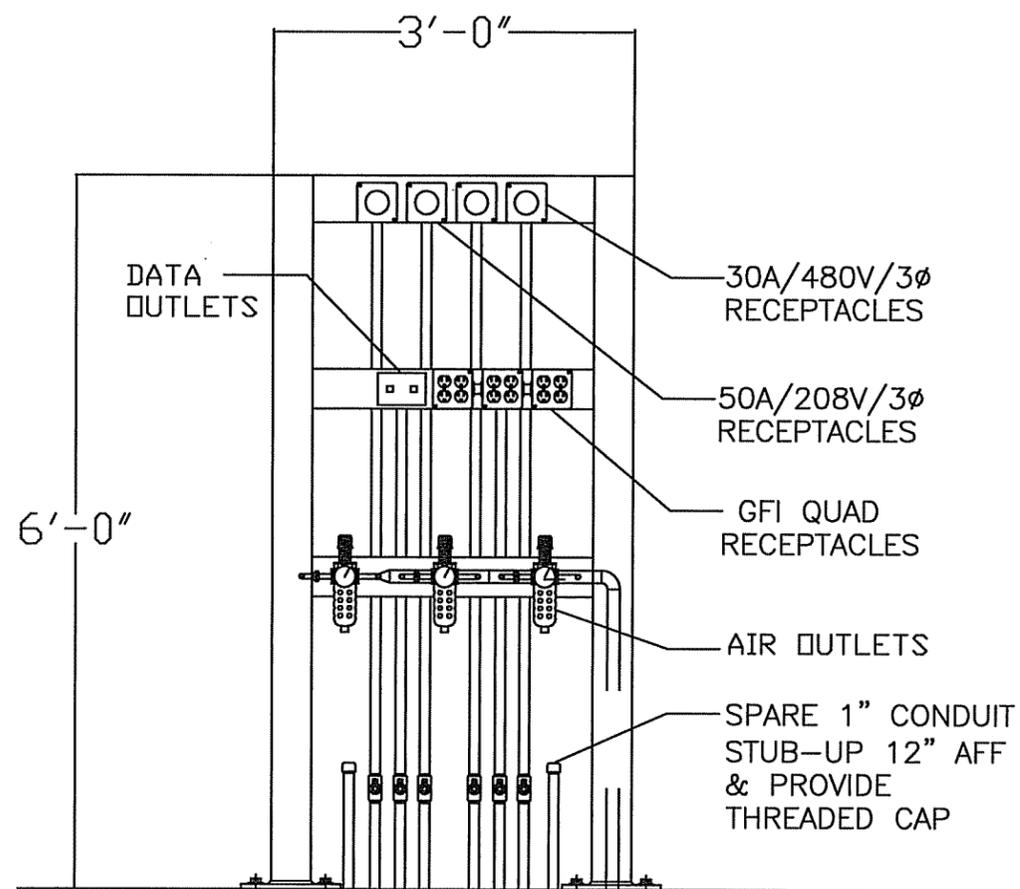
REAR ELEVATION



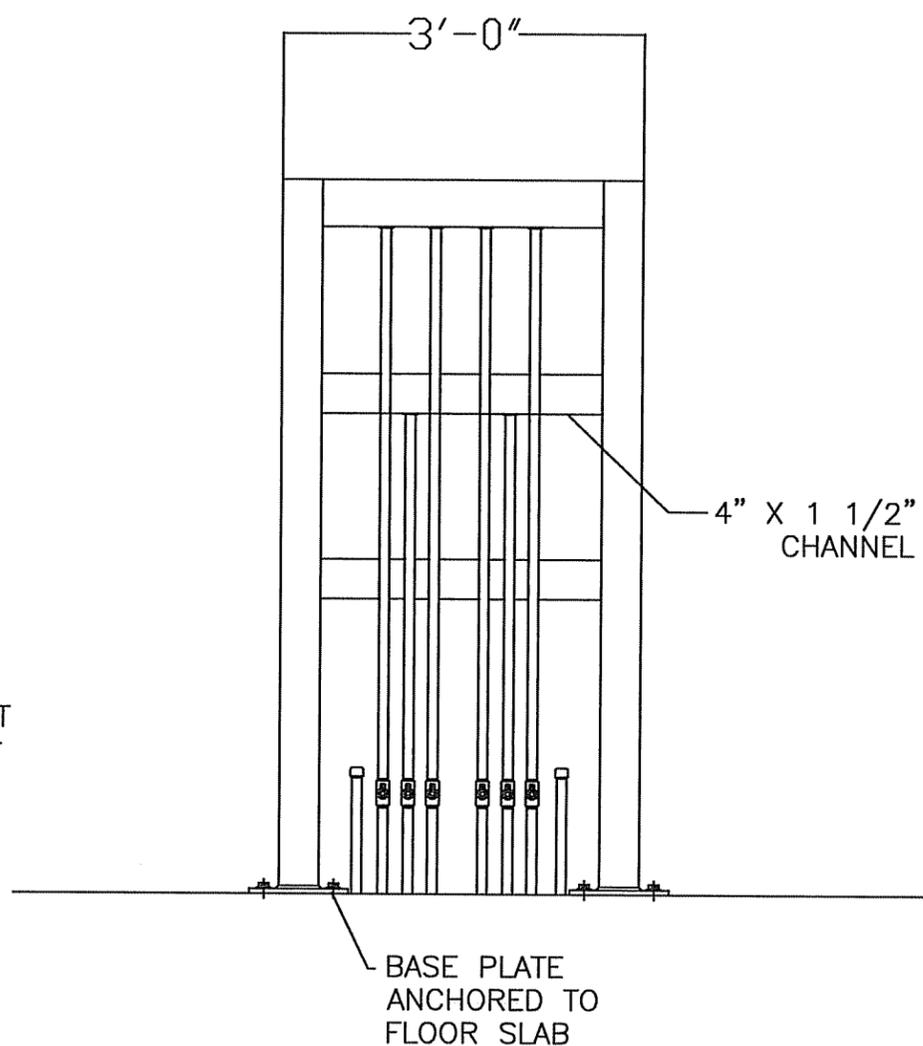
TOP VIEW

AIRCRAFT SERVICE POINT RACK (ASPR) DETAIL

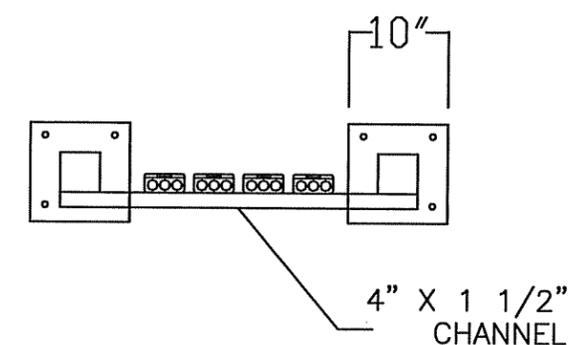
N.T.S.



FRONT ELEVATION



REAR ELEVATION



TOP VIEW

AIRCRAFT SERVICE POINT RACK (ASPR) DETAIL

Sample Utility Pedestal Photographs







APPENDIX MM
Construction Access Control Requirements

Appendix MM
Construction Access Control Requirements

The Contractor acknowledges and accepts all requirements included within this document and RFP as conditions of the contract.

Security is a primary concern for all personnel working on this project. Specific security measures are required to be implemented to allow for the on-going operation of the 160th Complex, while minimizing potential security risks.

The Contractor shall provide a minimum of one (1) full-time, unarmed Access Control Person at each site access gate and as required to maintain security to the project site. This person shall be stationed at each access gate and point of access to the project site during all working hours and any time the gate is open to Contractor access.

The Access Control Person shall be provided with a continuous means of communication to the Government's Identified Security Personnel and the Contractor's senior on-site manager. The Contractor shall provide the following means of communication, at a minimum:

- Three (3) two-way radios and chargers shall be provided to the Government's Identified Security Personnel. These radios shall be dedicated to the purpose of communicating security operations, and shall be used for no other purpose.
- One (1) two-way radio shall be in the possession of the Contractor's Access Control Person at all times, while on site.
- One (1) two-way radio shall be in the possession of the Contractor's Senior On-Site Manager at all times, while on site.
- Both the Contractor's Access Control Person and Senior On-Site Manager shall also be provided with a cell phone and have a copy of all phone numbers for Government Identified Security Personnel.

All access points to the project site shown in Appendix JJ Drawings shall be secured with a lockable gate controlled by key in accordance with AR 190-51 and CAM Regulation 190-1. Gate shall be locked at any time an Access Control Person briefed on these procedures is not present and during any non-working hours.

The Government:

- Reserves the right to remove Contractor personnel from the project for violating any security procedures identified in the RFP or implemented by the Government to maintain security. Personnel removed from the project site by the Government, may be prohibited from returning to the project.
- Reserves the right to continuously observe any and all activities of the Contractor using Government security personnel, cameras and/or other systems while located on Government property.
- Reserves the right to conduct random searches of vehicles, equipment and personnel while conducting work on Government property for compliance with the requirements of this document, the RFP, Ft. Campbell security regulations or other requirements.
- Reserves the right at any time to supersede the security requirements identified within this RFP to overcome shortcomings in the Contractor's security procedures.
- Reserves the right at any time to supersede the security requirements identified within this RFP based on the overall security posture of Ft. Campbell and/or the 160th Complex.

All Contractor Personnel shall:

- Follow all established security procedures.

- Immediately, notify the Contractor's Access Control Person or Government's Identified Security Personnel of any risks to security or breaches of the identified security procedures.
- Not leave the Contractor's established work limits without notification and approval of the Government's Identified Security Personnel. Temporary access for work outside the Contractor's established work limits shall be coordinated with the Government's Identified Security Personnel, a minimum of 48-hour prior to conducting the work.
- Not be allowed to take photographs while on Government property (including cell phone cameras).

The Contractor's Access Control Person shall:

- Meet the following minimum requirements:
 - Be a U.S. Citizen
 - Speak English
 - Have no felony convictions or outstanding warrants
- Immediately report any potential security risk or breach of these procedures to the Government's Identified Security Personnel.
- Provide a detailed briefing to all Contractor personnel accessing the site on their initial visit to the project site. The briefing shall be the Contractor developed and Government approved briefing indicated below.
- Provide a summary briefing to all Contractor personnel accessing the site on each subsequent visit indicating any changes to security procedures, access areas, construction limits, etc. The briefing shall be a summary of the Contractor developed and Government approved briefing indicated below.
- Maintain a daily roster of all known Contractor personnel, visitors and other personnel with authorized access to enter the project site. The list shall include only names of persons who are approved access to the project on a specific day.
 - A listing of all Contractor personnel who may be working on the project site is not acceptable.
 - A copy of the roster for Contractor personnel access shall be provided to the Government's identified security personnel a minimum of 24-hours in advance (i.e. a minimum of one day notice). Personnel who have not been previously granted access to the project site shall be specifically identified on the roster.
- Maintain a daily tally of all vehicles, equipment, etc. that entered the project site indicating general type and number of equipment.
- Allow access only to persons on the roster whose identify is verified with government issued identification (i.e. driver's license).
 - Record daily information of persons granted access to the project site, including times of access.
- Prevent access to the project site for any persons not identified on the daily roster.
 - Record daily information of persons denied access to the project site, identifying names and other available information.
- The Contractor's Senior On-Site Manager or their Government approved designee shall be allowed to grant daily access to persons through positive visual identification. The access control person shall make specific note of persons granted access through visual identification on the daily roster.
- Provide a copy of the completed daily roster to the Government's identified security personnel at the end of each working day.
- Lock gates in accordance AR 190-51 at the end of each working day and at any time that no Government approved Access Control Person is stationed at the gate. The Contractor's Access Control Person shall notify the Government's Identified Security Personnel each time the gate is locked or unlocked.

The Contractor shall:

- Provide a resume and full background check to the Government for approval of all personnel identified to serve as the Contractor's Access Control Person. No person shall serve as the Contractor's Access control Person who has not been approved by the Government.
- Immediately report any breach of these procedures to the Government's identified security personnel.
- Develop written procedures for maintaining and verifying that the access gates are locked and secure during all non-working hours. These procedures shall be submitted and approved by the Government. Any changes to these procedures shall be submitted to the Government for approval.
 - Maintain all fencing, gates and project limit control measures in a secure manner at all times.
 - Verify at the end of each working day that all gates and project access points are locked and secured in accordance with AR 190-51 and applicable Ft. Campbell physical security requirements.
 - Immediately notify the Government's identified security personnel of any deficiencies, damage or breach of fencing, gates or project limit control measures.
- Ensure that at least one properly briefed Access Control Person is stationed at each gate and project access point during all working hours.
- Ensure that no person shall act as an Access Control Person who has not been fully briefed on these requirements and Ft. Campbell's Physical Security Standards (CAM Regulation 190-1).
- Develop briefing (detailed and summary) information for all personnel accessing the project site including limits of project boundaries, access to the flight line and access to areas outside of the identified project boundaries. These procedures shall be submitted and approved by the Government. Any changes to these procedures shall be submitted to the Government for approval. This briefing material shall be presented to ALL Contractor personnel as indicated above. The Contractor's Access Control Person shall maintain a copy of the approved briefing material in their possession at all times.
- Prohibit any and all access to active flight lines, taxiways, aprons and similar areas without the approval of the Government. Any persons who access these areas without prior approval will be removed from the project site and prohibited from returning.
- Shall not allow access to the project site if a Contractor Access Control Person is not present at the access control gate.
- Prohibit any and all access to areas within the 160th Complex (and outside the project fence) without the approval of the Government. Any persons who access these areas without prior approval will be removed from the project site and prohibited from returning.
 - The Contractor shall provide full background check, driver's license number, date of birth and social security numbers to any person requiring access to the 160th Complex for approval and acceptance by the Government.
 - The Contractor shall coordinate this access and provide the required information for any persons accessing the project site prior to the project fence and other security measures identified above being fully implemented.
 - The Contractor shall provide a minimum of five (5) working days notice to the Government prior to requiring access to the 160th Complex outside the project fence.

APPENDIX NN
Geophysical Survey



Geophysical Survey Report

Evaluation of Potential Subsurface Concerns
MH-47 Hangar Construction Documents
Fort Campbell, Kentucky
Prism Project Number: 01.010.002

Prepared For:

Barge Waggoner Sumner & Cannon, Inc.
8280 Yankee Street
Dayton, OH 45458-1806

Prepared By:

Prism GeoImaging, Inc.
11057 Allisonville Rd., #144
Fishers, Indiana 46038

Prism Project Number:

01.010.002



11057 Allisonville Road, #144
Fishers, Indiana 46038-2331
www.primsmgeo.com

August 12, 2011

Jason Starner, PE, LEED AP BD+C
Civil Engineer
Barge Waggoner Sumner & Cannon, Inc.
8280 Yankee Street
Dayton, OH 45458

Re: Geophysical Investigation Report
MH-47 Study Area
Fort Campbell
Fort Campbell, Kentucky
Prism Project Number: 01.010.002

Dear Mr. Starner,

In accordance with my proposal via email dated July 1, 2011, Prism GeoImaging, Inc. (Prism) is pleased to present Barge Waggoner Sumner & Cannon, Inc. (BWSC) with this letter report documenting the geophysical investigation at the above-referenced project site (the "Site"). My documentation of this project is included in the following sections.

Introduction

The Site is a parcel of land approximately 22 acres in size. It is my understanding that BWSC is developing request for proposal (RFP) documents for a design/build construction contract of a hangar and helicopter ramp. As part of the preparation of these documents it is required that geophysical testing be completed in order to confirm existing utility locations and identify potential subsurface concerns. Specifically, the geophysical project objectives as provided by BWSC are defined as follows:

- a) Locate and delineate any areas that may contain subsurface waste, uncontrolled fill, underground utilities, or other subsurface anomalies that would impact the design/build contractor's cost, schedule, or construction methods. Portions of the project site may be inaccessible to surveying equipment due to the presence of buildings, construction trailers, or other obstructions.
- b) Provide additional documentation on the extent of known sinkholes and evaluate the possibility of additional unknown sinkhole features (see Figure 1 for historic sinkhole location information provided by BWSC).
- c) Perform an EM-61 type site investigation to characterize existing conditions.



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Scope of Work and Geophysical Methodology

The scope of work for this investigation was comprised of multiple geophysical methods in order to meet all the project objectives. A summary of the methods and the project objectives they address is as follows:

EM61 Metal Detection

The EM61 is an industry-standard metal detector manufactured by Geonics Ltd. in Mississauga, Ontario. EM61 geophysical surveys are commonly used to map the locations of metal objects such as underground storage tanks (USTs), buried drums, relict utilities and infrastructure, former building foundations, construction and industrial debris, and in some situations unexploded ordnance (UXO).

Mapping with the EM61 is a cost effective and highly sensitive method for screening large areas for the presence of buried metal objects. Using receiver coils at two different heights, the system can be used to estimate the size and proximity of metallic objects by the respective signal strengths recorded in millivolts. EM61 metal detection mapping is included in this scope of work to meet the stated project objectives (a) and (c).

EM-61 anomalies are generally consistent in character from site to site, independent of the environment. For a metal object buried at 2 to 4 feet in depth, the magnitude of the Channel 3 anomaly is generally in the upper 100's to near 1000 millivolts and the Channel Difference value is generally in the low to mid 100's millivolts. The contrast between the Channel 3 and Channel Difference values is more subdued for deeper metal objects than for shallow objects. Large metal objects close to the surface (e.g. reinforced concrete, manholes) cause too great of an instrument reading to be filtered out, so the anomalies from such features will remain on the channel difference map.

The instrument used for this work is an EM61-MK2-HP manufactured by Geonics Limited. The EM61-MK2-HP is a high-sensitivity, high-resolution, time-domain metal detector. It consists of two vertically separated 1-meter by 0.5-meter coaxial coils. The EM61-MK2-HP takes readings from the bottom coil (designated as channel three) and an additional reading from the top coil. The top and bottom coil readings are then subtracted to selectively filter out the effect from near-surface metal objects (designated as channel difference calculation). The channel three reading is considered to be a measure of all metal within the detection zone both shallow and deep, while the channel difference calculation is a measure of predominantly deeper metal only. The HP designation to this instrument indicates that it has been upgraded by the manufacturer to provide an eight-fold increase in the amount of signal received by the instrument, resulting in significant improvements to the signal-to-noise ratio (SNR). Compared to the standard EM61-MK2



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(or the older EM61), the HP modification increases the depth of detection by 45%-80% depending on target characteristics.

Electromagnetic Conductivity (EMC) Mapping

EMC mapping is often used for locating and mapping the extent of buried waste, fill material, and landfilled areas by providing indications of soil type based on the electrical conductivity. Typically, coarse materials (sand, gravel, non-reinforced concrete rubble, etc.) are the least conductive, whereas silt, clay, ash, cinders, wood, paper and other fine grained, moist materials are conductive to the highest degree of non-metallic materials. EMC mapping is also commonly used to locate potential cave and sinkhole features. Open voids in bedrock have very low electrical conductivity relative to the surrounding rock. Sinkhole features are typically much more conductive than competent rock due to the soil materials that wash into the sink feature. EMC mapping is included in this scope of work to meet the stated project objectives (a) and (b).

The instrument used for this work is a Profiler EMP-400 manufactured by Geophysical Survey Systems, Inc. The EMP-400 induces electrical current flow in the subsurface by generating an electromagnetic field using a transmitter coil; a receiver coil at the other end of the instrument is used to measure the subsurface current. The transmitter output and receiver input values are stored in a handheld computer for subsequent processing and conversion to apparent conductivity and magnetic susceptibility measurements using transform algorithms. Since the EMP-400 instrument does not require direct ground contact, data collection rates are relatively fast. This makes EMC mapping well-suited to rapid scanning of very large areas, though it affords limited information on the vertical distribution of anomalous areas.

2D Resistivity Imaging

Two-dimensional resistivity imaging (2DR) is used to provide highly detailed, cross-sectional images of the subsurface by measuring the distribution of electrical resistivity variations in subsurface materials along a single line of data collection. 2DR essentially measures the same physical property as ECM (resistivity is the mathematical inverse of conductivity), but rather than producing horizontal map view images, 2DR produces vertical-depth view images. Consequently, ECM and 2DR are often used as complementary methods: ECM to scan large areas and identify the horizontal limits of anomalous areas, and 2DR as a focused high-resolution method to quantify the vertical limits of the anomalies. The 2DR method is often used on karst mapping projects because of its ability to reveal complex vertical relationships from the surface down to well within competent bedrock. 2DR is included in this scope of work to meet the stated project objectives (a) and (b).



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Electrical resistivity is one of the most widely varying physical properties of natural materials. Certain minerals, such as native metals and graphite, conduct electricity via the passage of electrons; however, electronic conduction is generally very rare in the subsurface. Most minerals and rocks are insulators, and electrical current preferentially travels through the water-filled pores in soils and rocks by the passage of the free ions in pore waters (i.e., ionic conduction). It thus follows that degree of saturation, interconnected porosity, and water chemistry (i.e., total dissolved solids) are the major controlling variables of the resistivity of soils and rocks. In general, electrical resistivity directly varies with changes in these parameters. Fine-grained sediments, particularly clay-rich sediments such as glacial till, are excellent conductors of electricity, often much better than fresh water found in the pores of sand and gravel.

Two-dimensional resistivity (2DR) imaging consists of recording direct measurements of electrical resistivity at the earth surface in a profile-type data set. Data are acquired using a number of non-corrosive steel stakes (generally 50-60) that are driven into the ground along a given line of profile. A multi-conductor cable is used to connect the stakes to the instrument, which measures the subsurface resistivity using between 4 and 11 of the stakes per measurement cycle. Measurements from several hundred different combinations of stakes are utilized to construct a complete variable-depth dataset known as an apparent resistivity pseudo-section. The term "apparent" refers to the fact that this is a bulk average measurement that assumes the ground is homogeneous and isotropic, therefore the resistivity is apparent rather than actual.

Once the apparent resistivity data are collected, they are downloaded to a computer and inverse-modeled to obtain a cross-section of the actual resistivity values of subsurface materials. For this project, the software used to do this is *EarthImager* from Advanced Geosciences, Inc. The inverse modeling is accomplished through the process of generating a model resistivity cross-section, calculating the theoretical apparent resistivity pseudo-section that would result from such a model, and comparing the theoretical pseudo-section to the one collected in the field. The software then alters the model through several iterations until the theoretical and field-collected pseudo-sections closely match each other. At this point the model is considered to be a reasonable estimation of the actual resistivity values of the subsurface materials.

There is no unique direct conversion from resistivity values to lithology. However, based on site knowledge, geometric shapes and relationships of various anomalies, and the observed ranges of resistivity values, reasonable geologic interpretations can be made. Very often an experienced interpreter can readily recognize geologic features on these cross-sections.



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Data Collection

EM61-MK2-HP data were collected along predominantly northwest-southeast lines using a sub-meter accuracy GPS receiver to record the instrument location in real time (see Figure 2 for data coverage). After the data were collected they were downloaded to a computer for subsequent processing. The EM61-MK2-HP data were processed with *Surfer v10* to create a channel three map (see Figure 4) and a channel difference map (see Figure 5).

EMC data were collected along predominantly northwest-southeast lines using a GPS receiver to record the location of the EMP-400 in real time (see Figure 3 for data coverage). After the data were collected they were downloaded to a computer for subsequent processing. The EMC data were processed with *Surfer v10* to create a conductivity map (see Figure 6).

Three (3) 2DR lines were collected in the locations shown on Figure 7. These locations were chosen to 1) further investigate anomalous areas identified on the EM61 and EMC maps, and 2) to complete a reconnaissance level mapping of the soil and bedrock to identify possible karst areas. This is a preliminary type of survey to help make decisions for further evaluation, and should not be considered as a comprehensive site assessment for the presence of caves and sinkholes.

Site Specific Results and Interpretations

Buried Fill, Uncontrolled Waste, Underground Utilities

There were areas of the Site that were inaccessible for data collection (as indicated on Figures 2 and 3) due to physical obstructions and/or the presence of subsurface features that interfere with the instruments (e.g. steel reinforcement within concrete). These areas of the Site were not characterized with this geophysical investigation and possible anomalies of interest may exist within these areas.

The EM61 channel three map presented on Figure 4 shows all metal within the maximum detection depth of the instrument (generally 10-15 feet, depending on target characteristics). On this map can be seen two known utility lines, these are marked as solid black lines and labeled with the type of utility they represent (based on information provided by BWSC). Also seen on this map is a subtle linear anomaly that is interpreted as an unknown or relict utility line. This anomaly trends approximately north-south near the center of the study area. Three (3) shallow buried objects are also noted on this map; the nature of these anomalies is unknown, these may represent individual objects (e.g. buried drums) or accumulations of small metal objects (e.g. buried scrap metal). Additionally there are three areas that have a somewhat elevated EM61 response; these are



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interpreted as possible areas of fill or buried waste (i.e. soils containing numerous small scattered metal objects).

The EM61 channel difference map presented on Figure 5 shows predominantly deeper metal objects only and has most near-surface metal filtered out. Seen on this map is a linear feature trending west-east then turning to trend southwest-northeast to the western corner of the existing hangar; based on information from BWSC this is identified as a water main. Also seen on this map is a short linear feature at the southern corner of the ramp, this is a drainage pipe that feeds into a swale trending along the north-south taxiway. There are high EM61 readings along the fence that borders the western edge of the study area. Such readings are to be expected, however the high readings extend further away from the fence than typically occurs in similar situations. Therefore there is a possibility that the EM61 is detecting an unmapped utility line that trends along the fenceline. Also seen on this map are four (4) areas of relatively deeply buried metal objects. These four areas may represent individual objects (e.g. buried drums) or accumulations of smaller metal objects. The largest of the four is located just south of the radio tower between the ramp and the taxiway; this anomaly is consistent with a UST or concrete utility vault.

The EMC map (Figure 6) shows many of the same utility lines as the EM61 map. An additional anomaly evident on the EMC map is a linear feature trending north-northeast from the fenceline to a point near the covered storage structure where it turns and trends northwest and shortly thereafter turns again to trend northeast. Based on information provided by BWSC this feature is another water line. The fact that it was not detected with the EM61 may be due to one of several reasons, including that the water line is buried below the maximum detection depth for the EM61, or that the water pipe is non-ferrous and therefore is less detectable with the EM61. Two more linear anomalies are seen on the EMC map, one trending southwest and the other to the south from the radio tower located between the ramp and the taxiway. These anomalies are not as strong as the other utility anomalies, therefore these are interpreted as possible utility trenches.

Also evident on the EMC map is an area of somewhat higher conductivity located in the northern portion of the study area. It is difficult to determine whether these elevated conductivity readings are cause for concern or not. Conductivity readings in this range are consistent with increased clay or moisture content in the soil, however they are also consistent with possible fill or buried waste such as cinders or ash. 2DR lines 1 and 3 were located over this low conductivity material in an effort to determine the maximum depth of the material (see Figure 7). Based on these two 2DR lines the low conductivity material appears to be as much as 20 feet and possibly up to 30 feet deep (see Figure 8)



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Sinkhole Evaluation

No evidence of sinkhole activity was seen on the EMC map so the 2DR lines were simply located such as to give an overall characterization of the study area while also having one or more of the lines pass over the elevated conductivity area discussed above (see Figure 7). At the south end of Line 1 is an area of the bedrock that has an anomalously low resistivity. This feature is consistent with a soil-filled sink feature or a fracture zone in the bedrock, which is found at a depth of approximately 50 feet in this area. A similar feature is found at the southern end of Line 3 as well, though it is not as pronounced or as well imaged as the feature on Line 1. Near the northwestern end of Line 2 is seen an area of bedrock with a somewhat lower resistivity than the rest of the bedrock, this feature is consistent with a fracture zone within the rock.

The water line noted on the EM61 channel difference map (Figure 5) caused some interference in the 2DR data on Line 3, as a result the bedrock in the nearby vicinity was not well characterized. It is indeterminate whether a sink feature or fracture zone may be found in the bedrock in this area of Line 3. A similar interference pattern is found on Line 2 where it crosses the possible utility trenches noted on the EMC map. Again, it is indeterminate whether a sink feature or fracture zone may be found in this area of Line 2. If there is concern about possible sink features or fracture zones in these areas, it is recommended that boreholes be advanced to a depth sufficient to characterize the competency of the bedrock surface.

Results Summary

The results and interpretations of this investigation are presented on Figure 11 and summarized as follows:

1. Some areas of the Site were inaccessible for data collection due to physical obstruction or interference-causing features (e.g. metal structures or equipment). These areas were not characterized with this geophysical investigation and it is indeterminate whether these areas contain any features of potential interest to the design/build contractor.
2. Several known utility lines can be seen on the EM61 and EMC maps. These lines are denoted with a solid black line and have been labeled according to the type of utility they represent (using information provided by BWSC).
3. A subtle linear anomaly seen on the EM61 channel three map (Figure 4) is interpreted as an unknown utility.
4. There are three (3) areas of somewhat high EM61 channel three readings. These are interpreted as possible waste or fill material areas.



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5. There are seven (7) unknown buried metal objects seen on the EM61 maps. Three (3) of these are relatively shallow; four (4) of them persisted through the channel difference filtering, which generally indicates that such objects are buried at a relatively greater depth. The largest of these buried metal objects is consistent with a UST or concrete utility vault.
6. There are high EM61 readings along the fence in the northern portion of the study area. Elevated readings are to be expected in close proximity to a metal fence, however in this case the elevated readings continue to a greater distance away from the fence than is typically seen. This indicates that there may be an unknown utility line buried along the fence.
7. Two linear anomalies are evident on the EMC map. These are interpreted as possible utility trenches that may or may not have utility lines remaining within.
8. An area of elevated EMC readings is found in the northern portion of the study area. This is consistent with higher clay and/or moisture content in the soil, however it is also consistent with buried waste or fill material and consequently may be of concern to the design/build contractor. The 2DR lines over this area indicate that the high conductivity material extends to a depth of approximately 20 feet and possibly 30 feet in some areas.
9. No evidence of sinkhole activity is seen on the EMC map, consequently the 2DR lines were laid out to provide a broad characterization of the Site. Therefore the three 2DR lines presented in this report are not to be taken as a comprehensive site evaluation for karst hazards.
10. A possible sink feature is found at the southern end of Line 1. A similar but less pronounced feature is found at the southern end of Line 3. A possible fracture zone is noted near the northwestern end of Line 2.
11. There was interference in the 2DR lines where they crossed utility lines; it is indeterminate if there are sink features or fracture zones in the bedrock near these zones of interference. If there is concern that karst hazards may be found in these areas it is recommended that boreholes be used to evaluate the bedrock competency.

Limitations

This geophysical survey was intended primarily to locate areas of subsurface waste, uncontrolled fill, underground utilities, karst hazards, and other subsurface features that would impact the design/build contractor's cost, schedule, or construction methods.



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Subsurface features that are difficult to detect (e.g. plastic utility lines, buried wires, non-reinforced concrete rubble etc.) and would be of concern to the design/build contractor may have gone undetected by this investigation and may not be detectable by any geophysical investigation. Areas obscured by features such as buildings or other structures, vehicles, waste storage containers, either physically or electromagnetically, or areas that are specifically covered with reinforced concrete, may conceal additional objects of interest that are unknown at this time.

The enclosed maps are considered to be of sufficient accuracy and precision to provide positional data for further investigation activities. However the Site features presented on the base maps are for informational purposes only and no representation is made as to the accuracy or completeness of this information. The enclosed maps, while they may indicate locations of utilities, are not to be taken as a map of utility locations and are not a substitute for a private utility locate.

Closing

Prism Geolmaging, Inc. appreciates the opportunity to provide BWSC with this geophysical survey, and I look forward to working with you on future projects. If you should have any questions regarding this project, please do not hesitate to contact me at jvanderlaan@primsmgeo.com or 317-379-5796.

Sincerely,

Prism Geolmaging, Inc.

A handwritten signature in black ink that reads "John Vanderlaan".

John Vanderlaan, LPG, PG
President / Geophysicist

Attachments:	Figure 1.	Site Layout and Historic Sinkhole Locations
	Figure 2.	EM61 Data Coverage
	Figure 3.	Conductivity Data Coverage
	Figure 4.	EM61 Channel Three Map, Metal Both Shallow and Deep
	Figure 5.	EM61 Channel Difference Map, Predominantly Deeper Metal Only
	Figure 6.	EM Conductivity Map
	Figure 7.	2D Resistivity Line Locations
	Figure 8.	Resistivity Lines 1 and 3
	Figure 9.	Resistivity Line 2
	Figure 10.	2D Resistivity Lines, Pseudo 3D Map View
	Figure 11.	Results Summary Map



UTM Northings (m)



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Scale in Feet



1" = 200'



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Figure 1

Site Layout And Historic Sinkhole Locations

MH-47 Study Area
 Fort Campbell
 Prism Project No. 01-010-002
 Tuesday, December 20, 2011



UTM Northings (m)

4059400
4059350
4059300
4059250
4059200
4059150
4059100
4059050
4059000
4058950
4058900

455600 455650 455700 455750 455800 455850 455900 455950 456000 456050 456100 456150 456200 456250 456300 456350

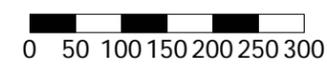
UTM Northings (m)

UTM Coordinate System, Meters, WGS84 Datum

 Area Inaccessible

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Scale in Feet



1" = 200'



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Figure 2

EM61 Data Coverage

MH-47 Study Area
Fort Campbell
Prism Project No. 01-010-002
Tuesday, December 20, 2011



 Area Inaccessible

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Scale in Feet



1" = 200'



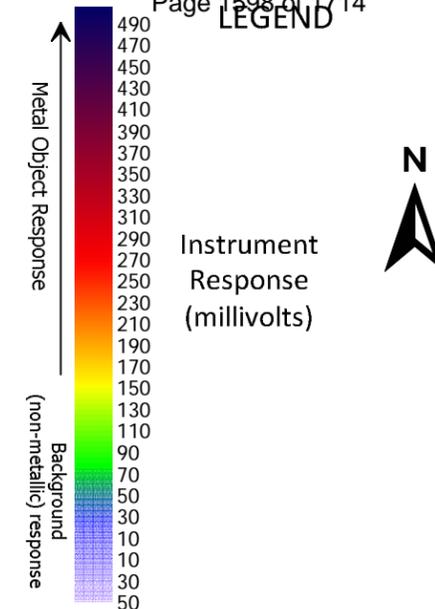
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Figure 3

Conductivity Data Coverage

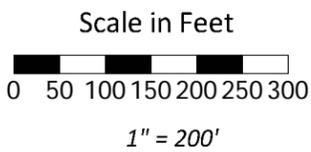
MH-47 Study Area
Fort Campbell

Prism Project No. 01-010-002
Tuesday, December 20, 2011



- Possible Fill or Waste Material
- Unknown Utility Line
- Shallow Buried Metal Object

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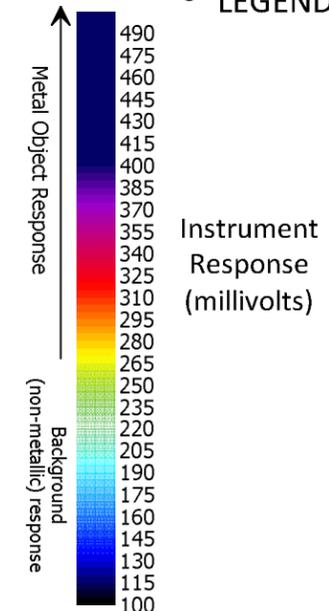


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Figure 4

**EM-61 Channel 3 Map
Metal both Shallow and Deep**

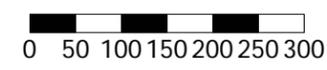
MH-47 Study Area
Fort Campbell
Prism Project No. 01-010-002
Tuesday, December 20, 2011



 Deep Buried Metal Object

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Scale in Feet



1" = 200'



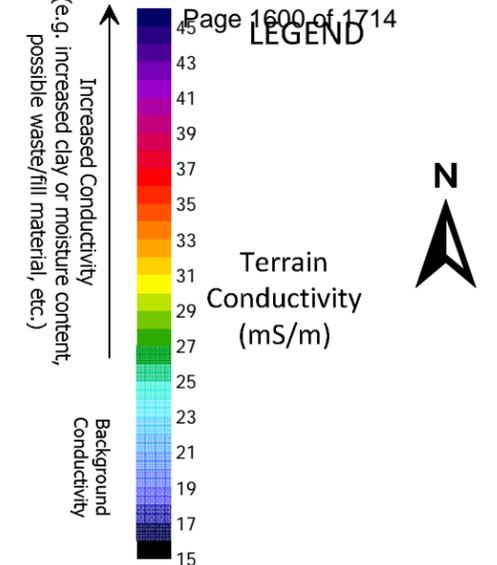
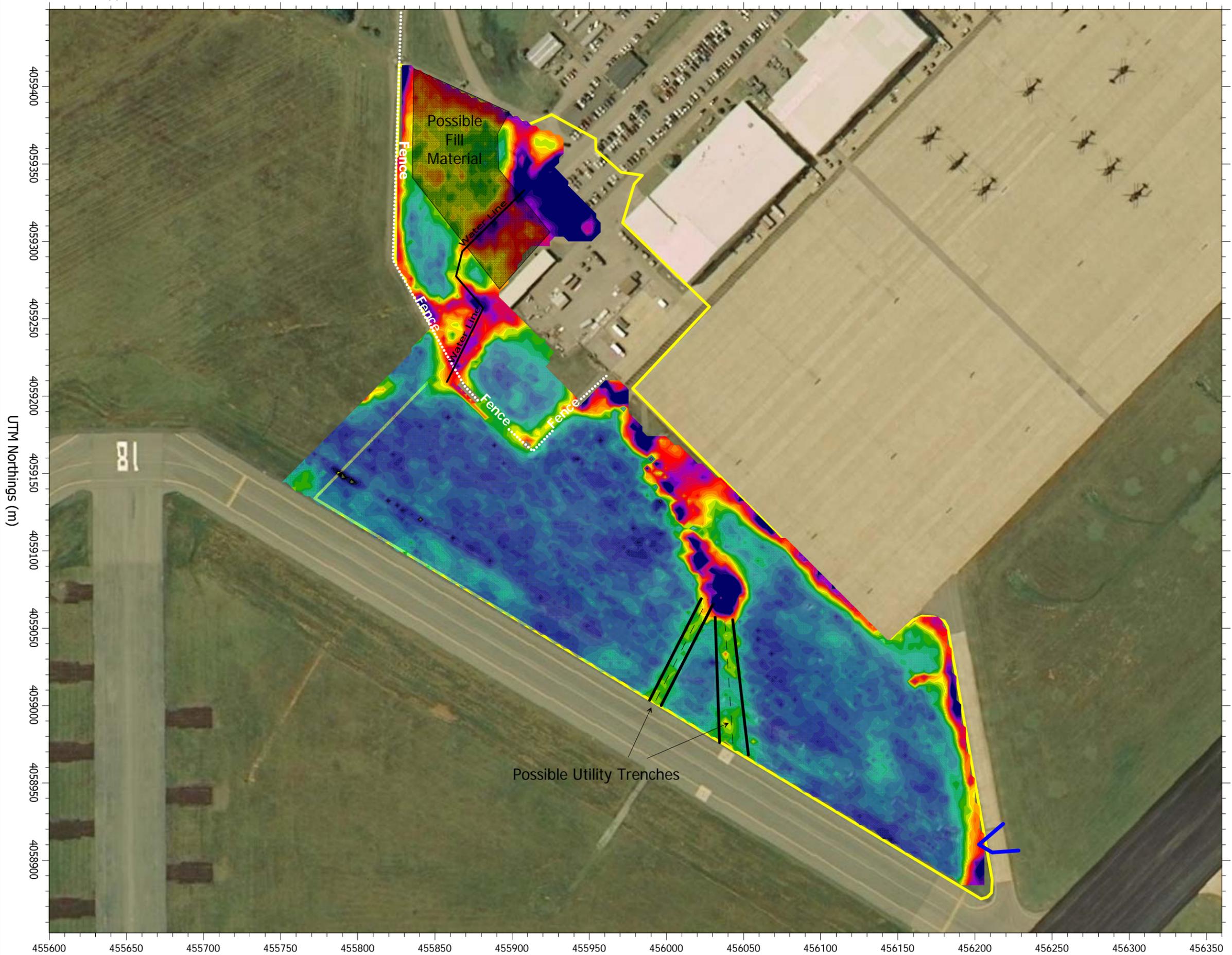
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Figure 5

**EM-61 Channel Difference Map
Predominantly Deeper Metal Only**

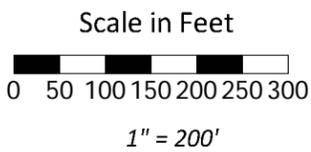
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Tuesday, December 20, 2011





- Possible Utility Trench
- Area of Anomalous Conductivity (e.g. possible waste/fill material)

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Figure 6
EM Conductivity Map

MH-47 Study Area
Fort Campbell
Prism Project No. 01-010-002
Tuesday, December 20, 2011



UTM Northings (m)



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Scale in Feet



1" = 200'



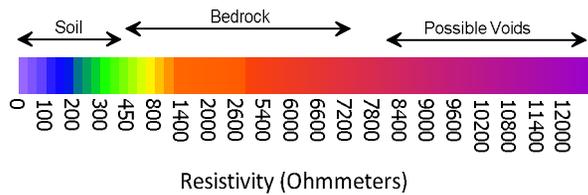
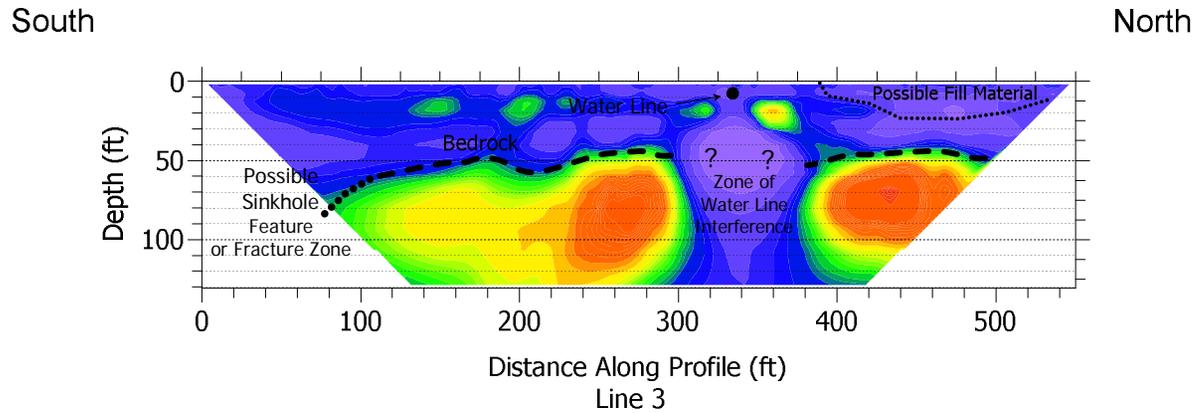
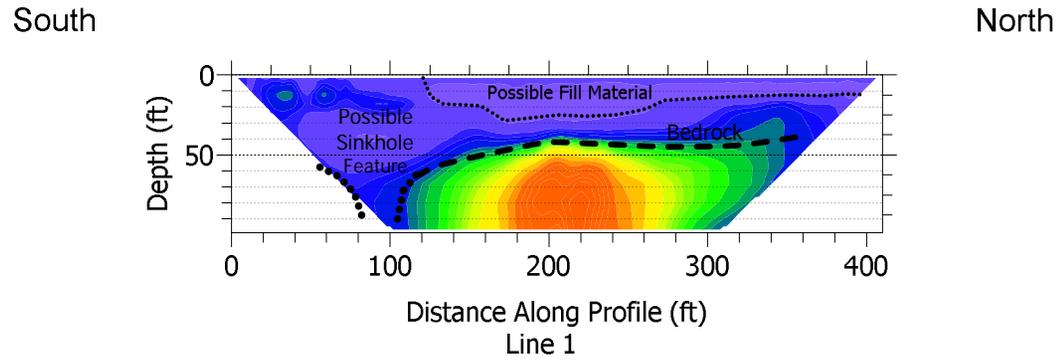
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Figure 7

2D Resistivity Line Locations

MH-47 Study Area
 Fort Campbell

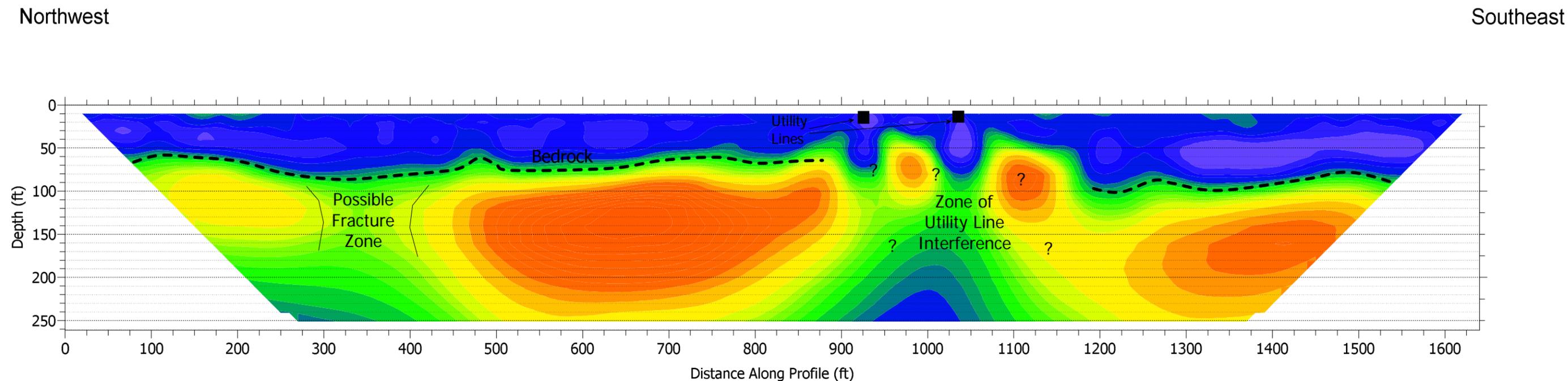
Prism Project No. 01-010-002
 Tuesday, December 20, 2011



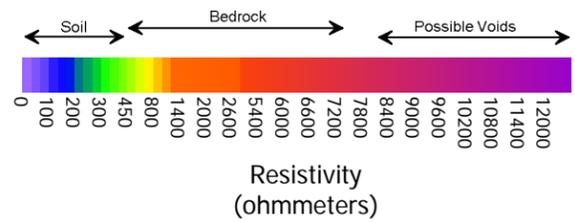
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Figure 8	<p>Resistivity Lines 1 and 3</p>	<p>MH-47 Study Area Fort Campbell Prism Project No. 01-010-002</p>	 <p>Prism GeoImaging, Inc. 11057 Allisonville Road, #144 Fishers, Indiana 46038-2331 www.prismgeo.com</p>
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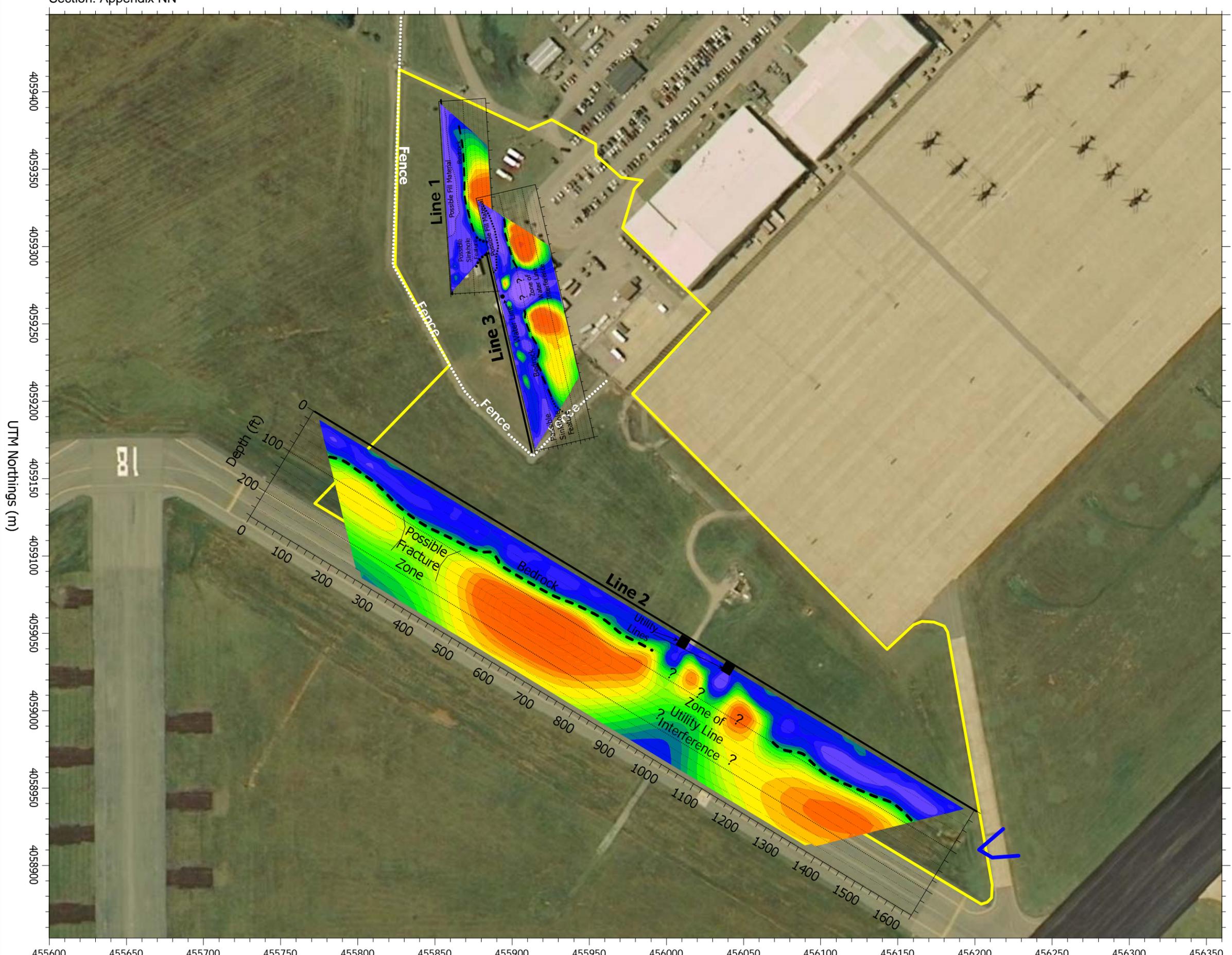
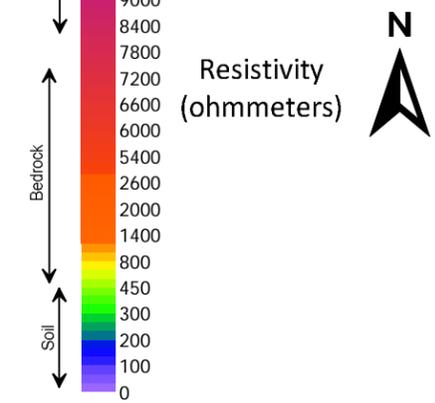
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Figure 9

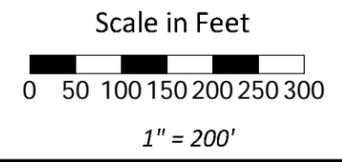
Resistivity Line 2

MH-47 Study Area
 Fort Campbell
 Prism Project No. 01-010-002

LEGEND



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Figure 10

**2D Resistivity Lines
Flattened to Pseudo-3D Space**

MH-47 Study Area
Fort Campbell
Prism Project No. 01-010-002
Tuesday, December 20, 2011

APPENDIX OO
Fort Campbell (FTC) Guide to Green Procurement for Construction

Fort Campbell (FTC) Guide to Green Procurement for Construction

Chapter 1 Introduction

1-1. Purpose

This Guide serves as a broad overview of green procurement requirements relevant to Fort Campbell (FTC) and is intended to aid construction designers, specification writers, and contractors. For specific requirements, refer to your organizational procedures and the applicable design standards/ specifications or other language of the contract.

1-2. Background

Various laws and Executive Orders direct federal agencies to purchase environmentally preferable products to the maximum extent practicable. Collectively, these legal requirements are referred to as "green procurement." Department of Defense (DoD) and Department of the Army (DA), require FTC to maintain a Green Procurement Program in accordance with these laws.

1-3. Applicability

This Guide is informational in nature and intended for projects on FTC, KY. FTC is working to incorporate green procurement requirements into its own construction, renovation, and repair contracts and design standards. The U.S. Army Corps of Engineers and other federal organizations also include various green procurement requirements in their contracts. Construction designers and contract writers working on FTC projects shall ensure all applicable green procurement requirements are incorporated into their project designs and contracts. Contractors and subcontractors shall ensure that all green procurement requirements stated in their contract, construction specifications, and/or request for proposal are met, including the submission of green procurement records and information. Note that FAR clause 52.236-7 requires compliance with Federal laws, including green procurement laws.

1-4. References

A complete listing of referenced publications can be found in Attachment 1.

1-5. Acronyms and Terms

Acronyms and special terms used in this document are explained in Attachment 2.

1-6. Questions/Points of Contact

Questions regarding this document or green procurement in general may be directed to the following:

DIRECTORATE OF PUBLIC WORKS
ATTN: IMSE-CAM-PWE (Green Procurement Program Coordinator)
BUILDING 865, 16th Street & Bastogne
FORT CAMPBELL, KY 42223

The FTC Green Procurement Program Action Officer can also be reached at (270) 798-9634.

Chapter 2 Green Procurement Requirements

2-1. Recycled/Recovered Materials

The Resource Conservation and Recovery Act (RCRA), Section 6002, requires federal construction, renovation, and repair contracts to incorporate recycled/recovered materials to the maximum extent practicable. Under this regulation, the Environmental Protection Agency (EPA) establishes Comprehensive Procurement Guidelines (CPG) that designate product categories included in this requirement and Recovered Materials Advisory Notices (RMAN) that provide the acceptable level of recovered material and postconsumer content for each product category. When using designated CPG items, construction, renovation, and repair projects are required to incorporate the highest recovered material content level practicable and should, at a minimum, meet the total recovered material and postconsumer content levels stated in the RMAN. When using items not designated by the EPA, construction, renovation, and repair projects should incorporate recycled content products to the maximum extent practicable in accordance with Executive Orders 13423 (PL 111-8) and 13514 as well as the Federal Acquisition Regulation (Part 23.4). Such items should have the highest recovered material content level practicable in accordance with the requirements of the design standards or contract.

More information can be found at: <http://www.epa.gov/epawaste/consERVE/tools/cpg/products/index.htm>.

The following list includes the CPG categories most likely to be associated with construction, renovation, and repair:

- Building insulation products
- Carpet (polyester)
- Carpet cushion
- Cement and concrete containing:
 - Coal fly ash
 - Ground granulated blast furnace slag
 - Cenospheres
 - Silica fume
- Consolidated and reprocessed latex paint
- Floor tiles
- Laminated paperboard
- Modular threshold ramps
- Non-pressure pipe
- Patio blocks
- Roofing materials
- Shower and restroom dividers/partitions
- Structural fiberboard
- Park benches and picnic tables
- Plastic fencing
- Playground equipment
- Playground surfaces
- Running tracks
- Bike racks
- Blasting grit
- Signage
- Compost and fertilizer made from recovered organic materials
- Garden and soaker hoses
- Hydraulic mulch
- Lawn and garden edging
- Plastic lumber landscaping timbers and posts

2-1-1. Exceptions

Specific exceptions to the EPA requirements are allowed if NO CPG compliant item:

- Is available within a reasonable period of time;
- Is available at a reasonable price; or
- Can meet the applicable performance standards

If your contract requires exception documentation, ensure it is submitted to the contracting officer for every case in which an exception is claimed. Designers and requirements generators should check the applicable design standards/specifications (including the FTC Design Standards, where appropriate) to determine exception justification and submission procedures.

2-1-2. Associated Federal Acquisition Regulation (FAR) Clauses

52.223-17 "Affirmative Procurement of EPA-designated Items in Service and Construction Contracts"; 52.223-9 "Estimate of Percentage of Recovered Material Content for EPA-Designated Item"; 52.236-7 "Permits and Responsibilities."

2-1-3. Associated Legal Requirements and Policy

RCRA, Section 6002; Executive Order 13423; Executive Order 13514; Federal Acquisition Regulation, Parts 23.4 and 36.601-3; and DoD/DA/policy.

2-2. Biobased Materials

The Farm Security and Rural Investment Act of 2002, Section 9002, requires federal construction, renovation, and repair contracts to incorporate designated biobased products. When using items designated under the BioPreferred Program established by the U.S. Department of Agriculture (USDA), construction, renovation, and repair projects should use products meeting the minimum biobased content percentage established by USDA. When using items not designated by the USDA, construction, renovation, and repair projects should incorporate rapidly renewable and certified sustainable wood products to the maximum extent practicable per Executive Orders 13423 and 13514 and the Federal Acquisition Regulation (Parts 23.4 and 23.7) and in accordance with the requirements of the design standards or contract.

More information can be found at: <http://www.biopreferred.gov/ProposedAndFinalItemDesignations.aspx>

The following list includes the designated biobased categories most likely to be associated with construction, renovation, and repair:

- Acoustical Composite Panels
- Interior Composite Panels
- Plastic Lumber Composite Panels
- Structural Interior Composite Panels
- Structural Wall Composite Panels
- Concrete and Asphalt Release Fluids
- Dust Suppressants
- Wood and Concrete Sealers
- Carpet
- Spray-In-Place Plastic Insulating Foam
- Roof Coatings
- Adhesive and Mastic Removers
- Fertilizer
- Transformer Dielectric Fluid
- Water Tank Coating
- Graffiti and Grease Removers
- Cable and Chain Lubricants
- Corrosion Preventatives

2-2-1. Exceptions

Specific exceptions to USDA requirements are allowed if NO compliant biobased item:

- Is available within a reasonable period of time;
- Is available at a reasonable price; or

- Can meet the applicable performance standards

If your contract requires exception documentation, ensure it is submitted to the contracting officer for every case in which an exception is claimed. Designers and requirements generators should check the applicable design standards/specifications (including the FTC Design Standards, where appropriate) to determine exception justification and submission procedures.

2-2-2. Overlap with CPG Requirements

Per federal guidance, whenever an item falls under both the EPA recovered materials requirements and USDA bio-based requirements, the product should, at a minimum, meet the EPA recovered materials requirement.

2-2-3. Associated Federal Acquisition Regulation (FAR) Clauses

52.223-1 "Bio-based Product Certification"; 52.223-2 "Affirmative Procurement of Bio-based Products Under Service and Construction Contracts"; 52.236-7 "Permits and Responsibilities."

2-2-4. Associated Legal Requirements and Policy

Farm Security and Rural Investment Act of 2002, Section 9002; Energy Policy Act of 2005, Section 943; Executive Order 13423; Executive Order 13514; Federal Acquisition Regulations, Parts 23.4 and 36.601-3; and DoD/DA/policy.

2-3. Energy Efficient Materials

The Energy Policy Act of 2005, Section 104, requires federal construction, renovation, and repair contracts to incorporate designated energy efficient materials to the maximum extent practicable.

When using energy-consuming items that fall under an Energy Star or Federal Energy Management Program (FEMP) product category, construction, renovation, and repair projects are required to use Energy Star or FEMP qualified products. In addition, AR 420-1 contains metering requirements for Army construction and renovation.

More information and a listing of qualified products or standards can be found at:

<http://www.energystar.gov/>

http://www1.eere.energy.gov/femp/technologies/eep_purchasingspecs.html

The following list includes the Energy Star categories most likely to be associated with construction, renovation, and repair:

- Room Air Conditioning
- Central Air Conditioning
- Boilers
- Ceiling Fans
- Furnaces
- Air-source Heat Pumps
- Geothermal Heat Pumps
- Light Commercial Heating and Cooling
- Programmable Thermostats
- Ventilating Fans
- Water Heaters
- Roof Products
- Compact Fluorescent Light Bulbs (CFLs)
- Fluorescent Light Fixtures
- LED Lighting

The following list includes the FEMP categories most likely to be associated with construction, renovation, and repair:

- Compact Fluorescent Lamps
- Fluorescent Tube Lamps
- Fluorescent Ballasts
- Fluorescent Luminaries
- Downlight Luminaries
- Industrial HID Luminaries
- Lighting Controls

- Commercial Unitary Air Conditioners
- Air-Cooled Chillers
- Water-Cooled Chillers
- Commercial Heat Pumps
- Ground-Source Heat Pumps
- Boilers
- Distribution Transformers (Medium)
- Electric Motors
- Centrifugal Pumping System
- Room Air Conditioners
- Central Air Conditioners
- Air Source Heat Pumps
- Ground-Source Heat Pumps
- Gas Furnaces
- Electric Water Heaters
- Gas Water Heaters
- Faucets
- Showerheads
- Urinals
- Roof Products
- Low Standby Power (for products that can operate in a standby power mode)

2-3-1. Exceptions

Specific exceptions are allowed if NO Energy Star or FEMP qualified item:

- Has a lower or equal life cycle cost compared to a non-compliant option; or
- Can meet the applicable functional requirements

Per Department of Energy guidance, life cycle cost determination shall rely on the life cycle cost analysis method in 10 CFR 436, subpart A or another method determined to be equivalent by the Department of Defense.

If your contract requires exception documentation, ensure it is submitted to the contracting officer for every case in which an exception is claimed. Designers and requirements generators should check the applicable design standards/specifications (including the FTC Design Standards, where appropriate) to determine exception justification and submission procedures.

2-3-2. Roofing

Roofing is not classified as an energy-consuming product by the Department of Energy and is thus not covered under the Energy Policy Act of 2005. However, Executive Orders 13423 and 13514 direct federal new construction, major renovation, and repair and alteration to incorporate Energy Star or FEMP qualified products to the maximum extent practicable without restricting the applicability to energy-consuming products. Thus, federal projects should utilize Energy Star qualified roofing whenever life cycle cost effective and permissible under the requirements and cost structure of the contract.

2-3-3. Solar Hot Water Heaters

The Energy Independence and Security Act of 2007 and Executive Orders 13423 and 13514 require new construction and major renovation of federal buildings to provide at least 30% of a building's hot water requirements through solar heating methodologies unless the results of a life cycle cost analysis demonstrate that no solar hot water system is life cycle cost effective in comparison with other reasonably available hot water heating technologies.

2-3-4. Additional Lighting Guidance

Army Regulation 420-1, paragraph 22-12(d)(1), states that interior lighting fixtures for new construction, remodeling, and modular office furniture shall use either the T-8 lamp with instant start electronic ballast or the T-5 lamp. Day-lighting and occupancy controls shall be used when determined to be cost-effective.

In addition, consideration should be given to LED lighting when it meets other requirements such as performance and cost. LED lighting can offer additional efficiency and life cycle cost benefits.

2-3-5. Ground Source Heat Pumps

Per Executive Orders 13423 and 13514, renewable energy features such as ground source heat pumps should be used when lifecycle cost effective. Thus, FTC projects should give full consideration to such features. Note that Energy Star requirements apply to smaller geothermal heat pumps.

2-3-6. Associated Federal Acquisition Regulation (FAR) Clauses

52.223-15 "Energy Efficiency in Energy-Consuming Products"; 52.236-7 "Permits and Responsibilities."

2-3-7. Associated Legal Requirements and Policy

Executive Order 13423; Executive Order 13514; Executive Order 13221; Energy Policy Act of 2005, Section 104; Energy Independence and Security Act of 2007, Sections 523-525; 74 FR 10830 "Federal Procurement of Energy Efficient Products – Final Rule"; Federal Acquisition Regulation, Parts 23.2 and 36.601-3, Army Regulation 420-1; DoD Electronics Stewardship Implementation Plan; and DoD/DA Policy.

2-4. EPEAT Computers

Executive Order 13423 and the Federal Acquisition Regulation require federal purchasers to buy computing equipment that is Electronic Products Environmental Assessment Tool (EPEAT) registered. When including desktop computers, laptops, workstation computers, integrated desktop computers, or monitors as part of the contract (e.g. as part of a Direct Digital Control System), construction and renovation contracts should specify EPEAT registered products. Per federal guidance, such equipment shall be EPEAT registered at a minimum Bronze level, but preferably at Silver or above. Computers and monitors must also meet the FEMP standard for standby power efficiency.

More information and a listing of qualified products or standards can be found at:

<http://www.epeat.net/>

http://www1.eere.energy.gov/femp/technologies/eep_standby_power.html

2-4-1. Associated Federal Acquisition Regulation (FAR) Clauses

52.223-15 "Energy Efficiency in Energy-Consuming Products" and 52.223-16 "IEEE 1680 Standard for the Environmental Assessment of Personal Computer Products"; 52.236-7 "Permits and Responsibilities."

2-4-2. Associated Legal Requirements and Policy

Executive Order 13423; Executive Order 13514; Executive Order 13221; Energy Policy Act of 2005, Section 104; Federal Acquisition Regulation, Parts 23.2, 23.7, and 36.601-3; DoD Electronics Stewardship Implementation Plan.

2-5. Water Efficient Materials and Services

Executive Orders 13423 and 13514 direct federal agencies to implement water efficiency measures, including a preference for Water Sense products and services. Thus, when using items or services that fall under a designated EPA Water Sense efficiency standard: construction, renovation, and repair projects should incorporate products and services that, at a minimum, meet the Water Sense standard. This includes a preference for irrigation designers and contractors certified by a Water Sense qualified program. If an item is not within a Water Sense category but does fall under a FEMP category, it should meet the associated FEMP efficiency standard. In addition, AR 420-1 contains metering requirements for Army construction and renovation.

More information can be found at:

<http://www.epa.gov/watersense/>

http://www1.eere.energy.gov/femp/technologies/eep_purchasingspecs.html

The following list includes the Water Sense and FEMP categories most likely to be associated with construction, renovation, and renovation:

- Bathroom Sink Faucets
- Urinals, Flush Type
- Showerheads
- Toilets, Flush Tank Type
- Landscape Irrigation Services
- Pre-Rinse Spray Valves

Note: Medical and other sanitary facilities should utilize appropriate conservation fixtures (e.g., laminar flow faucets rather than aerators) in accordance with medical/sanitary requirements.

2-5-1. Exceptions

Specific exceptions may be allowed if NO Water Sense or FEMP-designated item:

- Is reasonably available that meets the performance requirements; or
- Is cost effective over the life of the product taking energy and water cost savings into account

If your contract requires exception documentation, ensure it is submitted to the contracting officer for every case in which an exception is claimed. Designers and requirements generators should check the applicable design standards/specifications (including the FTC Design Standards, where appropriate) to determine exception justification and submission procedures.

2-5-2. Associated Federal Acquisition Regulation (FAR) Clauses

52.236-7 "Permits and Responsibilities."

2-5-3. Associated Legal Requirements and Policy

Executive Order 13423; Federal Acquisition Regulation, Parts 23.2 and 36.601-3; and DoD/DA policy.

2-6. Low Emitting Materials

Executive Orders 13423 and 13514 instruct federal new construction, major renovation, and repair contracts to incorporate low emitting interior products to the maximum extent practicable. Thus, such projects should specify interior materials and products with low emissions, including composite wood products, adhesives, sealants, interior paints and finishes, carpet systems, and furnishings. Guidance for low emission composite wood, adhesives, sealants, interior paints and finishes, carpet systems, and furnishings can be found in LEED NC credits IEQ 4.1 through 4.4 and LEED CI credit IEQ 4.5. Additional guidance is offered by third-party certifiers such as Greenguard and the Carpet and Rug Institute.

More information can be found at:

<http://www.usgbc.org/ShowFile.aspx?DocumentID=5546> (LEED NC)

<http://www.usgbc.org/ShowFile.aspx?DocumentID=5543> (LEED CI)

<http://www.carpet-rug.org/commercial-customers/green-building-and-the-environment/index.cfm>

<http://www.greenguard.org>

2-6-1. Associated Legal Requirements and Policy

Executive Order 13423; Federal Acquisition Regulation, Part 36.601-3; and DoD/DA/ policy.

2-7. Ozone Depleting Chemical (ODC) Alternatives

The Clean Air Act Amendments of 1990 instituted a production and importation phase-out of ozone depleting chemicals (ODC) within the United States. Army, and FTC policy is to eliminate dependency on ODCs. Thus, FTC construction, renovation, and repair projects should eliminate the use of ODCs before and after construction to the maximum extent practicable whenever alternative environmentally preferable products are available. EPA-designated acceptable alternatives can be found at the Significant New Alternatives Policy (SNAP) Program website:

<http://www.epa.gov/ozone/snap/> <<http://www.epa.gov/ozone/snap/>> .

For contracts that install/modify refrigerant containing equipment, the use of ODCs on FTC is restricted to refrigerants that have an ozone depleting potential (ODP) of 0.05 or less. The FTC Air Quality Program maintains an inventory of all refrigerant containing equipment on the installation (excluding Housing).

Any activity/shop/operation on FTC that will be conducting refrigerant repair/recovery work is required to comply with the applicable requirements in the "Air Quality Refrigerant Compliance System" and the applicable air quality procedure. Prior to commencement of refrigerant work, the activity/shop/operation must receive training by the FTC Air Quality Program personnel (Bldg 2182). Shops are required to procure refrigerant from the Pollution Prevention Operation Center (PPOC) located at 3rd Street and Wickham Avenue.

2-7-1. Associated Federal Acquisition Regulation (FAR) Clauses

52.223-11, "Ozone-Depleting Substances" and 52.223-12, "Refrigeration Equipment and Air Conditioners."

2-7-2. Associated Legal Requirements and Policy

Clean Air Act Amendments of 1990; Executive Order 13423; Executive Order 13514; Federal Acquisition Regulation, Parts 23.8 and 36.601-3; and DoD/DA policy.

2-8. Additional Environmentally Preferable Products

Certain specifications may include additional environmental performance requirements such as the use of less hazardous or non-toxic materials. Consult applicable contracts or design standards for specific requirements.

2-9. Guiding Principles for High Performance and Sustainable Buildings

Note that Executive Orders 13423 and 13514 require federal new construction, major renovation, and repair and alteration to comply with the *Guiding Principles for High Performance and Sustainable Buildings* to the maximum practicable extent.

Consult <http://www.wbdg.org/references/fhpsb.php> and applicable guidance.

ATTACHMENT 1

REFERENCED LAWS AND APPLICABLE POLICY

- **74 FR 10830** “Federal Procurement of Energy Efficient Products – Final Rule)
<http://edocket.access.gpo.gov/2009/pdf/E9-5459.pdf>
- **Clean Air Act Amendments** of 1990 (Clean Air Act, Title VI) (<http://www.epa.gov/air/caa/title6.html>)
- **Energy Independence and Security Act** of 2007 (http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=110_cong_bills&docid=f:h6enr.txt.pdf)
- **Energy Policy Act** of 2005 (http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=109_cong_bills&docid=f:h6enr.txt.pdf)
- **Executive Order 13221**, “Energy Efficient Standby Power Devices,” 2 August 2001 (http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=2001_register&docid=fr02au01-128.pdf)
- **Executive Order 13423**, “Strengthening Federal Environmental, Energy, and Transportation Management,” 24 January 2007 (<http://edocket.access.gpo.gov/2007/pdf/07-374.pdf>), (http://www.fedcenter.gov/_kd/Items/actions.cfm?action=Show&item_id=6825&destination=ShowItem), and (<http://www.wbdg.org/references/fhpsb.php>)
- **Executive Order 13514**, “**Federal Leadership in Environmental, Energy, and Economic Performance**,” 8 October 2009 (<http://edocket.access.gpo.gov/2009/pdf/E9-24518.pdf>)
- **Farm Security and Rural Investment Act** of 2002 (http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=107_cong_public_laws&docid=f:publ171.107.pdf)
- **Federal Acquisition Regulation** (<http://www.acquisition.gov/far/>)
- **Resource Conservation and Recovery Act**, Section 6002 (<http://www.ornl.gov/adm/ornlp2/sec6002.htm>)
- **Army Regulation 200-1**, “Environmental Protection and Enhancement” (13 December 2007)
- **Army Regulation 420-1**, “Army Facilities Management” (12 February 2008)
- Memorandum, OUSD (AT&L), 27 August 2004, subject: **Establishment of the DoD Green Procurement Program**
- **DoD Green Procurement Strategy**
- Memorandum, OUSD (AT&L), 17 August 2006, subject: **Department of Defense Biobased Products and Green Procurement Program**
- Memorandum, DA, 22 November 2006, subject: **Establishment of the Army Green Procurement Program**
- **Army Green Procurement Guide**, Version 1, August 2006**DoD Green Procurement Strategy:**
- http://www.fedcenter.gov/_kd/Items/actions.cfm?action=Show&item_id=12371&destination=ShowItem
- **DoD Electronics Stewardship Implementation Plan**
(http://www.fedcenter.gov/_kd/Items/actions.cfm?action=Show&item_id=6825&destination=ShowItem)
- **U.S. Army Energy Strategy for Installations**, 8 July 2005
- **Army Strategy for the Environment: Sustain the Mission, Secure the Future**, 1 October 2004
- Memorandum, ACSIM, 7 January 2003, subject: **Change in Army Policy for the Elimination of Ozone Depleting Chemicals**
- Memorandum, ASA (I&E), 22 November 2002, subject: **Elimination of Ozone-Depleting Chemicals (ODCs) in Army Facilities**
- **CAMREG 200-1**, “Installation Environmental Strategy Plan”

ATTACHMENT 2

ACRONYMS AND TERMS

AR – Army Regulation
CFR – Code of Federal Regulations
CPG – Comprehensive Procurement Guidelines
DA – Department of the Army
DoD – Department of Defense
EPA – Environmental Protection Agency
EPEAT – Electronic Product Environmental Assessment Tool
IEQ – Indoor Environmental Quality
FAR – Federal Acquisition Regulation
FEMP – Federal Energy Management Program
HM – Hazardous Material(s)
LED – Light Emitting Diode
LEED – (U.S. Green Building Council's) Leadership in Energy and Environmental Design (Rating System)
LEED CI – LEED Commercial Interiors (Rating System)
LEED NC – LEED New Construction (Rating System)
ODC – Ozone Depleting Chemical
PL – Public Law
PW – Directorate of Public Works, JBLM
RCRA – Resource Conservation and Recovery Act
RMAN – Recovered Materials Advisory Notice
RUL – Restricted Use List
SNAP – Significant New Alternatives Policy
UFGS – Unified Facilities Guide Specifications
USDA – U.S. Department of Agriculture

APPENDIX PP
LEED Submittal Requirements for Unregistered Projects

USACE LEED-NC 2009 Submittals for Unregistered Projects (01 June 2011)

PROJECT AND BUILDING:						
INSTRUCTIONS						
This spreadsheet is for documentation of LEED credits for unregistered buildings and projects. It indicates what is required and when it is due. It is also intended to be filled in and be submitted to meet submittal requirements. Submitter should fill in the "Points Claimed" column with number of points for each credit pursued, fill in the "Check Box if Applies" to indicate applicable credit options and their submittals, and complete the "Submittal Data" column as needed. Narratives may be placed directly in the "Submittal Data" cell or may be attached and indicated as attached in the cell. Submitters are to edit/modify this spreadsheet as needed to meet documentation requirements. This is intended to be a part of the LEED documentation submittal along with the LEED Project Checklist and needed attachments. Reviewers will have access to the project drawings, specifications and design analysis - it is not necessary to duplicate portions of them for the LEED submittal if reference to them is provided.						
GENERAL - All calculations shall be in accordance with LEED 2009 Reference Guide.						
GENERAL: Obtain blank excel version of this spreadsheet at http://en.sas.usace.army.mil/enWeb , "Engineering Criteria".						
GENERAL: Brackets ([]) indicate text options. Edit to delete inapplicable options, fill in required information and delete all brackets.						
GENERAL - For all credits, narrative/comments may be added to describe special circumstances or considerations regarding the project's credit approach.						
GENERAL: The Designer of Record will include all construction phase required documentation indicated below for all prerequisites and applicable credits in the project specifications submittal requirements .						
GENERAL - Include all required LEED drawings indicated below in contract drawings with applicable discipline drawings (label For Reference Only if they do not convey new contract requirements) OR include as attachments.						
GENERAL: The Designer of Record may delete all inapplicable credits from the spreadsheet at final design to reduce document size.						
GENERAL - Use of the tabs provided is optional. Other contractor-generated formats are acceptable if they provide all required information. Use of LEED Forms is NOT PERMITTED.						
LEED Credit Paragraph	Points Claimed	DUE AT	REQUIRED DOCUMENTATION	Check box if Applies	SUBMITTAL DATA	Government Reviewer's Use
GENERAL		Each Submittal	Current LEED Project Checklist	X	See attached LEED Project Checklist.	ARC
SSPR1 Construction Activity Pollution Prevention (PREREQUISITE)	PR	Final Design	List all drawings and specifications that address the erosion control, particulate/dust control and sedimentation control measures to be implemented:	X	The following drawings and specifications address this credit:	CIV
		Final Design	List all Site Plan drawings that show and label the LEED Project and/or Campus boundary.	X	LEED [Project][and] [Campus] Boundary is delineated and labeled on the following drawings:	CIV
		Final Design	Narrative that indicates which compliance path was used (NPDES or Local standards) and describes the measures to be implemented on the project. If a local standard was followed, provide specific information to demonstrate that the local standard is equal to or more stringent than the NPDES program.	X	Narrative:	CIV
SS1 Site Selection		Final Design	Statement confirming that project does not meet any of the prohibited criteria.		Confirmed by (name, role in project):	CIV
		Final Design	LEED Site plan drawing that shows all proposed development and line depicting boundary of all bodies of water and/or wetlands within 100 feet of project boundary OR statement that there are no water or wetlands within 100 feet of project boundary, including name and role in project of individual making statement.		[All proposed development and a line depicting boundary of all bodies of water and/or wetlands within 100 feet of project boundary is shown on the following drawing:xxx][There is no water or wetlands within 100 feet of project boundary. Confirmed by (name, role in project).]	CIV
		Final Design	For previously undeveloped site only: LEED Site plan drawing that shows all proposed development and line depicting 5' elevation above 100 year flood line that falls within project boundary OR statement that entire site is at least 5' elevation above 100 year flood elevation, including name and role in project of individual making statement.		[All proposed development, line depicting 5' elevation above 100 year flood line that falls within project boundary is shown on the following drawing:xxx][Entire site is at least 5' elevation above 100 year flood elevation. Confirmed by (name, role in project).]	CIV

SS2 Development Density & Community Connectivity		Final Design	Option 1: LEED Site vicinity plan showing project site and surrounding development. Show density boundary or note drawing scale.	Site vicinity plan with density boundary or drawing scale is shown on the following drawing:	CIV
		Final Design	Option 1: Table indicating, for project site and all surrounding sites within density radius (keyed to site vicinity plan), site area and building area. Project development density calculation. Density radius calculation. Development density calculation within density radius.	Table and density calculation are attached.	CIV
		Final Design	Option 2: LEED Site vicinity plan showing project site, the 1/2 mile community radius, pedestrian walkways and the locations of the residential development(s) and Basic Services surrounding the project site.	LEED Site vicinity plan labeling the project site, showing the 1/2 mile community radius, highlighting pedestrian walkways and labeling the locations of the residential development(s) and Basic Services surrounding the project site are shown on the following drawing:	CIV
SS3 Brownfield Redevelopment		Final Design	Narrative describing contamination and the remediation activities included in project. Include statement indicating how site was determined to be a brownfield.	Narrative:	CIV
SS4.1 Alternative Transportation: Public Transportation Access		Final Design	Option 1: LEED Site vicinity plan showing project site, mass transit stops and pedestrian path to them with path distance noted.	LEED Site vicinity plan showing project site, mass transit stops and pedestrian path to them with path distance noted are shown on the following drawing:	CIV
		Final Design	Option 2: LEED Site vicinity plan showing project site, bus stops and pedestrian path to them with path distance noted.	LEED Site vicinity plan showing project site, bus stops and pedestrian path to them with path distance noted are shown on the following drawing:	CIV
		Final Design	Option 2: Narrative indicating what bus routes serve the bus stops shown on the drawing and confirming that they are available for building occupant use.	Narrative:	CIV
SS4.2 Alternative Transportation: Bicycle Storage & Changing Rooms		Final Design	FTE calculation. Bicycle storage spaces calculation. Shower/changing facilities calculation.	See SS4.2 tab.	CIV
		Final Design	List of drawings that show the location(s) of bicycle storage areas. Statement indicating distance from building entrance.	Bicycle storage areas are shown on the following drawings: XX. Maximum distance from bicycle storage to building entrance is:	CIV
		Final Design	List of drawings that show the location(s) of shower/changing facilities and, if located outside the building, statement indicating distance from building entrance.	Shower/changing facilities are shown on the following drawings:	ARC
SS4.3 Alternative Transportation: Low Emitting & Fuel Efficient Vehicles		Final Design	Statement indicating total parking capacity of site.	See SS4.3 tab.	CIV
		Final Design	Option 1: Low-emission & fuel-efficient vehicle calculation.	See SS4.3 tab.	CIV
		Final Design	Option 1: Low-emission & fuel-efficient vehicle parking calculation.	See SS4.3 tab.	CIV
		Final Design	Option 1: List of drawings and specification references that show location and number of preferred parking spaces for low-emission & fuel-efficient vehicles and signage.	See SS4.3 tab.	CIV
		Final Design	Option 2: Low-emission & fuel-efficient vehicle refueling station calculation.	See SS4.3 tab.	CIV
		Final Design	Option 2: List of drawings and specifications indicating location and number of refueling stations, fuel type and fueling capacity for each station for an 8-hour period.	See SS4.3 tab.	CIV

		Closeout	Option 2: Construction product submittals indicating what was provided and confirming compliance with respect to fuel type and fueling capacity for each station for an 8-hour period.			CIV
		Final Design	Option 3: Statement indicating quantity, make, model and manufacturer of low-emission & fuel-efficient vehicles to be provided. Statement confirming vehicles are zero-emission or indicating ACEEE vehicle scores.	Narrative:		CIV
SS4.4 Alternative Transportation: Parking Capacity		Final Design	Option 1: Preferred parking calculation including number of spaces required, total provided, preferred spaces provided and percentage.	See SS4.4 tab.		CIV
		Final Design	Option 1: List of drawings and specification references that show location and number of preferred parking spaces and signage.	See SS4.4 tab.		CIV
		Final Design	Option 2: FTE calculation. Preferred parking calculation including number of spaces provided, preferred spaces provided and percentage.	See SS4.4 tab.		CIV
		Final Design	Option 2: List of drawings and specification references that show location and number of preferred parking spaces and signage.	See SS4.4 tab.		CIV
		Final Design	Option 3 (Case 2 Option 2): Statement confirming no new parking is provided.	No new parking is provided in this project.		CIV
		Final Design	Case 2 Residential Option 1: Calculation indicating number of spaces required and provided. Narrative describing infrastructure and support programs with description of project features to support them.	See SS4.4 tab for parking calculations. Narrative:		CIV
SS5.1 Site Development: Protect or Restore Habitat		Final Design	Option 1: List of drawing and specification references that convey site disturbance limits.	Site has not been previously developed. Site disturbance limits are shown on the following drawings:		CIV
		Final Design	Option 2: LEED site plan drawing that delineates boundaries of each preserved and restored habitat area with area (sf) noted for each. Percentage calculation of restored/preserved habitat to total site area.	Site has been previously developed or graded. Boundaries of each preserved and restored habitat area with area (sf) noted for each and percentage calculation of restored/preserved habitat to total site area are shown on the following drawing: XX		CIV
		Final Design	Option 2: List of drawings and specification references that convey restoration planting requirements.	Restoration planting is shown on the following drawings and specifications:		CIV
SS5.2 Site Development: Maximize Open Space		Final Design	Option 2: LEED site plan drawing delineating boundary of vegetated open space adjacent to building with areas of building footprint and designated open space noted. Percentage calculation of open space to building footprint area.	Site plan drawing delineating boundary of vegetated open space adjacent to building with areas of building footprint and designated open space and percentage calculation of open space to building footprint area noted are shown on the following drawing:		CIV
SS6.1 Stormwater Design: Quantity Control		Final Design	Option 1: Indicate whether existing site imperviousness is more or less than 50%. Indicate pre-development and post-development runoff rate(cfs) and runoff quantity (cf) -OR - Narrative describing site conditions, measures and controls to be implemented to prevent excessive stream velocities and erosion.	Narrative:		CIV
		Final Design	Option 2: Indicate whether existing site imperviousness is more or less than 50%. Indicate pre-development and post-development runoff rate(cfs) and runoff quantity (cf). Indicate percent reduction in each.	Narrative:		CIV

SS6.2 Stormwater Design: Quality Control	Final Design	For non-structural controls, list all BMPs used and, for each, describe the function of the BMP and indicate the percent annual rainfall treated. List all structural controls and, for each, describe the pollutant removal and indicate the percent annual rainfall treated.	Narrative:	CIV
SS7.1 Heat Island Effect: Non-Roof	Final Design	LEED site plan drawing indicating locations and quantities of each paving type, including areas of shaded pavement. Percentage calculation indicating percentage of reflective/shaded/open grid area.	See tab SS7.1 for calculations. Paving types and areas are labelled on the following drawing:	CIV
SS7.2 Heat Island Effect: Roof	Final Design	Option 1: Percentage calculation indicating percentage of SRI compliant roof area. List of drawings and specification references that convey SRI requirements and roof slopes.	See tab SS7.2 for calculation. Roof slopes and materials are shown on the following drawings: SRI requirements are in the following specifications:	ARC
	Closeout	Option 1: Manufacturer published product data or certification confirming SRI for each installed roof material.		PE
	Final Design	Option 2: Percentage calculation indicating percentage of vegetated roof area.	See SS7.2 tab.	ARC
	Final Design	Option 3: Combined reflective and green roof calculation. List of drawings and specification references that convey SRI requirements and roof slopes.	See tab SS7.2 for calculation. Roof slopes and materials are shown on the following drawing: XX. SRI requirements are in the following specifications:	ARC
	Closeout	Option 3: Manufacturer published product data or certification confirming SRI		PE
SS8 Light Pollution Reduction	Final Design	Interior Lighting: List of drawings and specification references that convey interior lighting requirements (location and type of all installed interior lighting, location of non-opaque exterior envelope surfaces, allowing confirmation that maximum candela value from interior fixtures does not intersect non-opaque building envelope surfaces). - OR - List of drawings and specification references that show automatic lighting controls compliance with credit requirement.	See the following drawings and specifications:	ELEC
	Final Design	Exterior Lighting: List of drawings and specification references that convey exterior lighting requirements (location and type of all site lighting and building facade/landscape lighting).	See the following drawings and specifications:	ELEC
	Final Design	Exterior Site Lighting Power Density (LPD): Tabulation for exterior site lighting indicating, for each location identification or description, units of measure, area or distance of the location, actual LPD using units consistent with ASHRAE 90.1, and the ASHRAE allowable LPD for that type of location. Percentage calculation of actual versus allowable LPD for all site lighting.	See attached narrative.	ELEC
	Final Design	Exterior Building Facade/Landscape Lighting Power Density (LPD): Tabulation for exterior building facade/landscape lighting indicating, for each location identification or description, units of measure, area or distance of the location, actual LPD using units consistent with ASHRAE 90.1, and the ASHRAE allowable LPD for that type of location. Percentage calculation of actual versus allowable LPD for all building facade/landscape lighting.	See attached narrative.	ELEC

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		Final Design	Exterior Lighting IESNA Zone: Indicate which IESNA zone is applicable to the project.		See attached narrative.	ELEC
		Final Design	Exterior Lighting Site Lumen table indicating, for each fixture type, quantity installed, initial lamp lumens per luminaire, initial lamp lumens above 90 degrees from Nadir, total lamp lumens and total lamp lumens above 90 degrees. Percentage of site lamp lumens above 90 degrees from nadir to total lamp lumens.		See attached narrative.	ELEC
		Final Design	Exterior Lighting Narrative describing analysis used for addressing requirements for light trespass at site boundary and beyond.		See attached narrative.	ELEC
WEPR1 Water Use Reduction: 20% Reduction	PR	Final Design	Occupancy calculation including male/female numbers for FTEs, visitors, students, customers, residential and other type occupants/users	X	See Water Reduction tab.	MEC
		Final Design	Statement indicating percent of male restrooms with urinals. Statement indicating annual days of operation.	X	See Water Reduction tab.	MEC
		Final Design	Baseline flush fixture calculation spreadsheet indicating, for each fixture type, gender, flush rate, daily uses per person for each occupant type identified in occupancy calculation and annual baseline flush fixture water usage.	X	See Water Reduction tab.	MEC
		Final Design	Design case flush fixture calculation spreadsheet indicating, for each fixture type, gender, flush rate, percent of occupants using this fixture type, daily uses per person for each occupant type identified in occupancy calculation and annual design case flush fixture water usage.	X	See Water Reduction tab.	MEC
		Closeout	Manufacturer published product data or certification confirming fixture water usage.	X	See attached	PE
WE1 Water Efficient Landscaping		Final Design				CIV
		Final Design	Projects with permanent irrigation: Calculation indicating, for baseline and design case, total water applied, total potable water applied, total non-potable water applied. Design case percent potable water reduction. If nonpotable water is used, indicate source of nonpotable water.		See attached narrative and calculations.	CIV
		Final Design	Projects with permanent irrigation: Narrative describing landscaping and irrigation design strategies, including water use calculation methodology used to determine savings and, if non-potable water is used, specific information about source and available quantity.		See attached narrative and calculations.	CIV
		Final Design	Projects with no permanent irrigation: Statement confirming project has no permanent irrigation. If temporary irrigation is provided for establishment, statement project includes its removal in one year or less. Location of drawings and specification references.		[Project has no permanent or temporary irrigation.][Project has temporary irrigation but no permanent irrigation. Requirement to remove temporary irrigation is located in the following drawing/specification: xxx]	CIV
WE2 Innovative Wastewater Technologies		Final Design	Occupancy calculation including male/female numbers for FTEs, visitors, students, customers, residential and other type occupants/users		See Water Reduction tab.	MEC
		Final Design	Statement indicating percent of male restrooms with urinals. Statement indicating annual days of operation.		See Water Reduction tab.	MEC
		Final Design	Baseline flush fixture calculation spreadsheet indicating, for each fixture type, gender, flush rate, daily uses per person for each occupant type identified in occupancy calculation and annual baseline flush fixture water usage.		See Water Reduction tab.	MEC
		Final Design	Design case flush fixture calculation spreadsheet indicating, for each fixture type, gender, fixture manufacturer, fixture model number, flush rate, percent of occupants using this fixture type, daily uses per person for each occupant type identified in occupancy calculation and annual design case flush fixture water usage.		See Water Reduction tab.	MEC

		Final Design	Option 1: If onsite non-potable water is used, identify source(s), indicate annual quantity from each source and indicate total annual quantity from all onsite non-potable water sources.		See Water Reduction tab.	MEC
		Final Design	Option 1: Summary calculation indicating baseline annual water consumption, design case annual water consumption, non-potable annual water consumption and total percentage annual water savings.		See Water Reduction tab.	MEC
		Final Design	Option 2: Statement confirming on-site treatment of all generated wastewater to tertiary standards and all treated wastewater is either infiltrated or used on-site. Narrative describing project strategy for reduction of potable water use for sewage conveyance, including specific information on reclaimed water usage and treated wastewater usage.		See attached narrative and calculations.	MEC
		Final Design	Option 2: List of drawing and specification references that convey design of on-site wastewater treatment features.		See the following drawings and specifications:	CIV
		Final Design	Option 2: On-site water treatment quantity calculation indicating all on-site wastewater source(s), annual quantity treated, annual quantity infiltrated and annual quantity re-used on site from each source and totals for annual quantity treated, annual quantity infiltrated and annual quantity re-used on site from all sources.		See attached narrative and calculations.	CIV
		Final Design	Option 2: Wastewater summary calculation indicating design case annual flush fixture water usage, annual on-site water treatment and percentage sewage conveyance reduction.		See attached narrative and calculations.	MEC
WE3 Water Use Reduction		Same as WEPR1	Same as WEPR1		See Water Reduction tab.	MEC
EAPR1 Fundamental Commissioning of the Building Energy Systems (PREREQUISITE)	PR	Concept Design	Completed Owner's Project Requirements document	X	See attached.	ALL
		Final Design	Completed Basis of Design document for commissioned systems	X	See attached.	MEC, ELEC
		Final Design	List of specification references that convey requirements.	X	See the following drawings and specifications:	MEC, ELEC
		Prior to commencement of commissioning	Commissioning Plan	X		PE
		Closeout	Commissioning Report	X		PE
EAPR2 Minimum Energy Performance (PREREQUISITE)	PR	Final Design	Completed ASHRAE 90.1 Users Manual Compliance documentation form: "Building Envelope Compliance Documentation Parts I and II". Include here or in architectural portion of design analysis.	X	Required form is [provided in the architectural portion of design analysis][attached].	ARC
		Final Design	Completed ASHRAE 90.1 Users Manual Compliance documentation form: "HVAC Simplified Approach Option - Part I" if applicable. If not, "HVAC Mandatory Provisions - Part II" and "HVAC Prescriptive Requirements - Part III". Include here or in mechanical portion of design analysis.	X	Required form is [provided in the mechanical portion of design analysis][attached].	MEC
		Final Design	Completed ASHRAE 90.1 Users Manual Compliance documentation form: "Service Water Heating Compliance Documentation". Include here or in plumbing portion of design analysis.	X	Required form is [provided in the plumbing portion of design analysis][attached].	MEC
		Final Design	Completed ASHRAE 90.1 Users Manual Compliance documentation form: "Lighting Compliance Documentation". Include here or in electrical portion of design analysis.	X	Required form is [provided in the electrical portion of design analysis][attached].	ELEC
		Final Design	Energy Star Target Finder score	X	See attached.	MEC
EAPR3 Fundamental Refrigerant Management (PREREQUISITE)	PR	Final Design	List of specification references that convey requirements.	X	See the following drawings and specifications:	MEC

		Final Design	For retained existing equipment: Narrative describing phase out plan, including specific information on phase out dates and refrigerant quantities. List of specification references that convey requirements.		See attached narrative. See the following drawings and specifications:	MEC
EA1 Optimize Energy Performance		Final Design	Simulation input summary for energy analysis.		See attached simulation input summary for energy analysis. Detailed energy analysis submittal is in the Mechanical section of Design analysis.	MEC
		Final Design	Conversion of federal percent energy use reduction calculation to LEED percent energy cost reduction		See EA1 tab.	MEC
EA2 On-Site Renewable Energy		Final Design	List all on-site renewable energy sources and indicate, for each source, backup energy type, annual energy generated, rated capacity and renewable energy cost. Indicate total annual energy use (all sources), total annual energy cost (all sources) and percent renewable energy cost.		See attached	ELEC
		Final Design	Narrative describing renewable systems and explaining calculation method used to estimate annual energy generated, including factors influencing performance.		Narrative:	ELEC
		Final Design	List of drawing and specification references that convey requirements.		See the following drawings and specifications:	ELEC
EA3 Enhanced Commissioning		Final Design	Copy of CxA Design Review Comments		See attached	
		Prior to commencement of commissioning	Commissioning Plan (BY CxA)			ELEC MEC
		Closeout	Statement by CxA confirming review of Contractor submittals for compliance with OPR and BOD (BY CxA)			PE
		Closeout	Systems Manual (BY CxA)			PE
		Closeout	Statement by CxA confirming completion of O&M staff and occupant training (BY CxA)			PE
		Closeout	Scope of work for post-occupancy review of building operation, including plan for resolution of outstanding issues (BY CxA)			PE
		Closeout	Commissioning Report (BY CxA)			PE
EA4 Enhanced Refrigerant Management		Final Design	Refrigerant impact calculation table with all building data and calculation values as shown in LEED 2009 Reference Guide Example Calculations. Narrative describing any special circumstances or explanatory remarks.		See attached narrative and calculations.	MEC
		Closeout	Cut sheets highlighting refrigerant data for all HVAC components.			PE
EA5 Measurement & Verification		Final Design	M&V plan to include systems to be measured and verified, scope of M&V activities, description of monitoring and controls equipment, performance targets for measured systems and parties responsible for each of the following: data collection, interpretation of data, corrective action process development if needed. For any portions to be done by the Government, attach written confirmation of commitment.		See attached	MEC, ELEC
		Final Design	List of drawing and specification references that convey requirements.		See the following drawings and specifications:	MEC, ELEC
EA6 Green Power		Final Design	Narrative indicating design total annual electric energy usage, amount required for this credit, method of provision by Installation (including method of distribution among buildings by Installation if applicable).		Narrative:	PE
		Final Design	Written confirmation from Installation that a contract to purchase green power will be in place at time of occupancy, will continue at least two years after occupancy, and that distribution of purchased green power includes the required amount for this building.		See attached.	PE
MRPR1 Storage & Collection of Recyclables (PREREQUISITE)	PR	Final Design	Narrative indicating location of recycling area(s) to accommodate recycling of plastic, metal, paper, cardboard and glass. Include discussion of any other materials addressed and coordination with pickup.	X	Narrative:	ARC

MR1.1 Building Reuse: Maintain Existing Walls, Floors & Roof	Final Design	Spreadsheet listing, for each building structural/envelope element, the existing area and reused area. Total percent reused.			ARC
MR1.2 Building Reuse: Maintain Interior Non-Structural Elements	Final Design	Spreadsheet listing, for each building interior non-structural element, the existing area and reused area. Total percent reused.			ARC
MR2 Construction Waste Management	Final Design	List of specification references that convey requirements.		See the following specifications:	CIV
	Preconstruction	Waste Management Plan			PE
	Construction Quarterly and Closeout	Spreadsheet calculations indicating material description, disposal/diversion location (or recycling hauler), weight, total waste generated, total waste diverted, diversion percentage. USACE waste diversion spreadsheet is available at http://en.sas.usace.army.mil/enWeb , "Engineering Criteria" for Contractor's optional use.			PE
	Construction Quarterly and Closeout	Receipts/tickets for all items on spreadsheet			PE
MR3 Materials Reuse	Final Design	Spreadsheet calculations indicating, for each re-used material, material name/description, source, estimated cost. Total estimated re-used materials cost, re-used materials percentage.		See attached.	ARC
	Final Design	List of drawings and specification references that convey requirements.		See the following drawings and specifications:	ARC
	Updated monthly and submitted at Closeout	Spreadsheet above, updated to indicate actual materials incorporated in the work and actual costs.		See attached.	PE
MR4 Recycled Content	Final Design	List of specification references that convey requirements.		See the following specifications:	ARC
	Preconstruction	Purchasing Plan consisting of spreadsheet indicated below, filled in with estimated quantities to show strategy for achieving goal.		See Recycled Content section of MR tab.	PE
	Updated monthly and submitted at Closeout	Spreadsheet calculations indicating, for each recycled content material, material name/description, manufacturer, cost, post-consumer recycled content percent, pre-consumer recycled content percent, source of recycled content data. Total post-consumer content materials cost, total pre-consumer content materials cost, total combined recycled content materials cost, recycled content materials percentage.		See Recycled Content section of MR tab.	PE
	Updated monthly and submitted at Closeout	Manufacturer published product data or certification, confirming recycled content percentages in spreadsheet		See attached.	PE
MR5 Regional Materials	Final Design	List of specification references that convey requirements.		See the following specifications:	ARC
	Preconstruction	Purchasing Plan consisting of spreadsheet indicated below, filled in with estimated quantities to show strategy for achieving goal.		See Regional section of MR tab.	PE
	Updated monthly and submitted at Closeout	Spreadsheet calculations indicating, for each regional material, material name/description, manufacturer, cost, percent compliant, harvest distance, manufacture distance, manufacture and harvest location. Total regional materials cost, regional materials percentage.		See Regional section of MR tab.	PE
	Updated monthly and submitted at Closeout	Manufacturer published product data or certification confirming regional material percentages in spreadsheet		See attached.	PE

MR6 Rapidly Renewable Materials		Final Design	List of specification references that convey requirements.		See the following specifications:	ARC
		Final Design	Purchasing Plan consisting of spreadsheet indicated below, filled in with estimated quantities to show strategy for achieving goal.		See Rapidly Renewable section of MR tab.	ARC
		Updated monthly and submitted at Closeout	Spreadsheet calculations indicating, for each rapidly renewable material, material name/description, manufacturer, cost, rapidly renewable content percent, rapidly renewable product value. Total rapidly renewable product value, rapidly renewable materials percentage.		See Rapidly Renewable section of MR tab.	PE
		Updated monthly and submitted at Closeout	Manufacturer published product data or certification confirming rapidly renewable material percentages in spreadsheet		See attached.	PE
MR7 Certified Wood		Final Design	List of specification references that convey requirements.		See the following specifications:	ARC
		Preconstruction	Purchasing Plan consisting of spreadsheet indicated below, filled in with estimated quantities to show strategy for achieving goal.		See MR7 tab.	PE
		Updated monthly and submitted at Closeout	Spreadsheet calculations indicating, for each certified wood material, material name/description, vendor, cost, wood component percent, certified wood percent of wood component, FSC chain of custody certificate number. Total certified wood product value, certified wood materials percentage.		See MR7 tab.	PE
		Updated monthly and submitted at Closeout	Vendor invoices, FSC chain of custody certificates and manufacturer published product data or certification confirming all certified wood materials percentages in spreadsheet.			PE
EQPR1 Minimum IAQ Performance (PREREQUISITE)	PR	Final Design	Statement confirming that project has been designed to meet ASHRAE 62.1.	X	Confirmed by (name, role in project):	MEC
EQPR2 Environmental Tobacco Smoke (ETS) Control (PREREQUISITE)	PR	Final Design	List of drawing and specification references that convey conformance to applicable requirements (signage, exhaust system, room separation details, etc).	X	See the following drawings and specifications:	ARC
EQ1 Outdoor Air Delivery Monitoring		Final Design	List of drawing and specification references that convey monitoring system.		See the following drawings and specifications:	MEC
		Final Design	Narrative describing the project's ventilation design and CO2 monitoring system, including specifics about monitors, operational parameters and setpoints.		Narrative is [provided in the mechanical portion of design analysis][attached].	MEC
		Closeout	Cut sheets for CO2 monitoring system.			PE
EQ2 Increased Ventilation		Final Design	Narrative describing the project's ventilation design, including specifics about zone fresh air intake volumes and demonstrating compliance.		Narrative is [provided in the mechanical portion of design analysis][attached].	MEC
		Final Design	For natural ventilation: Narrative describing design method used for determining natural ventilation design, including calculation methodology/model results and demonstrating compliance.		Narrative is [provided in the mechanical portion of design analysis][attached].	MEC
		Final Design	List of drawing and specification references that convey conformance to applicable requirements.		See the following drawings and specifications:	MEC
EQ3.1 Construction IAQ Management Plan: During Construction		Final Design	List of drawing and specification references that convey requirements.		See the following drawings and specifications:	MEC
		Preconstruction	Construction IAQ Management Plan		See attached.	PE
		Closeout	Dated jobsite photos showing examples of IAQ management plan practices being implemented. Label photos to indicate which practice they demonstrate. Minimum one photo of each practice at each building.		See attached.	PE
		Closeout	Spreadsheet indicating, for each filter installed during construction, the manufacturer, model number, MERV rating, location installed, and date replaced immediately prior to occupancy.		See attached.	PE

EQ3.2 Construction IAQ Management Plan: Before Occupancy	Final Design	List of drawing and specification references that convey requirements.	See the following drawings and specifications:	MEC
	Preconstruction	Construction IAQ Management Plan	See attached.	PE
	Closeout	For flushout prior to occupancy: Narrative describing the project's flushout process, including specifics about temperature, airflow and duration, special considerations (if any) and demonstrating compliance.		PE
	Closeout	For occupancy prior to flushout: Narrative describing the project's pre-occupancy and post-occupancy flushout processes, including specifics about temperature, airflow and duration, special considerations (if any) and demonstrating compliance.		PE
	Closeout	For IAQ testing option: Narrative describing the project's IAQ testing process, including specifics about contaminants tested for, locations, remaining work at time of test, retest parameters and special considerations (if any).		PE
	Closeout	For IAQ testing option: IAQ testing report demonstrating compliance.		PE
EQ4.1 Low Emitting Materials: Adhesives & Sealants	Final Design	List of drawing and specification references that convey requirements.	See the following drawings and specifications:	ARC
	Updated monthly and submitted at Closeout	Spreadsheet indicating, for each applicable product used, the product name/number and manufacturer, location(s) used, and VOC content.		PE
	Updated monthly and submitted at Closeout	Manufacturer published product data or certification confirming compliance for all applicable products.		PE
EQ4.2 Low Emitting Materials: Paints & Coatings	Final Design	List of drawing and specification references that convey requirements.	See the following drawings and specifications:	ARC
	Updated monthly and submitted at Closeout	Spreadsheet indicating, for each applicable product used, the product name/number and manufacturer, location(s) used, and VOC content.		PE
	Updated monthly and submitted at Closeout	Manufacturer published product data or certification confirming compliance for all applicable products.		PE
EQ4.3 Low Emitting Materials: Flooring Systems	Final Design	List of drawing and specification references that convey requirements.	See the following drawings and specifications:	ARC
	Updated monthly and submitted at Closeout	Manufacturer published product data or certification confirming compliance for all applicable products.		PE
EQ4.4 Low Emitting Materials: Composite Wood & Agrifiber Products	Final Design	List of drawing and specification references that convey requirements.	See the following drawings and specifications:	ARC
	Updated monthly and submitted at Closeout	Manufacturer published product data or certification confirming compliance for all applicable products.		PE

EQ5 Indoor Chemical & Pollutant Source Control		Final Design	Entry Systems: List of drawing and specification references that convey requirements.	See the following drawings and specifications:	ARC
		Final Design	Narrative indicating which spaces are chemical use areas and providing, for each, the room number, room name, description of room separation features (walls, floor/ceilings, openings) and pressure differential from surrounding spaces with doors closed - OR - Statement confirming that project includes no chemical use areas and that no hazardous cleaning materials are needed for building maintenance.	Narrative:	ARC MEC
		Final Design	If project includes chemical use areas: List of drawing and specification references that convey locations of chemical use areas, room separation features and exhaust system.	See the following drawings and specifications:	ARC MEC
		Final Design	If project includes places where water and chemical concentrate mixing occurs: List of drawing and specification references that convey provisions for containment of hazardous liquid wastes OR - Statement confirming that project includes no places where water and chemical concentrate mixing occurs.	Water and chemical concentrate mixing occurs in the following spaces: See the following drawings and specifications for containment of hazardous liquid wastes:	ARC MEC
EQ6.1 Controllability of Systems: Lighting		Final Design	Calculation indicating total number of individual workstations, number of workstations with individual lighting controls and the percentage of workstations with individual lighting controls.	See attached.	ELEC
		Final Design	For each shared multi-occupant space, provide a brief description of lighting controls.	Narrative:	ELEC
		Final Design	Narrative describing lighting control strategy, including type and location of individual controls and type and location of controls in shared multi-occupant spaces.	Narrative:	ELEC
EQ6.2 Controllability of Systems: Thermal Comfort		Final Design	Calculation indicating total number of individual workstations, number of workstations with individual thermal comfort controls and the percentage of workstations with individual thermal comfort controls.	See attached.	MEC
		Final Design	For each shared multi-occupant space, provide a brief description of thermal comfort controls.	Narrative:	MEC
		Final Design	Narrative describing thermal comfort control strategy, including type and location of individual and shared multi-occupant controls.	Narrative:	MEC
EQ7.1 Thermal Comfort: Design		Final Design	Design criteria spreadsheet indicating, for spring, summer, fall and winter, maximum indoor space design temperature, minimum indoor space design temperature and maximum indoor space design humidity.	Spreadsheet is [provided in the mechanical portion of design analysis][attached].	MEC
		Final Design	Narrative describing method used to establish thermal comfort control conditions and how systems design addresses the design criteria, including compliance with the referenced standard.	Narrative is [provided in the mechanical portion of design analysis][attached].	MEC
EQ7.2 Thermal Comfort: Verification		Final Design	Narrative describing the responsible party for each of the following: developing survey, conducting survey, analyzing survey results, developing corrective action plan if needed and providing LEED documentation. For any portions to be done by the Government, attach written confirmation of commitment.	Narrative:	MEC
		Final Design	List of drawing and specification references that convey permanent monitoring system and any activities associated with the survey that are the responsibility of the Contractor.	See the following drawings and specifications:	MEC
EQ8.1 Daylight & Views: Daylight 75% of Spaces		Final Design	Table indicating all regularly occupied spaces with space area and area with compliant daylight zone. Sum of regularly occupied areas and regularly occupied areas with compliant daylight zone. Percentage calculation of areas with compliant daylight zone to total regularly occupied areas.	See attached.	ARC
		Final Design	Option 1: Simulation model method, software and output data	See attached.	ELEC
		Final Design	Option 2: Daylight calculations and drawings.	See attached.	ELEC
		Final Design	For all occupied spaces excluded from the calculation, provide narrative indicating reasons for excluding the space.	Narrative:	ARC
		Final Design	List of drawing and specification references that convey exterior glazed opening head and sill heights, glazing performance properties and glare control/sunlight redirection devices.	See the following drawings and specifications:	ARC
		Closeout	Manufacturer published product data or certification confirming specified glazing performance properties	See attached.	PE

EQ8.2 Daylight & Views: Views for 90% of Spaces		Final Design	Table indicating all regularly occupied spaces with space area and space area with access to views. Sum of regularly occupied areas and regularly occupied areas with access to views. Percentage calculation of areas with views to total regularly occupied areas.		See attached.	ARC
		Final Design	For all occupied spaces excluded from the calculation, provide narrative indicating reasons for excluding the space.		Narrative:	ARC
		Final Design	LEED Floor plan drawings showing line of sight diagramming of views areas in each regularly occupied space. List of drawing/specification references that convey exterior glazed opening head and sill heights.		See the following drawings :	ARC
ID1 Credits		Final Design	Narrative describing intent, requirement for credit, project approach to the credit. List of drawings and specification references that convey implementation of credit. All other documentation that validates claimed credit.		Narrative:	
ID2 LEED Accredited Professional	1	Final Design	Design team LEED AP certificate. Specification reference for construction contractor LEED AP requirement.	X	Design team LEED AP certificate is attached. Contractor LEED AP requirements are in LEED DOCUMENTATION specification.	ARC
		Preconstruction	Construction team LEED AP certificate.	X		
RP1 Credits		Varies	No additional documentation required. Indicate credit name on LEED Project Checklist.			

APPENDIX QQ

Ft. Campbell Kentucky Pollutant Discharge Elimination System Permit



STEVEN L. BESHEAR
GOVERNOR

ENERGY AND ENVIRONMENT CABINET

LEONARD K. PETERS
SECRETARY

DEPARTMENT FOR ENVIRONMENTAL PROTECTION

DIVISION OF WATER

200 FAIR OAKS LANE

FRANKFORT, KENTUCKY 40601

www.kentucky.gov

FACT SHEET

**KENTUCKY POLLUTANT DISCHARGE ELIMINATION SYSTEM
PERMIT TO DISCHARGE TREATED WASTEWATER
INTO WATERS OF THE COMMONWEALTH**

KPDES No.: KY0108456 Permit Writer: Ronnie Thompson Date: November 10, 2010
AI No.: 751

1. **SYNOPSIS OF APPLICATION**

a. Name and Address of Applicant

Fort Campbell Military Reservation
IMSE-CAM-PWE, Building 2182, 13 1/2 Street
Fort Campbell, Kentucky 42223

b. Facility Location

Fort Campbell Military Reservation
39 Normandy Boulevard
Fort Campbell, Christian and Trigg Counties, Kentucky

c. Description of Applicant's Operation

Fort Campbell Military Reservation is a 106,700-acre federal military installation extending from Kentucky into Tennessee. The urbanized area of the base within Kentucky consists of approximately 5,000 acres. This area contains administrative buildings, vehicle storage and maintenance facilities, airfield operations and soldier housing units. The facility typically has multiple ongoing construction projects. This permit covers those Department of Defense contracted construction projects in and around the airfield that contribute to one or more of the six existing outfalls that drain the area (SIC Code 9711).

d. Production Capacity of Facility

N/A

e. Description of Existing Pollution Abatement Facilities

Erosion Prevention and Sediment Control (EPSC) measures for these projects include using seed, mulch, rock, erosion control blankets, silt traps and sediment ponds.

f. Permitting Action

This is a first issuance of a minor KPDES permit for construction projects at a military base.

2. RECEIVING WATERS

a. Name/Location

Runoff from construction projects discharge to unnamed tributaries of Dry Fork Creek from latitude 37-44-36 and longitude 83-34-57 to latitude 37-44-33 and longitude 83-30-27

b. Stream Segment Use Classifications

Pursuant to 401 KAR 10:026, Section 5, the unnamed tributaries of Dry Fork Creek carry the following classifications: Warmwater Aquatic Habitat, Primary/Secondary Contact Recreation and Domestic Water Supply.

c. Stream Segment Categorization

Pursuant to 401 KAR 10:030, Section 1, the unnamed tributaries of Dry Fork Creek are categorized as "High Quality".

d. Stream Low Flow Condition

The 7-day, 10-year low flow and harmonic mean conditions of the unnamed tributaries of Dry Fork Creek are 0 cfs and unknown, respectively.

3. **PROPOSED PERMIT REQUIREMENTS**

a. Storm Water Pollution Prevention Plan (SWPPP)

The permittee shall develop a Storm Water Pollution Prevention Plan (SWPPP) and implement the SWPPP at the commencement of construction disturbance. The SWPPP shall include erosion prevention measures, sediment control measures and other site management practices necessary to prevent the discharge of sediment and other pollutants into waters of the Commonwealth that would result in those waters being degraded or non-supportive of their designed uses. Sediment control measures and other site management practices are required to be properly selected based on site-specific conditions and shall be installed and maintained to effectively minimize such discharges from storm events up to and including a 2-year, 24-hour event.

The permittee shall utilize the Fort Campbell Policy for Storm Water Erosion and Sediment Control at Construction Projects document as a means of establishing sediment control measures, erosion control measures and other site management practices.

b. Minimize Size and Duration of Disturbance

As a means of providing adequate protection to the receiving stream, the permittee shall minimize disturbance and the time that unstabilized areas are exposed.

c. Stabilization Requirements

Final stabilization practices on those portions of the site where construction activities have permanently ceased shall be initiated within fourteen (14) days of the date of cessation of construction activities.

Temporary stabilization practices on those portions of the site where construction activities have been suspended shall be initiated within fourteen (14) days of the date of cessation of construction activities.

Final stabilization practices shall replace temporary stabilization practices on those portions of the site where construction activities have been suspended for more than 180 days. In such cases, final stabilization practices shall be initiated as soon as practical but no later than fourteen (14) days after the 180th day of suspended activity.

d. Buffer Zone

Where possible, the permittee shall maintain at a minimum a 50-foot buffer zone between any disturbance and all edges of the receiving water. In areas where maintaining a buffer zone is not possible, erosion prevention measures such as erosion control mats/blankets, mulch, straw blown in and secured with tackifiers or by treading, etc., shall be implemented within 24 hours (or at the earliest possible time when external factors such as inclement weather prevent implementation) after completion of disturbance/grading or following cessation of activities.

4. ANTI-DEGRADATION

The conditions of 401 KAR 10:029, Section 1 have been satisfied. This permitting action is the issuance of a new KPDES permit authorizing new discharges. This permit will meet the requirements of intergovernmental coordination in the Cabinet's public participation process. The Cabinet finds that the lowering of water quality in these receiving waters accommodates important economic and social development in the area in which these waters are located. This finding is based on the information submitted by the permittee in the form of a socioeconomic demonstration and alternatives analysis (SDAA) pursuant to 401 KAR 10:030, Section 1(3).

For those discharges subject to the provisions of 401 KAR 10:030 Section 1(3)(b)5, the permittee shall install, operate, and maintain wastewater treatment facilities consistent with those identified below:

Erosion Prevention and Sediment Control (EPSC) measures for these projects include using seed, mulch, rock, erosion control blankets, silt traps and sediment ponds.

5. PROPOSED COMPLIANCE SCHEDULE FOR ATTAINING EFFLUENT LIMITATIONS

The permittee will comply with all effluent limitations by the effective date of the permit.

6. PROPOSED SPECIAL CONDITIONS WHICH WILL HAVE A SIGNIFICANT IMPACT ON THE DISCHARGE

Erosion Prevention and Sediment Control (EPSC) measures developed for the area identified by this permit will include post construction measures to protect Dry Fork Creek and its tributaries.

7. PERMIT DURATION

Five (5) years. This facility is in the Four Rivers, Upper & Lower Cumberland Basin Management Unit as per the Kentucky Watershed Management Framework.

8. PERMIT INFORMATION

The application, draft permit fact sheet, public notice, comments received and additional information is available from the Division of Water at 200 Fair Oaks Lane, Frankfort, Kentucky 40601.

9. REFERENCES AND CITED DOCUMENTS

All material and documents referenced or cited in this fact sheet are a part of the permit information as described above and are readily available at the Division of Water Central Office. Information regarding these materials may be obtained from the person listed below.

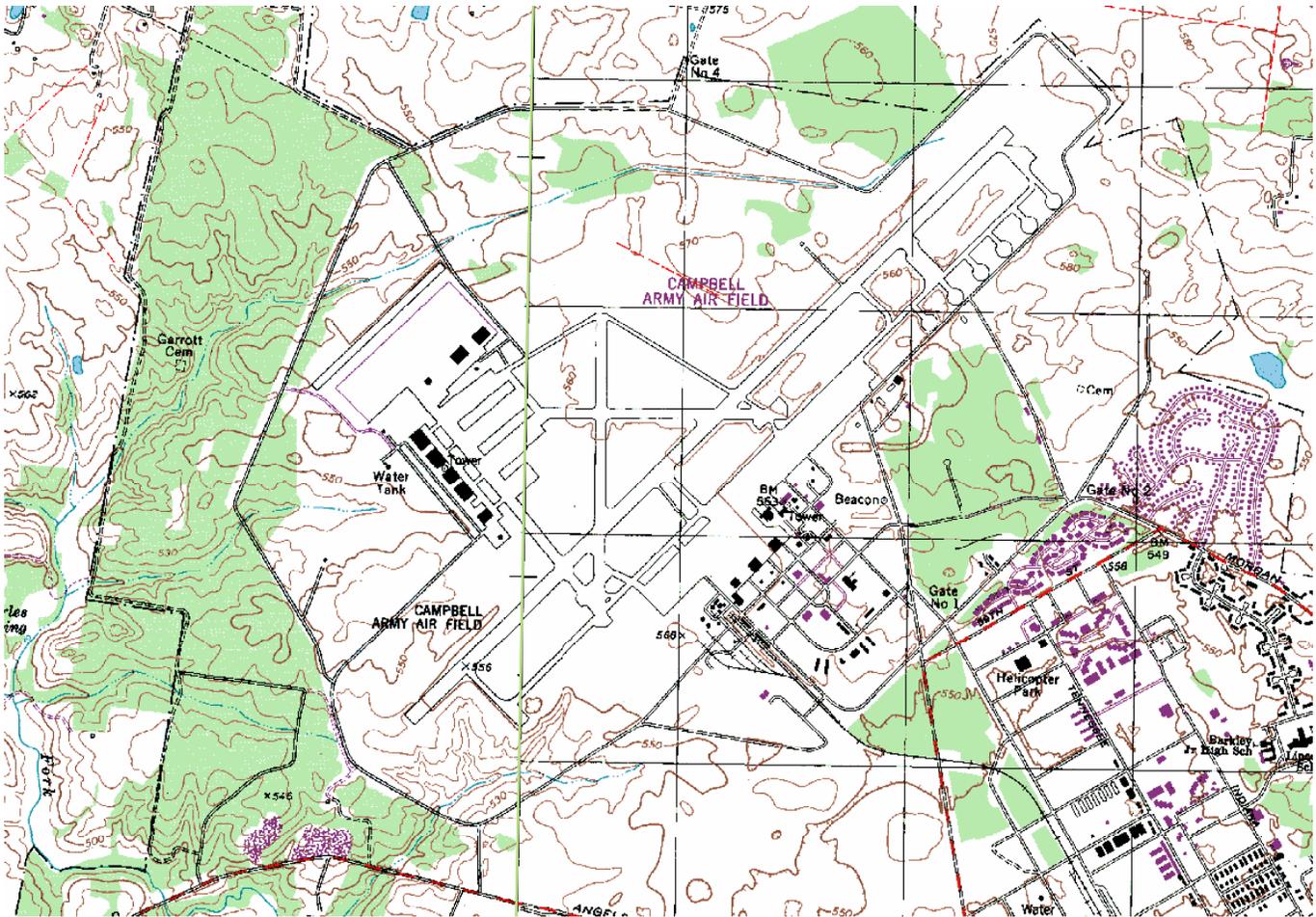
10. CONTACT

For further information on the draft permit or comment process, contact the individual identified on the Public Notice or the Permit Writer - Ronnie Thompson at (502) 564-8158, extension 4925 or e-mail Ronnie.Thompson@ky.gov.

11. PUBLIC NOTICE INFORMATION

Please refer to the attached Public Notice for details regarding the procedures for a final permit decision, deadline for comments, and other information required by 401 KAR 5:075, Section 4(2)(e).

Fort Campbell Military Reservation Airfield



KPDES

**KENTUCKY POLLUTANT
DISCHARGE ELIMINATION
SYSTEM**

PERMIT

PERMIT NO.: KY0108456
AI NO.: 751

**AUTHORIZATION TO DISCHARGE UNDER THE
KENTUCKY POLLUTANT DISCHARGE ELIMINATION SYSTEM**

Pursuant to Authority in KRS 224,

Fort Campbell Military Reservation
IMSE-CAM-PWE, Building 2182, 13 1/2 Street
Fort Campbell, Kentucky 42223

is authorized to discharge from a facility located at

Fort Campbell Military Reservation
39 Normandy Boulevard
Fort Campbell, Christian and Trigg Counties, Kentucky

to receiving waters named

Unnamed tributaries of Dry Fork Creek from latitude 37-44-36 and longitude 83-34-57 to latitude 37-44-33 and longitude 83-30-27

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I, II and III hereof. The permit consists of this cover sheet, Part I 2 pages, Part II 1 page and Part III 1 page.

This permit shall become effective on December 1, 2010.

This permit and the authorization to discharge shall expire at midnight, November 30, 2015.

November 10, 2010
Date Signed

Sandra L. Gruzesky, Director
Division of Water

PART I A - PERMIT REQUIREMENTS**Storm Water Pollution Prevention Plan (SWPPP)**

The permittee shall develop a Storm Water Pollution Prevention Plan (SWPPP) and implement the SWPPP at the commencement of construction disturbance. The SWPPP shall include erosion prevention measures, sediment control measures and other site management practices necessary to prevent the discharge of sediment and other pollutants into waters of the Commonwealth that would result in those waters being degraded or non-supportive of their designed uses. Sediment control measures and other site management practices are required to be properly selected based on site-specific conditions and shall be installed and maintained to effectively minimize such discharges from storm events up to and including a 2-year, 24-hour event.

The permittee shall utilize the Fort Campbell Policy for Storm Water Erosion and Sediment Control at Construction Projects document as a means of establishing sediment control measures, erosion control measures and other site management practices.

Minimize Size and Duration of Disturbance

As a means of providing adequate protection to the receiving stream, the permittee shall minimize disturbance and the time that unstabilized areas are exposed.

Stabilization Requirements

Final stabilization practices on those portions of the site where construction activities have permanently ceased shall be initiated within fourteen (14) days of the date of cessation of construction activities.

Temporary stabilization practices on those portions of the site where construction activities have been suspended shall be initiated within fourteen (14) days of the date of cessation of construction activities.

Final stabilization practices shall replace temporary stabilization practices on those portions of the site where construction activities have been suspended for more than 180 days. In such cases, final stabilization practices shall be initiated as soon as practical but no later than fourteen (14) days after the 180th day of suspended activity.

Buffer Zone

Where possible, the permittee shall maintain at a minimum a 50-foot buffer zone between any disturbance and all edges of the receiving water. In areas where maintaining a buffer zone is not possible, erosion prevention measures such as erosion control mats/blankets, mulch, straw blown in and secured with tackifiers or by treading, etc., shall be implemented within 24 hours (or at the earliest possible time when external factors such as inclement weather prevent implementation) after completion of disturbance/grading or following cessation of activities.

PART I B - SCHEDULE OF COMPLIANCE

The permittee shall achieve compliance with all requirements on the effective date of this permit.

PART II - STANDARD CONDITIONS FOR KPDES PERMIT

This permit has been issued under the provisions of KRS Chapter 224 and regulations promulgated pursuant thereto. Issuance of this permit does not relieve the permittee from the responsibility of obtaining any other permits or licenses required by this Cabinet and other state, federal, and local agencies.

It is the responsibility of the permittee to demonstrate compliance with permit parameter limitations by utilization of sufficiently sensitive analytical methods.

All conditions of 40 CFR 122.41 (401 KAR 5:065, Section 2(1)) are hereby incorporated by reference as conditions of this permit.

For existing manufacturing, commercial, mining and silvicultural discharges the conditions of 40 CFR 122.42 (a) (401 KAR 5:065, Section (2)) are hereby incorporated as conditions of this permit.

For those discharges subject to the provisions of 401 KAR 10:030 Section 1(3)(b)5, the permittee shall install, operate, and maintain wastewater treatment facilities consistent with those identified below:

Erosion Prevention and Sediment Control (EPSC) measures for these projects include using seed, mulch, rock, erosion control blankets, silt traps and sediment ponds.

PART III - OTHER REQUIREMENTS**A. Reopener Clause**

This permit shall be modified, or alternatively revoked and reissued, to comply with any applicable effluent standard or limitation issued or approved in accordance with 401 KAR 5:050 through 5:080, if the effluent standard or limitation so issued or approved:

1. Contains different conditions or is otherwise more stringent than any effluent limitation in the permit; or
2. Controls any pollutant not limited in the permit.

This permit may be reopened to implement the findings of a reasonable potential analysis performed by the Division of Water.

This permit shall be reopened if Division of Water determines surface waters are aesthetically or otherwise degraded by substances that:

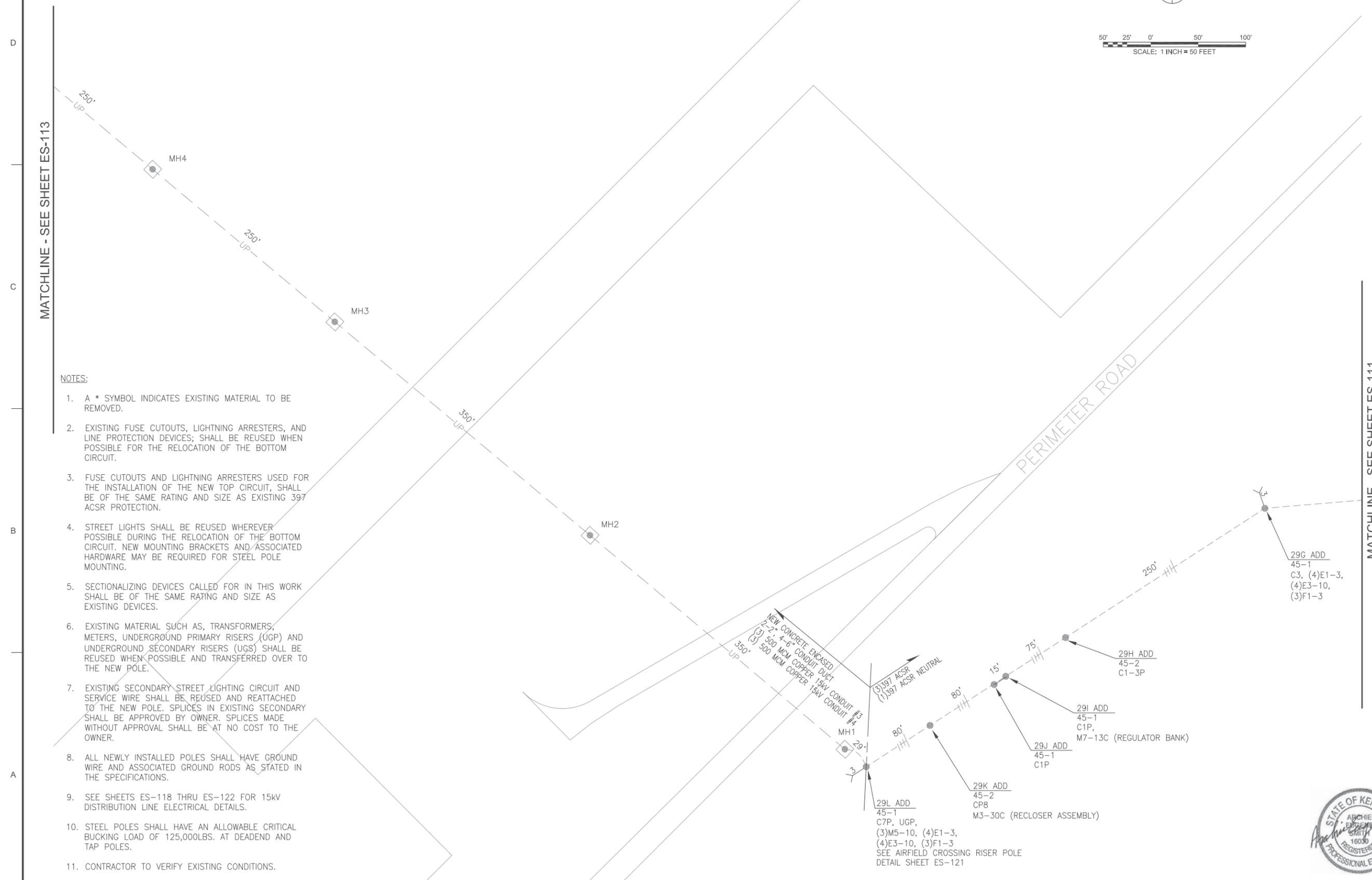
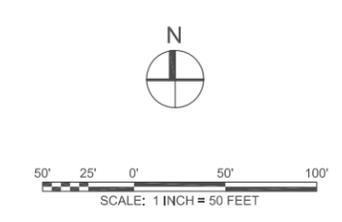
- (a) Settle to form objectionable deposits;
- (b) Float as debris, scum, oil, or other matter to form a nuisance;
- (c) Produce objectionable color, odor, taste, or turbidity;
- (d) Injure, are chronically or acutely toxic to or produce adverse physiological or behavioral responses in humans, animals, fish, and other aquatic life;
- (e) Produce undesirable aquatic life or result in the dominance of nuisance species; or
- (f) Cause fish flesh tainting

The permit as modified or reissued under this paragraph shall also contain any other requirements of KRS Chapter 224 when applicable.

B. Project Notifications

This permittee shall supply the Division of Water with written notification before beginning a construction project in the area identified by this permit. The notification shall include a description of the project, the number of acres disturbed and an expected completion date.

APPENDIX RR
15kv System Design



- NOTES:
1. A * SYMBOL INDICATES EXISTING MATERIAL TO BE REMOVED.
 2. EXISTING FUSE CUTOUTS, LIGHTNING ARRESTERS, AND LINE PROTECTION DEVICES; SHALL BE REUSED WHEN POSSIBLE FOR THE RELOCATION OF THE BOTTOM CIRCUIT.
 3. FUSE CUTOUTS AND LIGHTNING ARRESTERS USED FOR THE INSTALLATION OF THE NEW TOP CIRCUIT, SHALL BE OF THE SAME RATING AND SIZE AS EXISTING 397 ACSR PROTECTION.
 4. STREET LIGHTS SHALL BE REUSED WHEREVER POSSIBLE DURING THE RELOCATION OF THE BOTTOM CIRCUIT. NEW MOUNTING BRACKETS AND ASSOCIATED HARDWARE MAY BE REQUIRED FOR STEEL POLE MOUNTING.
 5. SECTIONALIZING DEVICES CALLED FOR IN THIS WORK SHALL BE OF THE SAME RATING AND SIZE AS EXISTING DEVICES.
 6. EXISTING MATERIAL SUCH AS, TRANSFORMERS, METERS, UNDERGROUND PRIMARY RISERS (UGP) AND UNDERGROUND SECONDARY RISERS (UGS) SHALL BE REUSED WHEN POSSIBLE AND TRANSFERRED OVER TO THE NEW POLE.
 7. EXISTING SECONDARY STREET LIGHTING CIRCUIT AND SERVICE WIRE SHALL BE REUSED AND REATTACHED TO THE NEW POLE. SPLICES IN EXISTING SECONDARY SHALL BE APPROVED BY OWNER. SPLICES MADE WITHOUT APPROVAL SHALL BE AT NO COST TO THE OWNER.
 8. ALL NEWLY INSTALLED POLES SHALL HAVE GROUND WIRE AND ASSOCIATED GROUND RODS AS STATED IN THE SPECIFICATIONS.
 9. SEE SHEETS ES-118 THRU ES-122 FOR 15KV DISTRIBUTION LINE ELECTRICAL DETAILS.
 10. STEEL POLES SHALL HAVE AN ALLOWABLE CRITICAL BUCKLING LOAD OF 125,000LBS. AT DEADEND AND TAP POLES.
 11. CONTRACTOR TO VERIFY EXISTING CONDITIONS.



CERTIFIED FINAL RFP (RTA)

DATE	DESCRIPTION	MARK

DESIGNED BY: JTS	DATE: 02/20/11
DRAWN BY: JTS	PROJECT NO. / CONTRACT NO.:
CHECKED BY: JTS	FILE NUMBER:
APPROVED BY: BWS	AS NOTED DATE: 11/19/2011
PROJECT NAME: Line Design working drawing.dwg	ANSI D:

U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT
LOUISVILLE, KENTUCKY

MIDSOUTH UTILITY CONSULTANTS
Louisville, KY 40203
1111 S. Industrial Blvd., Suite 200
Phone: 502-252-0278

SOF MH47 HANGAR
FT. CAMPBELL, KENTUCKY
PN 76374
P2 336955

15KV DISTRIBUTION LINE
PLAN VIEW: 15KV DISTRIBUTION STRUCTURES 29G - MH4

SHEET IDENTIFICATION
ES-112
SHEET 8 OF 18

MATCHLINE - SEE SHEET ES-116

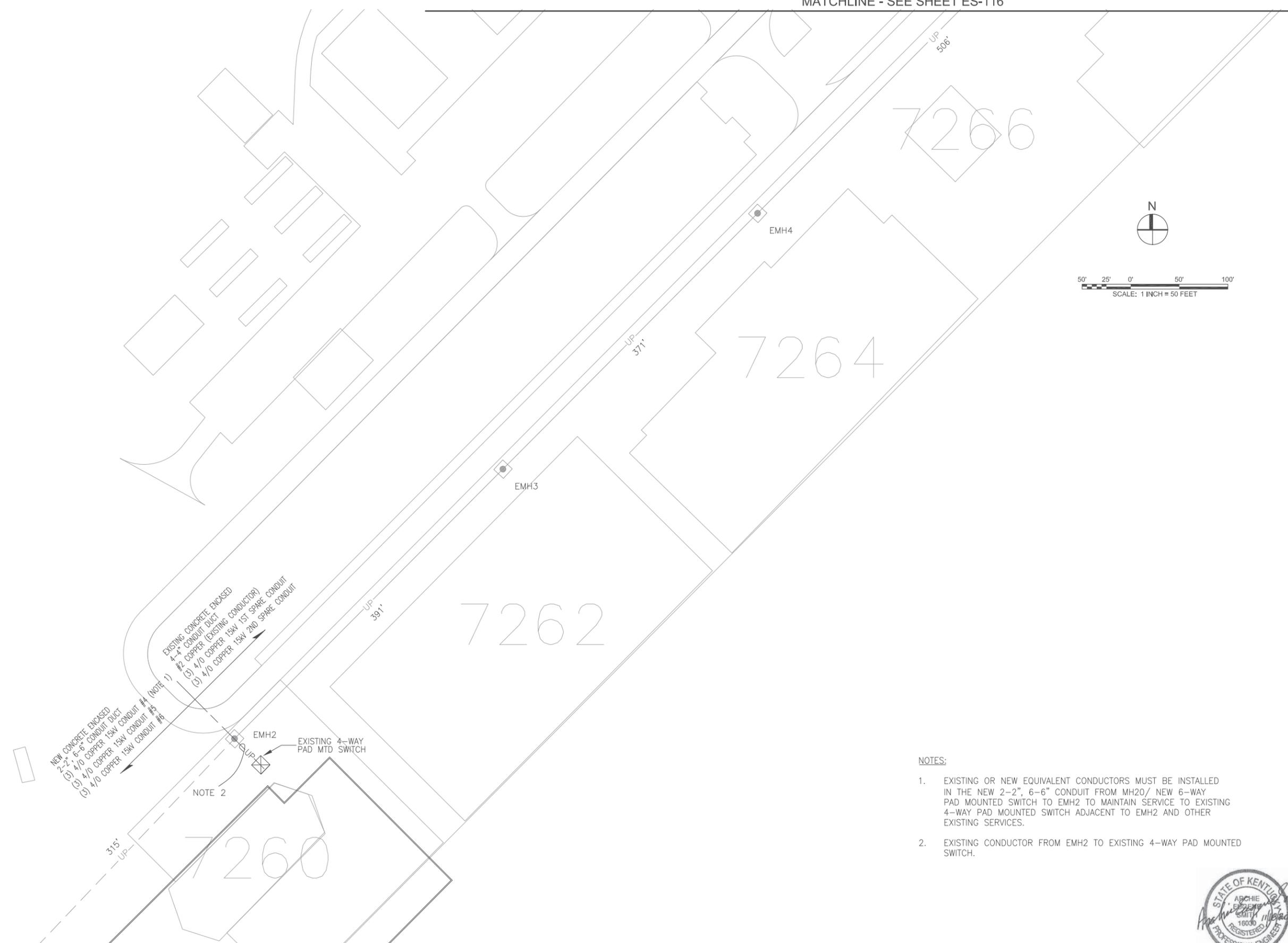
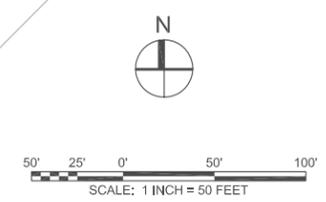


MARK	DESCRIPTION	DATE	APPR.	MARK	DESCRIPTION	DATE	APPR.

DESIGNED BY: JTS	DESIGNED BY: JTS	DATE: 11/18/2011	DATE: 11/18/2011
CHECKED BY: JTS	CHECKED BY: JTS	SUBMITTED BY: BWS	SUBMITTED BY: BWS
PROJECT NO.:	PROJECT NO.:	CONTRACT NO.:	CONTRACT NO.:
FILE NUMBER:	FILE NUMBER:	FILE NAME:	FILE NAME:
ANSI D	ANSI D	ANSI D	ANSI D

SOF MH47 HANGAR
FT. CAMPBELL, KENTUCKY
PN 76374
P2 336955
15KV DISTRIBUTION LINE
15KV DISTRIBUTION STRUCTURES EMH2 - EMH4
PLAN VIEW

SHEET IDENTIFICATION
ES-115
SHEET 11 OF 18



NEW CONCRETE ENCASED
2-2" 6-6" CONDUIT DUCT
(3) 4/0 COPPER 15KV CONDUIT #25
(3) 4/0 COPPER 15KV CONDUIT #8
(3) 4/0 COPPER 15KV CONDUIT #8

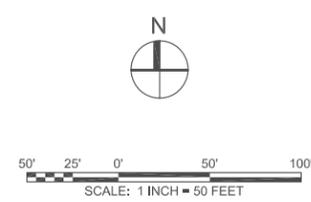
EXISTING CONCRETE ENCASED
4-4" CONDUIT DUCT
#2 COPPER (EXISTING CONDUCTOR)
(3) 4/0 COPPER 15KV 1ST SPARE CONDUIT
(3) 4/0 COPPER 15KV 2ND SPARE CONDUIT

- NOTES:
- EXISTING OR NEW EQUIVALENT CONDUCTORS MUST BE INSTALLED IN THE NEW 2-2", 6-6" CONDUIT FROM MH20/ NEW 6-WAY PAD MOUNTED SWITCH TO MAINTAIN SERVICE TO EXISTING 4-WAY PAD MOUNTED SWITCH ADJACENT TO EMH2 AND OTHER EXISTING SERVICES.
 - EXISTING CONDUCTOR FROM EMH2 TO EXISTING 4-WAY PAD MOUNTED SWITCH.



CERTIFIED FINAL RFP (RTA)

D
C
B
A



MATCHLINE - SEE SHEET ES-115

MATCHLINE - SEE SHEET ES-117

RECONDUCTOR TO 6-4/0 WITH NEW (2) 6" CONDUIT

3-4/0 ACSR

N.O. ABS

NEW 4-WAY PAD MTD SWITCH SEE SINGLE-LINE SHEET ES-121

EMH5

EXISTING CONCRETE ENCASED 4-4" CONDUIT DUCT

(2) 4/0 COPPER 15KV 1ST SPARE CONDUIT

(3) 4/0 COPPER 15KV 2ND SPARE CONDUIT

NEW CONCRETE ENCASED 2-2" 4-6" CONDUIT DUCT

(5) 4/0 COPPER 15KV CONDUIT #4

MARK	DATE	APPR.	DESCRIPTION

DESIGNED BY: JTS	CHECKED BY: JTS	DATE: 11/18/2011	PROJECT NO.:
SUBMITTED BY: BWS	APPROVED BY: BWS	CONTRACT NO.:	FILE NUMBER:
PLOT SCALE:		FILE NAME:	ANSI D
AS NOTED		Line Design working drawing.dwg	

SOF MH47 HANGAR
FT. CAMPBELL, KENTUCKY
PN 76374
P2 336955
15KV DISTRIBUTION LINE
PLAN VIEW: 15KV DISTRIBUTION STRUCTURES EMH5 - MH23



CERTIFIED FINAL RFP (RTA)

SHEET IDENTIFICATION
ES-116
SHEET 12 OF 18

ruling span 200 poles 19-29b 2acsr
ALUMINUM COMPANY OF AMERICA SAG AND TENSION DATA
Fort Campbell 15kv line

CONDUCTOR SPARROW #2 AWG 6/ 1 STRANDING ACSR

AREA= .0608 SQ. IN.
DATA FROM CHART NO. 1-1023
ENGLISH UNITS

SPAN= 200.0 FEET MEDIUM LOADING
CREEP IS A FACTOR * DESIGN CONDITION

TEMP	ICE	WIND	K	WEIGHT	FINAL		INITIAL	
					SAG	TENSION	SAG	TENSION
15.	.25	4.00	.20	.881	2.51	1159.	2.35	1240.*
0.	.00	.00	.00	.091	.46	985.	.40	1142.
15.	.00	.00	.00	.091	.52	876.	.42	1077.
30.	.00	.00	.00	.091	.59	769.	.45	1008.
60.	.00	.00	.00	.091	.81	561.	.53	861.
90.	.00	.00	.00	.091	1.21	376.	.65	702.
120.	.00	.00	.00	.091	1.64	278.	.86	532.
167.	.00	.00	.00	.091	2.02	226.	1.58	290.
194.	.00	.00	.00	.091	2.27	201.	2.20	208.
212.	.00	.00	.00	.091	2.45	186.	2.37	193.

STRINGING SAG AT TEMP DEG F

TEMP F >	RULING SPAN = 200.0								
	0.	15.	30.	60.	90.	120.	167.	194.	212.
SPAN	40.0	.02	.02	.02	.03	.03	.06	.09	.09
50.0	.02	.03	.03	.03	.04	.05	.10	.14	.15
60.0	.04	.04	.04	.05	.06	.08	.14	.20	.21
70.0	.05	.05	.06	.06	.08	.11	.19	.27	.29
80.0	.06	.07	.07	.08	.10	.14	.25	.35	.38
90.0	.08	.09	.09	.11	.13	.17	.32	.45	.48
100.0	.10	.11	.11	.13	.16	.21	.39	.55	.59
110.0	.12	.13	.14	.16	.20	.26	.48	.67	.72
120.0	.14	.15	.16	.19	.23	.31	.57	.79	.85
130.0	.17	.18	.19	.22	.27	.36	.67	.93	1.00
140.0	.20	.21	.22	.26	.32	.42	.77	1.08	1.16
150.0	.22	.24	.25	.30	.37	.48	.89	1.24	1.33
160.0	.26	.27	.29	.34	.42	.55	1.01	1.52	1.52
170.0	.29	.31	.33	.38	.47	.62	1.14	1.59	1.71
180.0	.32	.34	.37	.43	.53	.69	1.28	1.78	1.92
190.0	.36	.38	.41	.48	.59	.77	1.42	1.98	2.14
200.0	.40	.42	.45	.53	.65	.86	1.58	2.20	2.37
210.0	.44	.47	.50	.58	.72	.95	1.74	2.42	2.61
220.0	.48	.51	.55	.64	.79	1.04	1.91	2.66	2.87
230.0	.53	.56	.60	.70	.86	1.13	2.08	2.91	3.13
240.0	.58	.61	.65	.76	.94	1.24	2.27	3.17	3.41
250.0	.62	.66	.71	.83	1.02	1.34	2.46	3.44	3.70
260.0	.68	.72	.77	.90	1.10	1.45	2.66	3.72	4.00

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ruling span 200 poles 19-29d
ALUMINUM COMPANY OF AMERICA SAG AND TENSION DATA
Fort Campbell 15kv line

CONDUCTOR CHICKADEE 397.5 KCMIL 18/ 1 STRANDING ACSR

AREA= .3295 SQ. IN.
DATA FROM CHART NO. 1-844
ENGLISH UNITS

SPAN= 200.0 FEET MEDIUM LOADING
CREEP IS A FACTOR * DESIGN CONDITION

TEMP	ICE	WIND	K	WEIGHT	FINAL		INITIAL	
					SAG	TENSION	SAG	TENSION
15.	.25	4.00	.20	1.048	1.70	3083.	1.50	3500.*
0.	.00	.00	.00	.432	.69	3136.	.60	3605.
15.	.00	.00	.00	.432	.83	2603.	.67	3224.
30.	.00	.00	.00	.432	1.03	2103.	.76	2828.
60.	.00	.00	.00	.432	1.65	1308.	1.07	2017.
90.	.00	.00	.00	.432	2.46	876.	1.65	1311.
120.	.00	.00	.00	.432	3.23	668.	2.44	887.
167.	.00	.00	.00	.432	4.15	521.	3.60	601.
194.	.00	.00	.00	.432	4.36	496.	4.17	518.
212.	.00	.00	.00	.432	4.50	481.	4.44	488.

STRINGING SAG AT TEMP DEG F

TEMP F >	RULING SPAN = 200.0								
	0.	15.	30.	60.	90.	120.	167.	194.	212.
SPAN	60.0	.05	.06	.07	.10	.15	.22	.32	.38
70.0	.07	.08	.09	.13	.20	.30	.44	.51	.54
80.0	.10	.11	.12	.17	.26	.39	.58	.67	.71
90.0	.12	.14	.15	.22	.33	.49	.73	.84	.90
100.0	.15	.17	.19	.27	.41	.61	.90	1.04	1.11
110.0	.18	.20	.23	.32	.50	.74	1.09	1.26	1.34
120.0	.22	.24	.27	.39	.59	.88	1.30	1.50	1.60
130.0	.25	.28	.32	.45	.70	1.03	1.52	1.76	1.87
140.0	.29	.33	.37	.52	.81	1.19	1.76	2.04	2.17
150.0	.34	.38	.43	.60	.93	1.37	2.02	2.35	2.50
160.0	.38	.43	.49	.68	1.05	1.56	2.30	2.67	2.84
170.0	.43	.48	.55	.77	1.19	1.76	2.60	3.01	3.21
180.0	.48	.54	.62	.87	1.33	1.97	2.92	3.38	3.59
190.0	.54	.60	.69	.97	1.49	2.20	3.25	3.77	4.00
200.0	.60	.67	.76	1.07	1.65	2.44	3.60	4.17	4.44
210.0	.66	.74	.84	1.18	1.81	2.69	3.97	4.60	4.89
220.0	.72	.81	.92	1.29	1.99	2.95	4.36	5.05	5.37
230.0	.79	.89	1.01	1.42	2.18	3.22	4.76	5.52	5.87
240.0	.86	.96	1.10	1.54	2.37	3.51	5.18	6.01	6.39
250.0	.94	1.05	1.19	1.67	2.57	3.81	5.63	6.52	6.94
260.0	1.01	1.13	1.29	1.81	2.78	4.12	6.09	7.05	7.50

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ruling span 150 poles 1-10
ALUMINUM COMPANY OF AMERICA SAG AND TENSION DATA
Fort Campbell 15kv line

CONDUCTOR CHICKADEE 397.5 KCMIL 18/ 1 STRANDING ACSR

AREA= .3295 SQ. IN.
DATA FROM CHART NO. 1-844
ENGLISH UNITS

SPAN= 150.0 FEET MEDIUM LOADING
CREEP IS A FACTOR * DESIGN CONDITION

TEMP	ICE	WIND	K	WEIGHT	FINAL		INITIAL	
					SAG	TENSION	SAG	TENSION
15.	.25	4.00	.20	1.048	1.02	2893.	.89	3300.*
0.	.00	.00	.00	.432	.39	3129.	.35	3511.
15.	.00	.00	.00	.432	.47	2577.	.39	3120.
30.	.00	.00	.00	.432	.59	2048.	.45	2711.
60.	.00	.00	.00	.432	1.04	1170.	.65	1858.
90.	.00	.00	.00	.432	1.70	714.	1.10	1104.
120.	.00	.00	.00	.432	2.32	523.	1.76	692.
167.	.00	.00	.00	.432	2.86	425.	2.68	454.
194.	.00	.00	.00	.432	3.04	400.	2.98	408.
212.	.00	.00	.00	.432	3.16	385.	3.10	393.

STRINGING SAG AT TEMP DEG F

TEMP F >	RULING SPAN = 150.0								
	0.	15.	30.	60.	90.	120.	167.	194.	212.
SPAN	90.0	.12	.14	.16	.24	.40	.63	.96	1.07
100.0	.15	.17	.20	.29	.49	.78	1.19	1.33	1.38
110.0	.19	.21	.24	.35	.59	.94	1.44	1.60	1.67
120.0	.22	.25	.29	.42	.70	1.12	1.71	1.91	1.98
130.0	.26	.29	.34	.49	.83	1.32	2.01	2.24	2.33
140.0	.30	.34	.39	.57	.96	1.53	2.33	2.60	2.70
150.0	.35	.39	.45	.65	1.10	1.76	2.68	2.98	3.10
160.0	.39	.44	.51	.74	1.25	2.00	3.05	3.39	3.52
170.0	.44	.50	.58	.84	1.41	2.26	3.44	3.83	3.98

Page 1

ruling span 230 poles 29d-29i
ALUMINUM COMPANY OF AMERICA SAG AND TENSION DATA
Fort Campbell 15kv line

CONDUCTOR CHICKADEE 397.5 KCMIL 18/ 1 STRANDING ACSR

AREA= .3295 SQ. IN.
DATA FROM CHART NO. 1-844
ENGLISH UNITS

SPAN= 235.0 FEET MEDIUM LOADING
CREEP IS A FACTOR * DESIGN CONDITION

TEMP	ICE	WIND	K	WEIGHT	FINAL		INITIAL	
					SAG	TENSION	SAG	TENSION
15.	.25	4.00	.20	1.048	2.27	3189.	2.01	3600.*
0.	.00	.00	.00	.432	.96	3102.	.82	3621.
15.	.00	.00	.00	.432	1.15	2586.	.92	3246.
30.	.00	.00	.00	.432	1.41	2111.	1.04	2859.
60.	.00	.00	.00	.432	2.17	1377.	1.44	2076.
90.	.00	.00	.00	.432	3.08	969.	2.11	1410.
120.	.00	.00	.00	.432	3.94	758.	2.99	996.
167.	.00	.00	.00	.432	5.09	586.	4.30	694.
194.	.00	.00	.00	.432	5.38	556.	4.96	602.
212.	.00	.00	.00	.432	5.53	540.	5.36	557.

STRINGING SAG AT TEMP DEG F

TEMP F >	RULING SPAN = 235.0								
	0.	15.	30.	60.	90.	120.	167.	194.	212.
SPAN	225.0	.75	.84	.96	1.32	1.94	2.74	3.94	4.55
235.0	.82	.92	1.04	1.44	2.11	2.99	4.30	4.96	5.36
245.0	.89	1.00	1.13	1.56	2.30	3.25	4.68	5.39	5.83
250.0	.93	1.04	1.18	1.62	2.39	3.39	4.87	5.61	6.07

Page 1

ruling span 165 poles 10-19a
ALUMINUM COMPANY OF AMERICA SAG AND TENSION DATA
Fort Campbell 15kv line

CONDUCTOR CHICKADEE 397.5 KCMIL 18/ 1 STRANDING ACSR

AREA= .3295 SQ. IN.
DATA FROM CHART NO. 1-844
ENGLISH UNITS

SPAN= 165.0 FEET MEDIUM LOADING
CREEP IS A FACTOR * DESIGN CONDITION

TEMP	ICE	WIND	K	WEIGHT	FINAL		INITIAL	
					SAG	TENSION	SAG	TENSION
15.	.25	4.00	.20	1.048	1.23	2902.	1.08	3300.*
0.	.00	.00	.00	.432	.48	3071.	.42	3473.
15.	.00	.00	.00	.432	.58	2527.	.48	3083.
30.	.00	.00	.00	.432	.73	2010.	.55	2675.
60.	.00	.00	.00	.432	1.23	1178.	.80	1836.
90.	.00	.00	.00	.432	1.96	750.	1.31	1120.
120.	.00	.00	.00	.432	2.62	561.	2.01	730.
167.	.00	.00	.00	.432	3.27	450.	3.00	490.
194.	.00	.00	.00	.432	3.46	426.	3.40	433.
212.	.00	.00	.00	.432	3.58	411.	3.52	418.

STRINGING SAG AT TEMP DEG F

TEMP F >	RULING SPAN = 165.0								
	0.	15.	30.	60.	90.	120.	167.	194.	212.
SPAN	90.0	.13	.14	.16	.24	.39	.60	.89	1.01
100.0	.16	.18	.20	.29	.48	.74	1.10	1.25	1.29
110.0	.19	.21	.24	.36	.58	.90	1.33	1.51	1.56
120.0	.22	.25	.29	.42	.69	1.07	1.59	1.80	1.86
130.0	.26	.30	.34	.50	.81	1.25	1.86	2.11	2.18
140.0	.30	.34	.40	.58	.94	1.45	2.16	2.45	2.53
150.0	.35	.39	.45	.66	1.08	1.66	2.48	2.81	2.91
160.0	.40	.45	.52	.75	1.23	1.89	2.82	3.19	3.31
170.0	.45	.51	.58	.85	1.39	2.14	3.19	3.61	3.74
180.0	.50	.57	.65	.95	1.56	2.40	3.57	4.04	4.19
190.0	.56	.63	.73	1.06	1.74	2.67	3.98	4.51	4.67

Page 1

ruling span 165 poles 10-19a 2acsr
ALUMINUM COMPANY OF AMERICA SAG AND TENSION DATA
Fort Campbell 15kv line

CONDUCTOR SPARROW #2 AWG 6/ 1 STRANDING ACSR

AREA= .0608 SQ. IN.
DATA FROM CHART NO. 1-1023
ENGLISH

PROJECT TABLE OF CONTENTS

DIVISION 33 - UTILITIES

33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM (LOW-VOLTAGE), UNDERGROUND
33 70 03.00 10 ELECTRICAL DISTRIBUTION SYSTEM (MEDIUM-VOLTAGE),
UNDERGROUND

-- End of Project Table of Contents --

SECTION 33 70 02.00 10

ELECTRICAL DISTRIBUTION SYSTEM (LOW-VOLTAGE), UNDERGROUND
11/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)

ATIS ANSI O5.1 (2008) Wood Poles -- Specifications & Dimensions

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M (2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A153/A153M (2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A48/A48M (2003; R 2008) Standard Specification for Gray Iron Castings

ASTM C 478 (2009) Standard Specification for Precast Reinforced Concrete Manhole Sections

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2007; Errata 06-1; TIA 07-1; TIA 07-2; TIA 07-3; Errata 07-2; TIA 08-4; TIA 08-5; TIA 08-6; TIA 08-7; TIA 08-8; TIA 08-9; TIA 08-10; TIA 08-11; TIA 09-12; TIA 09-13; TIA 09-14; Errata 09-3; TIA 09-15; TIA 09-16; TIA 10-17) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA TC 6 & 8 (2003) Standard for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 486A-486B (2003; Reprint Feb 2010) Wire Connectors

UL 651

(2005; Reprint Mar 2010) Standard for
Schedule 40 and 80 Rigid PVC Conduit and
Fittings

1.2 SYSTEM DESCRIPTION

Items provided under this section shall be specifically suitable for the following service conditions. Seismic details shall be as indicated.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G
As-Built Drawings; G

Drawings, as specified.

SD-03 Product Data

Precast concrete structures; G

Sealing Material

Manhole frames and covers; G

Handhole frames and covers; G

Frames and Covers for Airfield Facilities; G

Ductile Iron Frames and Covers for Airfield Facilities; G

Composite/fiberglass handholes; G

Cable supports (racks, arms and insulators); G

The study with protective device equipment submittals. No time extension or similar contract modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed shall be based on recommendations of this study. The Government will not be responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered and/or procured prior to approval of the study.

Catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material and Equipment; G

A complete itemized listing of equipment and materials proposed

for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item.

As a minimum, installation procedures for transformers, substations, switchgear, and splices. Procedures shall include cable pulling plans, diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment.

1.4 QUALITY ASSURANCE

1.4.1 Detail Drawings

Submit detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings.

- a. If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the detail drawings. Approved departures shall be made at no additional cost to the Government.
- b. Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:
 - (1) Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. All optional items shall be clearly identified as included or excluded.
 - (2) Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.
 - (3) Detail drawings shall as a minimum depict the installation of the following items:
 - (a) Medium-voltage cables and accessories including cable installation plan.
 - (b) Transformers.
 - (c) Substations.
 - (d) Switchgear.

(e) Pad-mounted loadbreak switches.

(f) Busways.

(g) Surge arresters.

1.4.2 As-Built Drawings

The as-built drawings shall be a record of the construction as installed. The drawings shall include the information shown on the contract drawings as well as deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be a full sized set of prints marked to reflect deviations, modifications, and changes. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, provide three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. Correct and return the as-built drawings to the Contracting Officer for approval within 10 calendar days from the time the drawings are returned to the Contractor.

1.5 DELIVERY, STORAGE, AND HANDLING

Visually inspect devices and equipment when received and prior to acceptance from conveyance. Protect stored items from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Store oil filled transformers and switches in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with [ATIS ANSI O5.1](#). Handle wood poles in accordance with [ATIS ANSI O5.1](#), except that pointed tools capable of producing indentations more than 1 inch in depth shall not be used. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

1.6 EXTRA MATERIALS

One additional spare fuse or fuse element for each furnished fuse or fuse element shall be delivered to the contracting officer when the electrical system is accepted. Two complete sets of all special tools required for maintenance shall be provided, complete with a suitable tool box. Special tools are those that only the manufacturer provides, for special purposes (to access compartments, or operate, adjust, or maintain special parts).

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Provide [material and equipment](#) which are the standard product of a manufacturer regularly engaged in the manufacture of the product and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 CORROSION PROTECTION

2.2.1 Aluminum Materials

Aluminum shall not be used in contact with earth or concrete. Where aluminum conductors are connected to dissimilar metal, fittings conforming to [UL 486A-486B](#) shall be used.

2.2.2 Ferrous Metal Materials

2.2.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with [ASTM A153/A153M](#) and [ASTM A123/A123M](#).

2.3 CONDUIT AND DUCTS

Duct lines shall be concrete-encased, thin-wall type for duct lines between manholes and for other medium-voltage lines.

2.3.1 Nonmetallic Ducts

2.3.1.1 Concrete Encased Ducts

[UL 651](#) Schedule 40 or [NEMA TC 6 & 8](#) Type EB.

2.1.6 Innerduct

Provide corrugated or solid wall polyethylene (PE) or PVC innerducts with pullwire. Size as indicated.

2.3.2 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as [35 degrees F](#), shall neither slump at a temperature of [300 degrees F](#), nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

2.1.8.2 PVC Conduit Fittings

[UL 514B](#), [UL 651](#)

2.4 Pull Rope

Shall be plastic or flat pull line (bull line) having a minimum tensile strength of 890 N 200 pounds.

2.5 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section [03 30 00.00 10](#) CAST-IN-PLACE CONCRETE. In addition, provide concrete for encasement of underground ducts with [3000 psi](#) minimum 28-day compressive strength. Concrete associated with electrical work for other than encasement of underground ducts shall be [4000 psi](#) minimum 28-day compressive strength unless specified otherwise.

2.14 UNDERGROUND STRUCTURES

Provide precast concrete underground structures or standard type cast-in-place manhole types as indicated, conforming to [ASTM C 857](#) and [ASTM C 478](#). Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. Locate duct entrances and windows near the corners of structures to facilitate cable racking. Covers shall fit the frames without undue play. Form steel and iron to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. Install a pulling-in iron in the wall opposite each duct line entrance. Cable racks, including rack arms and insulators, shall be adequate to accommodate the cable.

2.14.1 Cast-In-Place Concrete Structures

Concrete shall conform to Section [03 30 00.00 10](#) CAST-IN-PLACE CONCRETE. Construct walls on a footing of cast-in-place concrete except that precast concrete base sections may be used for precast concrete manhole risers. Concrete block is not allowed in areas subject to aircraft loading.

2.6 Precast Concrete Structures, Risers and Tops

In lieu of cast-in-place, Contractors, at their option, may provide precast concrete underground structures subject to the requirements specified below. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes.

2.6.1 General

[Precast concrete structures](#) shall have the same accessories and facilities as required for cast-in-place structures. Likewise, precast structures shall have plan area and clear heights not less than those of cast-in-place structures. Concrete materials and methods of construction shall be the same as for cast-in-place concrete construction, as modified herein. Slope in floor may be omitted provided precast sections are poured in reinforced steel forms. Concrete for precast work shall have a 28-day compressive strength of not less than [4000 psi](#). Structures may be precast to the design and details indicated for cast-in-place construction, precast monolithically and placed as a unit, or structures may be assembled sections, designed and produced by the manufacturer in accordance with the requirements specified. Structures shall be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.

2.6.2 Design for Precast Structures

[ACI 318M](#). In the absence of detailed on-site soil information, design for the following soil parameters/site conditions:

- a. Angle of Internal Friction (ϕ) = [30 degrees](#)
- b. Unit Weight of Soil (Dry) = [110 pcf](#), (Saturated) = [130 pcf](#)
- c. Coefficient of Lateral Earth Pressure (K_a) = [0.33](#)

- d. Ground Water Level = 3 feet below ground elevation
- e. Vertical design loads shall include full dead, superimposed dead, and live loads including a 30 percent magnification factor for impact. Live loads shall consider all types and magnitudes of vehicular (automotive, industrial, or aircraft) traffic to be encountered. The minimum design vertical load shall be for H20 highway loading per AASHTO HB-17.
- f. Horizontal design loads shall include full geostatic and hydrostatic pressures for the soil parameters, water table, and depth of installation to be encountered. Also, horizontal loads imposed by adjacent structure foundations, and horizontal load components of vertical design loads, including impact, shall be considered, along with a pulling-in iron design load of 6000 pounds.
- g. Each structural component shall be designed for the load combination and positioning resulting in the maximum shear and moment for that particular component.
- h. Design shall also consider the live loads induced in the handling, installation, and backfilling of the manholes. Provide lifting devices to ensure structural integrity during handling and installation.

2.6.3 Construction

Structure top, bottom, and wall shall be of a uniform thickness of not less than 6 inches. Thin-walled knock-out panels for designed or future duct bank entrances shall not be permitted. Quantity, size, and location of duct bank entrance windows shall be as directed, and cast completely open by the precaster. Size of windows shall exceed the nominal duct bank envelope dimensions by at least 12 inches vertically and horizontally to preclude in-field window modifications made necessary by duct bank misalignment. However, the sides of precast windows shall be a minimum of 6 inches from the inside surface of adjacent walls, floors, or ceilings. Form the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope. Provide welded wire fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes. Provide additional reinforcing steel comprised of at least two No. 4 bars around window openings. Provide drain sumps a minimum of 12 inches in diameter and 4 inches deep for precast structures.

2.6.4 Joints

Provide tongue-and-groove joints on mating edges of precast components. Shiplap joints are not allowed. Design joints to firmly interlock adjoining components and to provide waterproof junctions and adequate shear transfer. Seal joints watertight using preformed plastic strip conforming to AASHTO M 198, Type B. Install sealing material in strict accordance with the sealant manufacturer's printed instructions. Provide waterproofing at conduit/duct entrances into structures, and where access frame meets the top slab, provide continuous grout seal.

2.7 Manhole Frames and Covers

Provide cast iron frames and covers for manholes conforming to CID A-A-60005. Cast the words "ELECTRIC" or "TELECOMMUNICATIONS" in the top face of power

and telecommunications manhole covers, respectively.

2.8 Handhole Frames and Covers

Frames and covers of steel shall be welded by qualified welders in accordance with standard commercial practice. Steel covers shall be rolled-steel floor plate having an approved antislip surface. Hinges shall be of stainless steel with bronze hinge pin, 5 by 5 inches by approximately 3/16 inch thick, without screw holes, and shall be for full surface application by fillet welding. Hinges shall have nonremovable pins and five knuckles. The surfaces of plates under hinges shall be true after the removal of raised antislip surface, by grinding or other approved method.

2.9 Frames and Covers for Airfield Facilities

Fabricate frames and covers for airfield use of standard commercial grade steel welded by qualified welders in accordance with AWS D1.1/D1.1M. Covers shall be of rolled steel floor plate having an approved anti-slip surface. Steel frames and covers shall be hot dipped galvanized after fabrication.

2.10 Ductile Iron Frames and Covers for Airfield Facilities

At the contractor's option, ductile iron covers and frames designed for a minimum proof load of 100,000 pounds, may be provided in lieu of the steel frames and covers indicated. Covers shall be of the same material as the frames (i.e. ductile iron frame with ductile iron cover, galvanized steel frame with galvanized steel cover). Proof loading shall be performed in accordance with CID A-A-60005 and ASTM A48/A48M. Proof loads shall be physically stamped into the cover. Provide the Contracting Officer copies of previous proof load test results performed on the same frames and covers as proposed for this contract. The top of the structure shall be modified to accept the ductile iron structure in lieu of the steel structure indicated. The finished structure shall be level and non-rocking, with the top flush with the surrounding pavement.

2.11 Brick for Manhole Collar

Brick shall be sewer and manhole brick conforming to ASTM C 32, Grade MS.

2.12 Composite/Fiberglass Handholes and Covers

Provide handholes and covers of polymer concrete, reinforced with heavy weave fiberglass.

2.15 CABLE SUPPORTS (RACKS, ARMS, AND INSULATORS)

The metal portion of racks and arms shall be zinc-coated after fabrication.

2.13 Cable Racks

The wall bracket shall be 4 inches by approximately 1-1/2 inch by 3/16 inch channel steel, 48 inches long (minimum) in manholes. Slots for mounting cable rack arms shall be spaced at 8 inch intervals.

2.14 Rack Arms

Cable rack arms shall be steel or malleable iron or glass reinforced nylon and shall be of the removable type. Rack arm length shall be a minimum of

8 inches and a maximum of 12 inches.

2.15 Insulators

Insulators for metal rack arms shall be dry-process glazed porcelain. Insulators are not required for nylon arms.

2.16 CONCRETE AND REINFORCEMENT

Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE. Concrete reinforcing shall be as specified in Section 03 20 00.00 10 CONCRETE REINFORCING.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

3.2 DUCT LINES

3.2.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 4 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3 inch diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes.

3.2.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.2.3 Concrete Encasement

Ducts requiring concrete encasements shall comply with NFPA 70, except that electrical duct bank configurations for ducts 6 inches in diameter shall be determined by calculation and as shown on the drawings. The separation between adjacent electric power and communication ducts shall conform to

IEEE C2. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. Submit proposed bonding method for approval in accordance with the detail drawing portion of paragraph SUBMITTALS. At any point, except railroad and airfield crossings, tops of concrete encasements shall be not less than the cover requirements listed in **NFPA 70**. At railroad and airfield crossings, duct lines shall be encased with concrete and reinforced as indicated to withstand specified surface loadings. Tops of concrete encasements shall be not less than **5 feet** below tops of rails or airfield paving unless otherwise indicated. Where ducts are jacked under existing pavement, rigid steel conduit will be installed because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. For crossings of existing railroads and airfield pavements greater than **50 feet** in length, the predrilling method or the jack-and-sleeve method will be used. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than **4 feet** on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least **6 inches** vertically.

3.2.4 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

3.2.4.1 Bituminized-Fiber Ducts

Bituminized-fiber ducts shall be used to interface with existing bituminized-fiber duct as shown. To ensure a watertight joint, tapered ends or joints of the same material as the ducts shall be swabbed with bituminous or joint-sealing compound before couplings are applied. Plastic or nonmetallic couplings shall be tightly driven onto unswabbed ducts. Due to the brittleness of plastic couplings at low temperatures, such couplings shall not be installed when temperatures are below **0 degrees F**. Couplings shall be warmed in hot water or by another approved method when installed at temperatures below **32 degrees F**.

3.2.4.2 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.

3.2.5 Duct Line Markers

Duct line markers shall be provided at the ends of long duct line stubouts or for other ducts whose locations are indeterminate because of duct curvature or terminations at completely below-grade structures. In addition to markers, a **5 mil** brightly colored plastic tape, not less than **3 inches** in width and suitably inscribed at not more than **10 feet** on centers with a continuous metallic backing and a corrosion-resistant **1 mil** metallic foil core to permit easy location of the duct line, shall be placed approximately **12 inches** below finished grade levels of such lines.

3.3 MANHOLES, HANDHOLES, AND PULLBOXES

3.3.1 General

Manholes shall be constructed approximately where shown. The exact location of each manhole shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. The location of each manhole shall be approved by the Contracting Officer before construction of the manhole is started. Manholes shall be the type noted on the drawings and shall be constructed in accordance with the applicable details as indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. The Contractor may, as an option, utilize monolithically constructed precast-concrete manholes having the required strength and inside dimensions as required by the drawings or specifications. In paved areas, frames and covers for manhole and handhole entrances in vehicular traffic areas shall be flush with the finished surface of the paving. In unpaved areas, the top of manhole covers shall be approximately 1/2 inch above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to existing grade level. All duct lines entering manholes must be installed on compact soil or otherwise supported when entering a manhole to prevent shear stress on the duct at the point of entrance to the manhole. Duct lines entering cast-in-place concrete manholes shall be cast in-place with the manhole. Duct lines entering precast concrete manholes through a precast knockout penetration shall be grouted tight with a portland cement mortar. PVC duct lines entering precast manholes through a PVC endbell shall be solvent welded to the endbell. A cast metal grille-type sump frame and cover shall be installed over the manhole sump. A cable-pulling iron shall be installed in the wall opposite each duct line entrance.

3.3.2 Communications Manholes

The number of hot-dip galvanized cable racks with a plastic coating over the galvanizing indicated shall be installed in each telephone manhole. Each cable rack shall be provided with 2 cable hooks. Cables for the telephone and communication systems will be installed by others.

3.3.3 Handholes

Handholes shall be located approximately as shown. Handholes shall be of the type noted on the drawings and shall be constructed in accordance with the details shown.

3.3.4 Pullboxes

Pullbox tops shall be flush with sidewalks or curbs or placed 1/2 inch above surrounding grades when remote from curbed roadways or sidewalks. Covers shall be marked "Low-Voltage" and provided with 2 lifting eyes and 2 hold-down bolts. Each box shall have a suitable opening for a ground rod. Conduit, cable, ground rod entrances, and unused openings shall be sealed with mortar.

3.3.5 Ground Rods

A ground rod shall be installed at the manholes, handholes and pullboxes. Ground rods shall be driven into the earth before the manhole floor is poured so that approximately 4 inches of the ground rod will extend above

the manhole floor. When precast concrete manholes are used, the top of the ground rod may be below the manhole floor and a No. 1/0 AWG ground conductor brought into the manhole through a watertight sleeve in the manhole wall.

3.4 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

SECTION 33 70 02.00 10

ELECTRICAL DISTRIBUTION SYSTEM (MEDIUM-VOLTAGE), UNDERGROUND

11/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)

ATIS ANSI O5.1 (2008) Wood Poles -- Specifications & Dimensions

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC C8 (2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV

AEIC CS8 (2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M (2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A153/A153M (2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM B3 (2001; R 2007) Standard Specification for Soft or Annealed Copper Wire

ASTM B496 (2004e1; R 2010) Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors

ASTM B8 (2011) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

ASTM C 478 (2009) Standard Specification for Precast Reinforced Concrete Manhole Sections

ASTM C 478M (2009) Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric)

FM GLOBAL (FM)

FM APP GUIDE (updated on-line) Approval Guide
<http://www.approvalguide.com/>

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- IEEE 242 (2001; Errata 2003) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems - Buff Book
- IEEE 386 (2006) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V
- IEEE 399 (1997) Brown Book IEEE Recommended Practice for Power Systems Analysis
- IEEE 404 (2006) Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500,000 V
- IEEE 48 (2009) Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV
- IEEE 81 (1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
- IEEE C2 (2007; Errata 06-1; TIA 07-1; TIA 07-2; TIA 07-3; Errata 07-2; TIA 08-4; TIA 08-5; TIA 08-6; TIA 08-7; TIA 08-8; TIA 08-9; TIA 08-10; TIA 08-11; TIA 09-12; TIA 09-13; TIA 09-14; Errata 09-3; TIA 09-15; TIA 09-16; TIA 10-17) National Electrical Safety Code
- IEEE C37.20.1 (2002; INT 1 2005; AMD A 2005; AMD B 2006; R 2007) Standard for Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
- IEEE C37.20.2 (1999; R 2005) Standard for Metal-Clad Switchgear
- IEEE C37.20.3 (2001; R 2006) Standard for Metal-Enclosed Interrupter Switchgear
- IEEE C37.46 (2010) Standard for High Voltage Expulsion and Current-Limiting Type Power Class Fuses and Fuse Disconnecting Switches
- IEEE C57.12.28 (2005) Standard for Pad-Mounted Equipment - Enclosure Integrity
- IEEE C62.11 (2005; Amd 1 2008) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C80.1	(2005) American National Standard for Electrical Rigid Steel Conduit (ERSC)
ANSI/NEMA FB 1	(2007; AMD 2010) Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
NEMA LA 1	(2009) Standard for Surge Arresters
NEMA TC 6 & 8	(2003) Standard for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; TIA 11-1; Errata 2011) National Electrical Code
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UNDERWRITERS LABORATORIES (UL)

UL 1242	(2006; Reprint Jul 2007) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 467	(2007) Grounding and Bonding Equipment
UL 486A-486B	(2003; Reprint Feb 2010) Wire Connectors
UL 514A	(2004; Reprint Apr 2010) Metallic Outlet Boxes
UL 6	(2007; reprint Nov 2010) Electrical Rigid Metal Conduit-Steel
UL 651	(2005; Reprint Mar 2010) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G
As-Built Drawings; G

Drawings, as specified.

SD-03 Product Data

[Fault Current Analysis; G](#)
[Protective Device; G](#)
[Coordination Study; G](#)

The study with protective device equipment submittals. No time extension or similar contract modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed shall be based on recommendations of this study. The Government will not be responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered and/or procured prior to approval of the study.

[Nameplates; G](#)

Catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

[Material and Equipment; G](#)

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item.

[Installation Requirements; G](#)

As a minimum, installation procedures for transformers, substations, switchgear, and splices. Procedures shall include cable pulling plans, diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment.

[SD-06 Test Reports](#)

[Factory Tests](#)

Certified factory test reports shall be submitted when the manufacturer performs routine factory tests, including tests required by standards listed in paragraph REFERENCES. Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days following successful completion of the tests. The manufacturer's pass-fail criteria for tests specified in paragraph FIELD TESTING shall be included.

[Field Testing](#)

A proposed field test plan, 30 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

[Operating Tests](#)

Six copies of the tests report in 8-1/2 by 11 inch binders having a minimum of three rings, including a separate section for

each test. Sections shall be separated by heavy plastic dividers with tabs.

Cable Installation

Six copies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Sections shall be separated by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

- a. Site layout drawing with cable pulls numerically identified.
- b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.
- c. The cable manufacturer and type of cable.
- d. The dates of cable pulls, time of day, and ambient temperature.
- e. The length of cable pull and calculated cable pulling tensions.
- f. The actual cable pulling tensions encountered during pull.

SD-07 Certificates

Material and Equipment

Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), submit proof that the items provided conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be acceptable as evidence that the item conforms. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies. Compliance with above-named requirements does not relieve the Contractor from compliance with any other requirements of the specifications.

Cable Joints

A certification that contains the names and the qualifications

of people recommended to perform the splicing and termination of medium-voltage cables approved for installation under this contract. The certification shall indicate that any person recommended to perform actual splicing and terminations has been adequately trained in the proper techniques and have had at least three recent years of experience in splicing and terminating the same or similar types of cables approved for installation. In addition, any person recommended by the Contractor may be required to perform a practice splice and termination, in the presence of the Contracting Officer, before being approved as a qualified installer of medium-voltage cables. If that additional requirement is imposed, provide short sections of the approved types of cables along with the approved type of splice and termination kits, and detailed manufacturer's instruction for the proper splicing and termination of the approved cable types.

Installation Engineer

Provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. A resume shall be provided showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

Six copies of operation and maintenance manuals, within 7 calendar days following the completion of tests and including assembly, installation, operation and maintenance instructions, spare parts data which provides supplier name, current cost, catalog order number, and a recommended list of spare parts to be stocked. Manuals shall also include data outlining detailed procedures for system startup and operation, and a troubleshooting guide which lists possible operational problems and corrective action to be taken. A brief description of all equipment, basic operating features, and routine maintenance requirements shall also be included. Documents shall be bound in a binder marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information and contents of the manual. Tabs shall be provided to separate different types of documents, such as catalog ordering information, drawings, instructions, and spare parts data. Index sheets shall be provided for each section of the manual when warranted by the quantity of documents included under separate tabs or dividers. Three additional copies of the instructions manual shall be provided within 30 calendar days following the manuals.

1.3 QUALITY ASSURANCE

1.3.1 Detail Drawings

Submit detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the

contract drawings.

- a. If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the detail drawings. Approved departures shall be made at no additional cost to the Government.
- b. Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:
 - (1) Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. All optional items shall be clearly identified as included or excluded.
 - (2) Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.
 - (3) Detail drawings shall as a minimum depict the installation of the following items:
 - (a) Medium-voltage cables and accessories including cable installation plan.
 - (b) Transformers.
 - (c) Switchgear.
 - (d) Pad-mounted loadbreak switches.
 - (e) Surge arresters.

1.3.2 As-Built Drawings

The as-built drawings shall be a record of the construction as installed. The drawings shall include the information shown on the contract drawings as well as deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be a full sized set of prints marked to reflect deviations, modifications, and changes. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, provide three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. Correct

and return the as-built drawings to the Contracting Officer for approval within 10 calendar days from the time the drawings are returned to the Contractor.

1.4 DELIVERY, STORAGE, AND HANDLING

Visually inspect devices and equipment when received and prior to acceptance from conveyance. Protect stored items from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Store oil filled transformers and switches in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with [ATIS ANSI O5.1](#). Handle wood poles in accordance with [ATIS ANSI O5.1](#), except that pointed tools capable of producing indentations more than 1 inch in depth shall not be used. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

1.5 EXTRA MATERIALS

One additional spare fuse or fuse element for each furnished fuse or fuse element shall be delivered to the contracting officer when the electrical system is accepted. Two complete sets of all special tools required for maintenance shall be provided, complete with a suitable tool box. Special tools are those that only the manufacturer provides, for special purposes (to access compartments, or operate, adjust, or maintain special parts).

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Provide [material and equipment](#) which are the standard product of a manufacturer regularly engaged in the manufacture of the product and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 NAMEPLATES

2.2.1 General

Each major component of this specification shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Nameplates shall be made of noncorrosive metal. Equipment containing liquid dielectrics shall have the type of dielectric on the nameplate. Sectionalizer switch nameplates shall have a schematic with all switch positions shown and labeled. As a minimum, nameplates shall be provided for transformers, circuit breakers, meters, switches, and switchgear.

2.3 CORROSION PROTECTION

2.3.1 Aluminum Materials

Aluminum shall not be used in contact with earth or concrete. Where aluminum conductors are connected to dissimilar metal, fittings conforming to [UL 486A-486B](#) shall be used.

2.3.2 Ferrous Metal Materials

2.3.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with [ASTM A153/A153M](#) and [ASTM A123/A123M](#).

2.4 CABLES

Cables shall be single conductor type unless otherwise indicated.

2.4.1 Medium-Voltage Cables

2.4.1.1 General

Cable construction shall be concentric neutral underground distribution cable conforming to [AIEIC C8](#). Cables shall be manufactured for use in duct or direct burial applications as indicated.

2.4.1.2 Ratings

Cables shall be rated for a circuit voltage of 15 kV.

2.4.1.3 Conductor Material

Underground cables shall be soft drawn copper complying with [ASTM B3](#) and [ASTM B8](#) for regular concentric and compressed stranding or [ASTM B496](#) for compact stranding.

2.4.1.4 Insulation

Cable insulation shall be ethylene-propylene-rubber (EPR) insulation conforming to the requirements of [AIEIC CS8](#). A 133 percent insulation level shall be used on 5 kV, 15 kV and 25 kV rated cables.

2.4.1.5 Shielding

Cables rated for 2 kV and above shall have a semiconducting insulation shield, for each phase.

2.4.1.6 Neutrals

Concentric neutrals conductors shall be tinned copper, having a combined ampacity 1/3 of the phase conductor ampacity rating [for three phase installations](#).

2.4.1.7 Jackets

Cables shall be provided with a [ethylene-propylene-rubber \(EPR\)](#) jacket. Direct buried cables shall be rated for direct burial.

2.5 CABLE JOINTS, TERMINATIONS, AND CONNECTORS

2.5.1 Medium-Voltage Cable Joints

Medium-voltage cable joints shall comply with [IEEE 404](#). Medium-voltage cable terminations shall comply with [IEEE 48](#). Joints shall be the standard products of a manufacturer and shall be either of the factory preformed type or of the kit type containing tapes and other required parts. Joints

shall have ratings not less than the ratings of the cables on which they are installed. Splice kits may be of the heat-shrinkable type for voltages up to 15 kV, of the premolded splice and connector type, the conventional taped type, or the resin pressure-filled overcast taped type for voltages up to 35 kV; except that for voltages of 7.5 kV or less a resin pressure-filled type utilizing a plastic-tape mold is acceptable. Joints used in manholes, handholes, vaults and pull boxes shall be certified by the manufacturer for waterproof, submersible applications.

2.5.2 Medium-Voltage Separable Insulated Connectors

Separable insulated connectors shall comply with [IEEE 386](#) and shall be of suitable construction or standard splice kits shall be used. Separable insulated connectors are acceptable for voltages up to 35 kV. Connectors shall be of the loadbreak type as indicated, of suitable construction for the application and the type of cable connected, and shall include cable shield adaptors. Separable insulated connectors shall not be used as substitutes for conventional permanent splices. External clamping points and test points shall be provided.

2.5.3 Terminations

Terminations shall be in accordance with [IEEE 48](#), Class 1 or Class 2; of the molded elastomer, wet-process porcelain, prestretched elastomer, heat-shrinkable elastomer, or taped type. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations shall be of the outdoor type, except that where installed inside outdoor equipment housings which are sealed against normal infiltration of moisture and outside air, indoor, Class 2 terminations are acceptable. Class 3 terminations are not acceptable. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, and armor.

2.5.3.1 Factory Preformed Type

Molded elastomer, wet-process porcelain, prestretched, and heat-shrinkable terminations shall utilize factory preformed components to the maximum extent practicable rather than tape build-up. Terminations shall have basic impulse levels as required for the system voltage level. Leakage distances shall comply with wet withstand voltage test requirements of [IEEE 48](#) for the next higher Basic Insulation Level (BIL) level.

2.6 CONDUIT AND DUCTS

Ducts shall be single, round-bore type, with wall thickness and fittings suitable for the application. Duct lines shall be concrete-encased, thin-wall type for duct lines between manholes and for other medium-voltage lines.

2.6.1 Metallic Conduit

Intermediate metal conduit shall comply with [UL 1242](#). Rigid galvanized steel conduit shall comply with [UL 6](#) and [ANSI C80.1](#). Metallic conduit fittings and outlets shall comply with [UL 514A](#) and [ANSI/NEMA FB 1](#).

2.6.2 Nonmetallic Ducts

2.6.2.1 Concrete Encased Ducts

UL 651 Schedule 40 or NEMA TC 6 & 8 Type EB.

2.6.2.2 Direct Burial

UL 651 Schedule 80, or NEMA TC 6 & 8 Type DB.

2.6.3 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 35 degrees F, shall neither slump at a temperature of 300 degrees F, nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

2.7 MANHOLES, HANDHOLES, AND PULLBOXES

Manholes, handholes, and pullboxes shall be as indicated. Strength of manholes, handholes, and pullboxes and their frames and covers shall conform to the requirements of IEEE C2. Precast-concrete manholes shall have the required strength established by ASTM C 478, ASTM C 478M. Frames and covers shall be made of gray cast iron and a machine-finished seat shall be provided to ensure a matching joint between frame and cover. Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers.

2.8 POLES AND HARDWARE

Poles and hardware shall be in accordance with Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION.

2.9 TRANSFORMERS, SUBSTATIONS, AND SWITCHGEAR

2.9.1 Pad-Mounted, Metal-Enclosed, Switchgear

The switchgear shall be configured, as indicated. The outgoing compartments shall be provided, as indicated.

2.9.1.1 Ratings at 60 Hz shall be:

Nominal voltage (kV)	14.4
Rated maximum voltage (kV)	17
Rated continuous current (A)	600
Maximum symmetrical interrupting capacity (kA)	25
Maximum asymmetrical interrupting capacity (kA)	65

BIL (kV)	95

2.9.1.2 Operators, Devices, and Controls

Operators and controls shall be provided for the switchgear as follows:

- a. Switches shall be provided with a manual, handle-type operator or a push-button mechanical spring tripping mechanism, utilizing a stored-energy mechanism to simultaneously open or close all phases. The switchgear shall be configured so that the switch actuator is padlockable, but may be accessed without opening the switch compartment doors.

2.9.1.3 Enclosures

Switchgear enclosures shall be of freestanding, self-supporting construction provided with separate incoming and outgoing compartments configured for bottom cable entry. Enclosures shall be of deadfront construction, provided with a hinged door for access to each compartment, and conform to the requirements of [IEEE C57.12.28](#) and [IEEE C37.20.3](#), Category A.

2.10 METERING AND PROTECTIVE DEVICES

2.10.1 Fuses, Medium-Voltage, Including Current-Limiting

2.10.1.1 Construction

Units shall be suitable for outdoor use. Fuses shall have integral blown-fuse indicators. All ratings shall be clearly visible.

2.10.1.2 Ratings

Current-limiting power fuses shall have ratings in accordance with [IEEE C37.46](#) and as follows:

Nominal voltage (kV)	15
Rated maximum voltage (kV)	17
Rated continuous current (A)	200
Maximum symmetrical interrupting capacity (kA)	14
BIL (kV)	95

2.10.1.3 E-Rated, Current-Limiting Power Fuses

E-rated, current-limiting, power fuses shall conform to [IEEE C37.46](#).

2.10.1.4 C-Rated, Current-Limiting Power Fuses

C-rated, current-limiting power fuses shall open in 1000 seconds at currents between 170 and 240 percent of the C rating.

2.11 SURGE ARRESTERS

Surge arresters shall comply with NEMA LA 1, and IEEE C62.11 and shall be provided where indicated. Arresters shall be distribution class, rated as shown. Arresters for use at elevations in excess of 6000 feet above mean sea level shall be specifically rated for that purpose. Arresters shall be equipped with mounting brackets suitable for the indicated installations. Arresters shall be of the metal-oxide varistor type.

2.12 GROUNDING AND BONDING

2.12.1 Driven Ground Rods

Ground rods shall be copper-clad steel conforming to UL 467 not less than 5/8 inch in diameter by 8 feet in length. Sectional type rods may be used.

2.12.2 Grounding Conductors

Grounding conductors shall be bare, except where installed in conduit with associated phase conductors. Insulated conductors shall be of the same material as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Bare conductors shall be ASTM B8 soft-drawn unless otherwise indicated. Aluminum is not acceptable.

2.13 CONCRETE AND REINFORCEMENT

Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE. Concrete reinforcing shall be as specified in Section 03 20 00.00 10 CONCRETE REINFORCING.

2.14 FACTORY TESTS

- a. Outdoor Switchgear: Manufacturer's standard tests in accordance with IEEE C37.20.1, IEEE C37.20.2, and IEEE C37.20.3.

2.15 COORDINATED POWER SYSTEM PROTECTION

Analyses shall be prepared to demonstrate that the equipment selected and system constructed meet the contract requirements for equipment ratings, coordination, and protection. They shall include a load flow analysis, a fault current analysis, and a protective device coordination study. The studies shall be performed by a registered professional engineer with demonstrated experience in power system coordination in the last three years. Provide a list of references complete with points of contact, addresses and telephone numbers. The selection of the engineer is subject to the approval of the Contracting Officer.

2.15.1 Scope of Analyses

The fault current analysis, and protective device coordination study shall begin at: the source bus and extend down to system bused where fault availability is 10,000 amperes (symmetrical) for building/facility 600 volt level distribution buses.

2.15.2 Determination of Facts

The time-current characteristics, features, and nameplate data for each existing protective device shall be determined and documented. Coordinate

with the commercial power company for fault current availability at the site.

2.15.3 Single Line Diagram

A single line diagram shall be prepared to show the electrical system buses, devices, transformation points, and all sources of fault current (including generator and motor contributions). A fault-impedance diagram or a computer analysis diagram may be provided. Each bus, device or transformation point shall have a unique identifier. If a fault-impedance diagram is provided, impedance data shall be shown. Locations of switches, breakers, and circuit interrupting devices shall be shown on the diagram together with available fault data, and the device interrupting rating.

2.15.4 Fault Current Analysis

2.15.4.1 Method

The fault current analysis shall be performed in accordance with methods described in IEEE 242, and IEEE 399.

2.15.4.2 Data

Actual data shall be utilized in fault calculations. Bus characteristics and transformer impedances shall be those proposed. Data shall be documented in the report.

2.15.5 Coordination Study

The study shall demonstrate that the maximum possible degree of selectively has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. The study shall include a description of the coordination of the protective devices in this project. Provide a written narrative that describes: which devices may operate in the event of a fault at each bus; the logic used to arrive at device ratings and settings; situations where system coordination is not achievable due to device limitations (an analysis of any device curves which overlap); coordination between upstream and downstream devices; and any relay settings. Recommendations to improve or enhance system reliability, and detail where such changes would involve additions or modifications to the contract and cost changes (addition or reduction) shall be provided. Composite coordination plots shall be provided on log-log graph paper.

2.15.6 Study Report

- a. The report shall include a narrative describing: the analyses performed; the bases and methods used; and the desired method of coordinated protection of the power system.
- b. The study shall include descriptive and technical data for existing devices and new protective devices proposed. The data shall include manufacturers published data, nameplate data, and definition of the fixed or adjustable features of the existing or new protective devices.
- c. The report shall document existing power system data including time-current characteristic curves and protective device ratings and settings.

- d. The report shall contain fully coordinated composite time-current characteristic curves for each bus in the system, as required to ensure coordinated power system protection between protective devices or equipment. The report shall include recommended ratings and settings of all protective devices in tabulated form.
- e. The report shall provide the calculation performed for the analyses, including computer analysis programs utilized. The name of the software package, developer, and version number shall be provided.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

3.2 INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Circuits installed aerially shall conform to the requirements of Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section 31 00 00 EARTHWORK. Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE.

3.2.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable.

3.3 CABLE AND BUSWAY INSTALLATION

Obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, etc. And then perform pulling calculations and prepare a pulling plan which shall be submitted along with the manufacturers instructions in accordance with SUBMITTALS.

3.3.1 Cable Installation Plan and Procedure

Cable shall be installed strictly in accordance with the cable manufacturer's recommendations. Each circuit shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, handhole, junction box, and each terminal. Each tag shall contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

3.3.1.1 Cable Inspection

The cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable in accordance with the cable manufacturer's recommendations.

3.3.1.2 Duct Cleaning

Duct shall be cleaned with an assembly that consists of a flexible mandrel (manufacturers standard product in lengths recommended for the specific size and type of duct) that is 1/4 inch less than inside diameter of duct, 2 wire brushes, and a rag. The cleaning assembly shall be pulled through conduit a minimum of 2 times or until less than a volume of 8 cubic inches of debris is expelled from the duct.

3.3.1.3 Duct Lubrication

The cable lubricant shall be compatible with the cable jacket for cable that is being installed. Application of lubricant shall be in accordance with lubricant manufacturer's recommendations.

3.3.1.4 Cable Installation

Provide a cable feeding truck and a cable pulling winch as required. Provide a pulling grip or pulling eye in accordance with cable manufacturer's recommendations. The pulling grip or pulling eye apparatus shall be attached to polypropylene or manila rope followed by lubricant front end packs and then by power cables. A dynamometer shall be used to monitor pulling tension. Pulling tension shall not exceed cable manufacturer's recommendations. Do not allow cables to cross over while cables are being fed into duct. For cable installation in cold weather, cables shall be kept at 50 degrees F temperature for at least 24 hours before installation.

3.3.1.5 Cable Installation Plan

Submit a cable installation plan for all cable pulls in accordance with the detail drawings portion of paragraph SUBMITTALS. Cable installation plan shall include:

- a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.
- b. List of cable installation equipment.
- c. Lubricant manufacturer's application instructions.
- d. Procedure for resealing cable ends to prevent moisture from entering cable.
- e. Cable pulling tension calculations of all cable pulls.
- f. Cable percentage conduit fill.
- g. Cable sidewall thrust pressure.
- h. Cable minimum bend radius and minimum diameter of pulling wheels used.
- i. Cable jam ratio.
- j. Maximum allowable pulling tension on each different type and size of conductor.
- k. Maximum allowable pulling tension on pulling device.

3.3.2 Duct Line

Cables shall be installed in duct lines where indicated. Cable joints in medium-voltage cables shall be made in manholes or approved pullboxes only.

Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

3.3.3 Electric Manholes

Cables shall be routed around the interior walls and securely supported from walls on cables racks. Cable routing shall minimize cable crossover, provide access space for maintenance and installation of additional cables, and maintain cable separation in accordance with [IEEE C2](#).

3.4 CABLE JOINTS

Medium-voltage cable joints shall be made by qualified cable splicers only. Qualifications of cable splicers shall be submitted in accordance with paragraph SUBMITTALS. Shields shall be applied as required to continue the shielding system through each entire cable joint. Shields may be integrally molded parts of preformed joints. Shields shall be grounded at each joint or in accordance with manufacturer's recommended practice. Cable joints shall provide insulation and jacket equivalent to that of the associated cable. Armored cable joints shall be enclosed in compound-filled, cast-iron or alloy, splice boxes equipped with stuffing boxes and armor clamps of a suitable type and size for the cable being installed.

3.5 FIREPROOFING

Fire-stops shall be installed in each conduit entering or leaving a manhole.

3.5.1 Sprayable Method

Manholes shall be power ventilated until coatings are dry and dewatered and the coatings are cured. Ventilation requirements shall be in accordance with the manufacturer's instruction, but not less than 10 air changes per hour shall be provided. Cable coatings shall be applied by spray, brush, or glove to a wet film thickness that reduces to the dry film thickness approved for fireproofing by [FM APP GUIDE](#). Application methods and necessary safety precautions shall be in accordance with the manufacturers instructions. After application, cable coatings shall be dry to the touch in 1 to 2 hours and fully cured in 48 hours, except where the manufacturer has stated that because of unusual humidity or temperature, longer periods may be necessary.

3.6 DUCT LINES

3.6.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of [4 inches per 100 feet](#). Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be [18 inches](#) for ducts of less than [3 inch](#) diameter, and [36 inches](#) for ducts [3 inches](#) or greater in diameter. Otherwise, long sweep bends

having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes.

3.6.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.6.3 Concrete Encasement

Ducts requiring concrete encasements shall comply with NFPA 70, except that electrical duct bank configurations for ducts 6 inches in diameter shall be determined by calculation and as shown on the drawings. The separation between adjacent electric power and communication ducts shall conform to IEEE C2. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. Submit proposed bonding method for approval in accordance with the detail drawing portion of paragraph SUBMITTALS. At any point, except railroad and airfield crossings, tops of concrete encasements shall be not less than the cover requirements listed in NFPA 70. At railroad and airfield crossings, duct lines shall be encased with concrete and reinforced as indicated to withstand specified surface loadings. Tops of concrete encasements shall be not less than 5 feet below tops of rails or airfield paving unless otherwise indicated. Where ducts are jacked under existing pavement, rigid steel conduit will be installed because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. For crossings of existing railroads and airfield pavements greater than 50 feet in length, the predrilling method or the jack-and-sleeve method will be used. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 4 feet on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 6 inches vertically.

3.6.4 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

3.6.4.1 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.

3.6.5 Duct Line Markers

Duct line markers shall be provided at the ends of long duct line stubouts or for other ducts whose locations are indeterminate because of duct curvature or terminations at completely below-grade structures. In addition to markers, a 5 mil brightly colored plastic tape, not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers with a continuous metallic backing and a corrosion-resistant 1 mil metallic foil core to permit easy location of the duct line, shall be placed approximately 12 inches below finished grade levels of such lines.

3.7 MANHOLES, HANDHOLES, AND PULLBOXES

3.7.1 General

Manholes shall be constructed approximately where shown. The exact location of each manhole shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. The location of each manhole shall be approved by the Contracting Officer before construction of the manhole is started. Manholes shall be the type noted on the drawings and shall be constructed in accordance with the applicable details as indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. The Contractor may, as an option, utilize monolithically constructed precast-concrete manholes having the required strength and inside dimensions as required by the drawings or specifications. In paved areas, frames and covers for manhole and handhole entrances in vehicular traffic areas shall be flush with the finished surface of the paving. In unpaved areas, the top of manhole covers shall be approximately 1/2 inch above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to existing grade level. All duct lines entering manholes must be installed on compact soil or otherwise supported when entering a manhole to prevent shear stress on the duct at the point of entrance to the manhole. Duct lines entering cast-in-place concrete manholes shall be cast in-place with the manhole. Duct lines entering precast concrete manholes through a precast knockout penetration shall be grouted tight with a portland cement mortar. PVC duct lines entering precast manholes through a PVC endbell shall be solvent welded to the endbell. A cast metal grille-type sump frame and cover shall be installed over the manhole sump. A cable-pulling iron shall be installed in the wall opposite each duct line entrance.

3.7.2 Electric Manholes

Cables shall be securely supported from walls by hot-dip galvanized cable racks with a plastic coating over the galvanizing and equipped with adjustable hooks and insulators. The number of cable racks shall be installed in each manhole and not less than 2 spare hooks shall be installed on each cable rack. Insulators shall be made of high-glazed porcelain. Insulators will not be required on spare hooks.

3.7.3 Ground Rods

A ground rod shall be installed at the manholes, handholes and pullboxes. Ground rods shall be driven into the earth before the manhole floor is poured so that approximately 4 inches of the ground rod will extend above the manhole floor. When precast concrete manholes are used, the top of the

ground rod may be below the manhole floor and a No. 1/0 AWG ground conductor brought into the manhole through a watertight sleeve in the manhole wall.

3.8 PAD-MOUNTED EQUIPMENT INSTALLATION

Pad-mounted equipment, shall be installed on concrete pads in accordance with the manufacturer's published, standard installation drawings and procedures, except that they shall be modified to meet the requirements of this document. Units shall be installed so that they do not damage equipment or scratch painted or coated surfaces. After installation, surfaces shall be inspected and scratches touched up with a paint or coating provided by the manufacturer especially for this purpose.

3.8.1 Concrete Pads

3.8.1.1 Construction

Concrete pads for pad-mounted electrical equipment may be either pre-fabricated or poured-in-place. Pads shall be constructed as indicated, except that exact pad dimensions and mounting details are equipment specific and are the responsibility of the Contractor. Tops of concrete pads shall be level and shall project **4 inches** above finished paving or grade and sloped to drain. Edges of concrete pads shall have **3/4 inch** chamfer. Conduits for primary, secondary, and grounding conductors shall be set in place prior to placement of concrete pads. Where grounding electrode conductors are installed through concrete pads, PVC conduit sleeves shall be installed through the concrete to provide physical protection. To facilitate cable installation and termination, the concrete pad shall be provided with a rectangular hole below the primary and secondary compartments, sized in accordance with the manufacturer's recommended dimensions. Upon completion of equipment installation the rectangular hole shall be filled with masonry grout.

3.8.1.2 Concrete and Reinforcement

Concrete work shall have minimum **3000 psi** compressive strength and conform to the requirements of Section **03 30 00.00 10** CAST-IN-PLACE CONCRETE.

3.8.2 Padlocks

Padlocks shall be provided for pad-mounted equipment. Padlocks shall be keyed as directed by the Contracting Officer.

3.9 CONNECTIONS BETWEEN AERIAL AND UNDERGROUND SYSTEMS

Connections between aerial and underground systems shall be made as shown. Underground cables shall be extended up poles in conduit to cable terminations. Conduits shall be secured to the poles by 2-hole galvanized steel pipe straps spaced not more than **10 feet** apart and with 1 strap not more than **12 inches** from any bend or termination. Cable guards shall be secured to poles in accordance with the manufacturer's published procedures. Conduits shall be equipped with bushings to protect cables and minimize water entry. Capnut potheads shall be used to terminate medium-voltage multiple-conductor cable. Cables shall be supported by devices separate from the conduit or guard, near their point of exit from the conduit or guard. Pole installation shall be in accordance with Section **33 71 01** OVERHEAD TRANSMISSION AND DISTRIBUTION.

3.10 GROUNDING

3.10.1 Grounding Electrodes

Grounding electrodes shall be installed as shown on the drawings and as follows:

- a. Driven rod electrodes - Unless otherwise indicated, ground rods shall be driven into the earth until the tops of the rods are approximately 1 foot below finished grade.
- b. Additional electrodes - When the required ground resistance is not met, additional electrodes shall be provided to achieve the specified ground resistance. The additional electrodes will be up to three, 8 feet rods spaced a minimum of 10 feet apart. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately.

3.10.2 Grounding and Bonding Connections

Connections above grade shall be made by the fusion-welding process or with bolted solderless connectors, in compliance with UL 467, and those below grade shall be made by a fusion-welding process. Where grounding conductors are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be used.

3.10.3 Grounding and Bonding Conductors

Grounding and bonding conductors include conductors used to bond transformer enclosures and equipment frames to the grounding electrode system. Grounding and bonding conductors shall be sized and located to provide maximum physical protection. Bends greater than 45 degrees in ground conductors are not permitted. Routing of ground conductors through concrete shall be avoided. When concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit so as to provide an opening for the ground conductor, and the opening shall be sealed with a suitable compound after installation.

3.10.4 Surge Arrester Grounding

Surge arresters and neutrals shall be bonded directly to the equipment enclosure and then to the grounding electrode system with a bare copper conductor, sized as shown. Lead lengths shall be kept as short as practicable with no kinks or sharp bends.

3.10.5 Manhole, Handhole, or Concrete Pullbox Grounding

Ground rods installed in manholes, handholes, or concrete pullboxes shall be connected to cable racks, cable-pulling irons, the cable shielding, metallic sheath, and armor at each cable joint or splice by means of a No. 4 AWG braided tinned copper wire. Connections to metallic cable sheaths shall be by means of tinned terminals soldered to ground wires and to cable sheaths. Care shall be taken in soldering not to damage metallic cable sheaths or shields. Ground rods shall be protected with a double wrapping of pressure-sensitive plastic tape for a distance of 2 inches above and 6 inches below concrete penetrations. Grounding electrode conductors shall be neatly and firmly attached to manhole or handhole walls and the amount

of exposed bare wire shall be held to a minimum.

3.10.6 Riser Pole Grounding

A single continuous vertical grounding electrode conductor shall be installed on each riser pole and connected directly to the grounding electrodes indicated on the drawings or required by these specifications. All equipment, neutrals, surge arresters, and items required to be grounded shall be connected directly to this vertical conductor. The grounding electrode conductor shall be sized as shown. Grounding electrode conductors shall be stapled to wood poles at intervals not exceeding 2 feet.

3.11 FIELD TESTING

3.11.1 General

Field testing shall be performed in the presence of the Contracting Officer. Notify the Contracting Officer 2 days prior to conducting tests. Furnish all materials, labor, and equipment necessary to conduct field tests. Perform all tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. Maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field test reports shall be signed and dated by the Contractor.

3.11.2 Safety

Provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. Replace any devices or equipment which are damaged due to improper test procedures or handling.

3.11.3 Ground-Resistance Tests

The resistance of each grounding electrode shall be measured using the fall-of-potential method defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

- a. Single rod electrode - 25 ohms.

3.11.4 Medium-Voltage Cable Test

After installation and before the operating test or connection to an existing system, the medium-voltage cable system shall be given a high potential test. Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors as one terminal and connecting grounds or metallic shieldings or sheaths of the cable as the other terminal for each test. Prior to making the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The test shall be conducted with all splices, connectors, and terminations in place. The method, voltage, length of time, and other characteristics of the test for initial installation shall be for the

particular type of cable installed, except that 28 kV and 35 kV insulation test voltages shall be in accordance with either [AEIC C8](#) or [AEIC CS8](#) as applicable, and shall not exceed the recommendations of [IEEE 404](#) for cable joints and [IEEE 48](#) for cable terminations unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or other connections, make necessary repairs or replace cables as directed. Repaired or replaced cables shall be retested.

3.11.5 Pre-Energization Services

Calibration, testing, adjustment, and placing into service of the installation shall be accomplished by a manufacturer's product field service engineer or independent testing company with a minimum of 2 years of current product experience. The following services shall be performed on the equipment listed below. These services shall be performed subsequent to testing but prior to the initial energization. The equipment shall be inspected to ensure that installation is in compliance with the recommendations of the manufacturer and as shown on the detail drawings. Terminations of conductors at major equipment shall be inspected to ensure the adequacy of connections. Bare and insulated conductors between such terminations shall be inspected to detect possible damage during installation. If factory tests were not performed on completed assemblies, tests shall be performed after the installation of completed assemblies. Components shall be inspected for damage caused during installation or shipment to ensure packaging materials have been removed. Components capable of being both manually and electrically operated shall be operated manually prior to the first electrical operation. Components capable of being calibrated, adjusted, and tested shall be calibrated, adjusted, and tested in accordance with the instructions of the equipment manufacturer. Items for which such services shall be provided, but are not limited to, are the following:

- a. Switches

3.11.6 Operating Tests

After the installation is completed, and at such times as the Contracting Officer may direct, conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the requirements herein. An operating test report shall be submitted including the following:

- a. A list of equipment used, with calibration certifications.
- b. A copy of measurements taken.
- c. The dates of testing.
- d. The equipment and values to be verified.
- e. The condition specified for the test.
- f. The test results, signed and dated.
- g. A description of adjustments made.

3.12 MANUFACTURER'S FIELD SERVICE

3.12.1 Onsite Training

Conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, and servicing the equipment, as well as all major elements of the [operation and maintenance manuals](#). Additionally, the course instructions shall demonstrate all routine maintenance operations. A DVD format video tape of the entire training session shall be submitted.

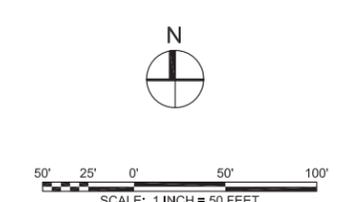
3.12.2 [Installation Engineer](#)

After delivery of the equipment, furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of the equipment, assist in the performance of the onsite tests, initial operation, and instruct personnel as to the operational and maintenance features of the equipment.

3.13 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

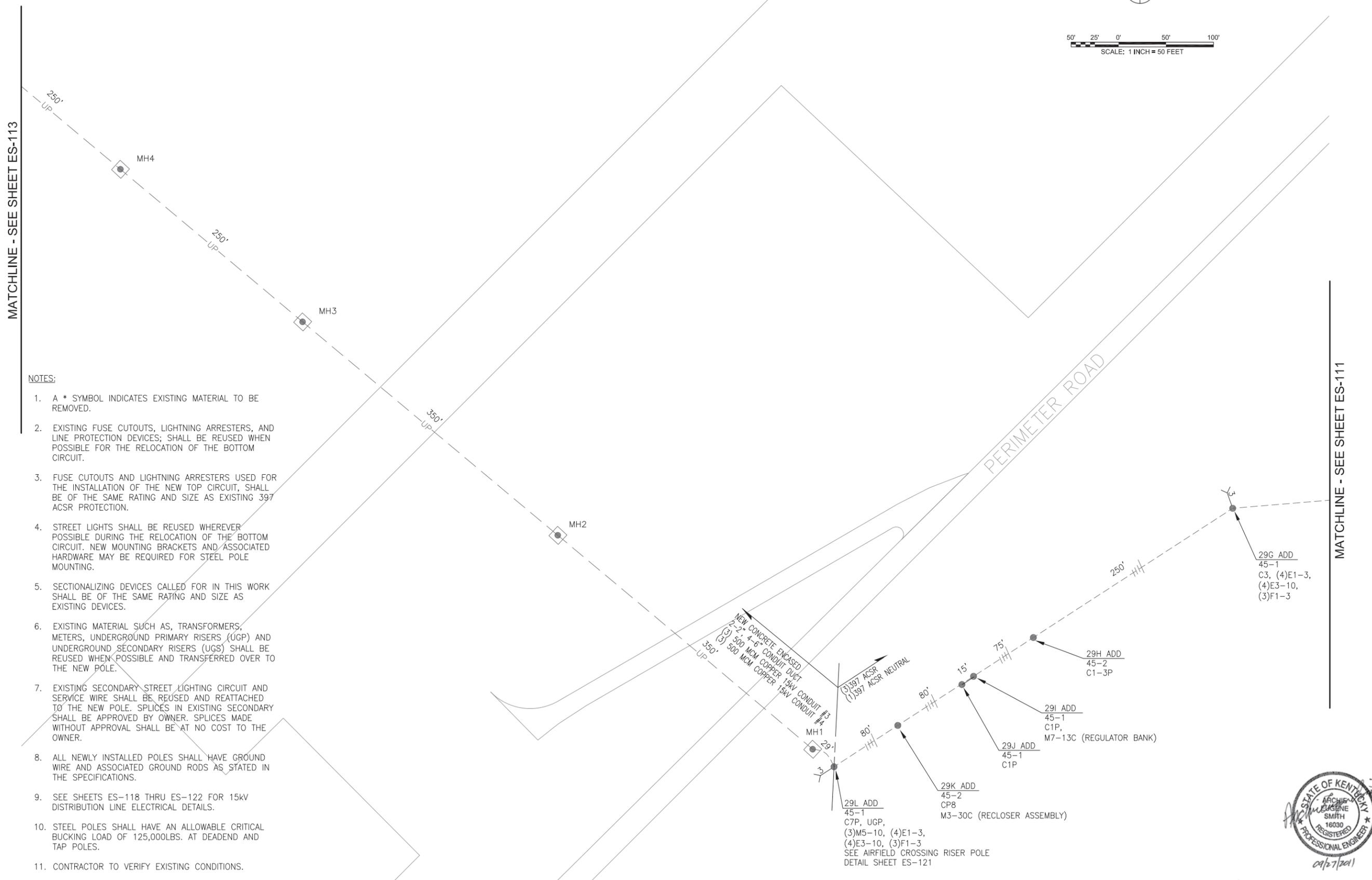
-- End of Section --



MATCHLINE - SEE SHEET ES-113

MATCHLINE - SEE SHEET ES-111

- NOTES:
1. A * SYMBOL INDICATES EXISTING MATERIAL TO BE REMOVED.
 2. EXISTING FUSE CUTOUTS, LIGHTNING ARRESTERS, AND LINE PROTECTION DEVICES; SHALL BE REUSED WHEN POSSIBLE FOR THE RELOCATION OF THE BOTTOM CIRCUIT.
 3. FUSE CUTOUTS AND LIGHTNING ARRESTERS USED FOR THE INSTALLATION OF THE NEW TOP CIRCUIT, SHALL BE OF THE SAME RATING AND SIZE AS EXISTING 397 ACSR PROTECTION.
 4. STREET LIGHTS SHALL BE REUSED WHEREVER POSSIBLE DURING THE RELOCATION OF THE BOTTOM CIRCUIT. NEW MOUNTING BRACKETS AND ASSOCIATED HARDWARE MAY BE REQUIRED FOR STEEL POLE MOUNTING.
 5. SECTIONALIZING DEVICES CALLED FOR IN THIS WORK SHALL BE OF THE SAME RATING AND SIZE AS EXISTING DEVICES.
 6. EXISTING MATERIAL SUCH AS, TRANSFORMERS, METERS, UNDERGROUND PRIMARY RISERS (UGP) AND UNDERGROUND SECONDARY RISERS (UGS) SHALL BE REUSED WHEN POSSIBLE AND TRANSFERRED OVER TO THE NEW POLE.
 7. EXISTING SECONDARY STREET LIGHTING CIRCUIT AND SERVICE WIRE SHALL BE REUSED AND REATTACHED TO THE NEW POLE. SPLICES IN EXISTING SECONDARY SHALL BE APPROVED BY OWNER. SPLICES MADE WITHOUT APPROVAL SHALL BE AT NO COST TO THE OWNER.
 8. ALL NEWLY INSTALLED POLES SHALL HAVE GROUND WIRE AND ASSOCIATED GROUND RODS AS STATED IN THE SPECIFICATIONS.
 9. SEE SHEETS ES-118 THRU ES-122 FOR 15KV DISTRIBUTION LINE ELECTRICAL DETAILS.
 10. STEEL POLES SHALL HAVE AN ALLOWABLE CRITICAL BUCKLING LOAD OF 125,000LBS. AT DEADEND AND TAP POLES.
 11. CONTRACTOR TO VERIFY EXISTING CONDITIONS.



DATE	DESCRIPTION	MARK	DATE	APPR.

DESIGNED BY: JTS	CHECKED BY: JTS	DATE: 02/20/11
PROJECT NO.:	CONTRACT NO.:	FILE NUMBER:
DATE:	DATE:	DATE:
FILE NAME:	FILE NAME:	FILE NAME:
ANSI D:	ANSI D:	ANSI D:

U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT
LOUISVILLE, KENTUCKY

MIDSOUTH
UTILITY CONSULTANTS
L.L.C.
Louisville, KY 40203
Phone: 502-422-0270
Fax: 502-422-0270

PLAN VIEW: 15KV DISTRIBUTION STRUCTURES 29G - MH4



CERTIFIED FINAL RFP (RTA)

SHEET IDENTIFICATION ES-112

MATCHLINE - SEE SHEET ES-116



DATE	DESCRIPTION	MARK	DATE	DESCRIPTION	MARK

DESIGNED BY: JTS	DESIGNED BY: JTS	DATE: 01/27/2011	CONTRACT NO.:
CHECKED BY: JTS	CHECKED BY: JTS	CONTRACT NO.:	FILE NUMBER:
DATE: 01/27/2011	DATE: 01/27/2011	FILE NAME:	FILE NAME:
FILE NAME:	FILE NAME:	ANSI D	ANSI D

SOF MH47 HANGAR
FT. CAMPBELL, KENTUCKY
PN 76374
P2 336955
15KV DISTRIBUTION LINE
PLAN VIEW: 15KV DISTRIBUTION STRUCTURES EMH2 - EMH4

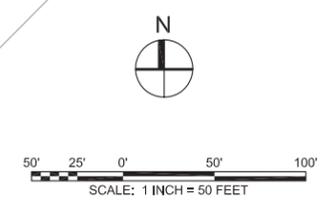
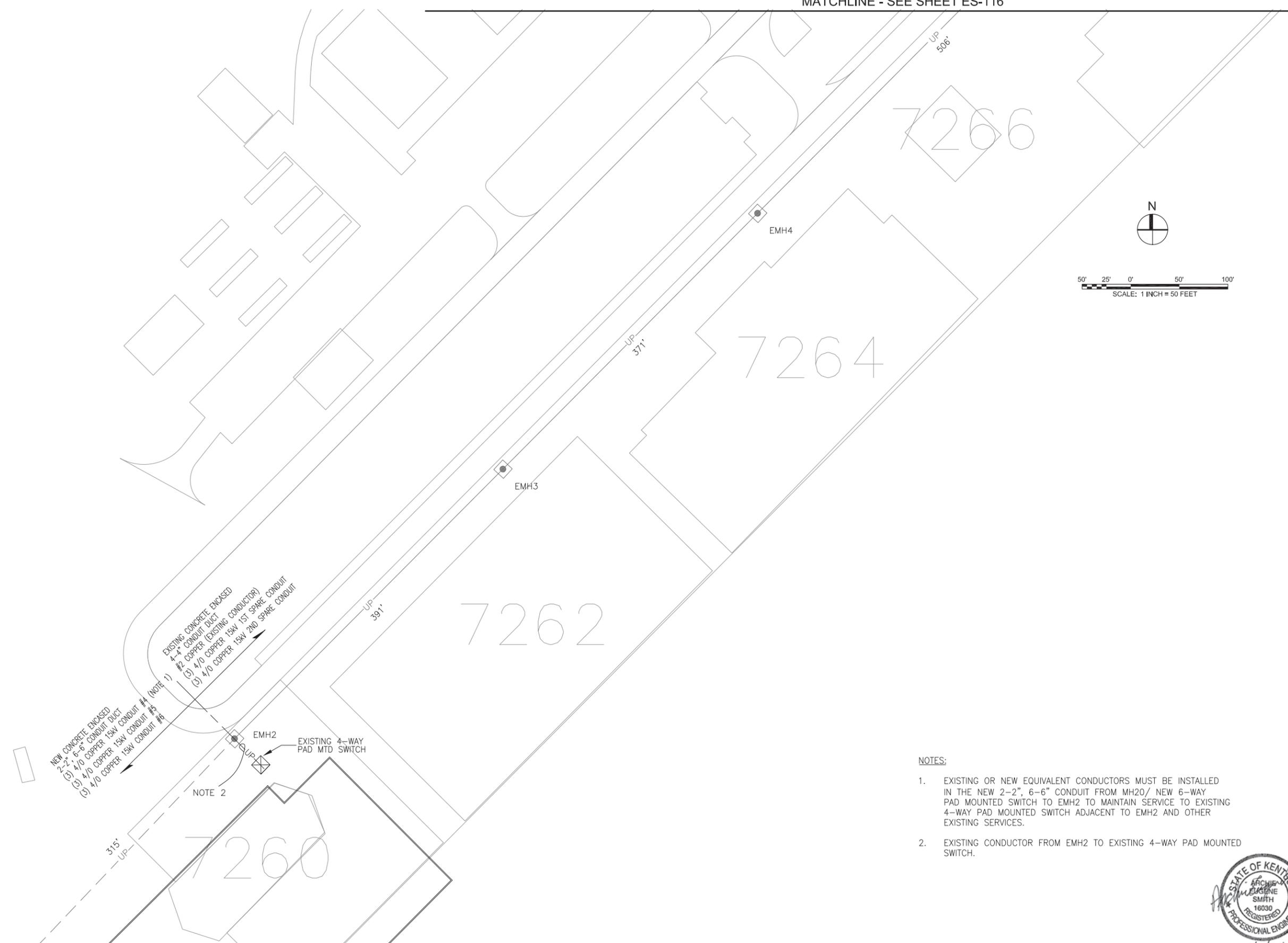
SHEET IDENTIFICATION
ES-115
SHEET 11 OF 18

D

C

B

A

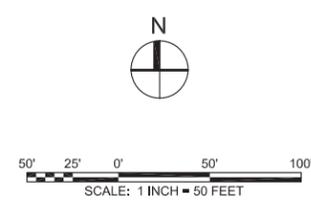
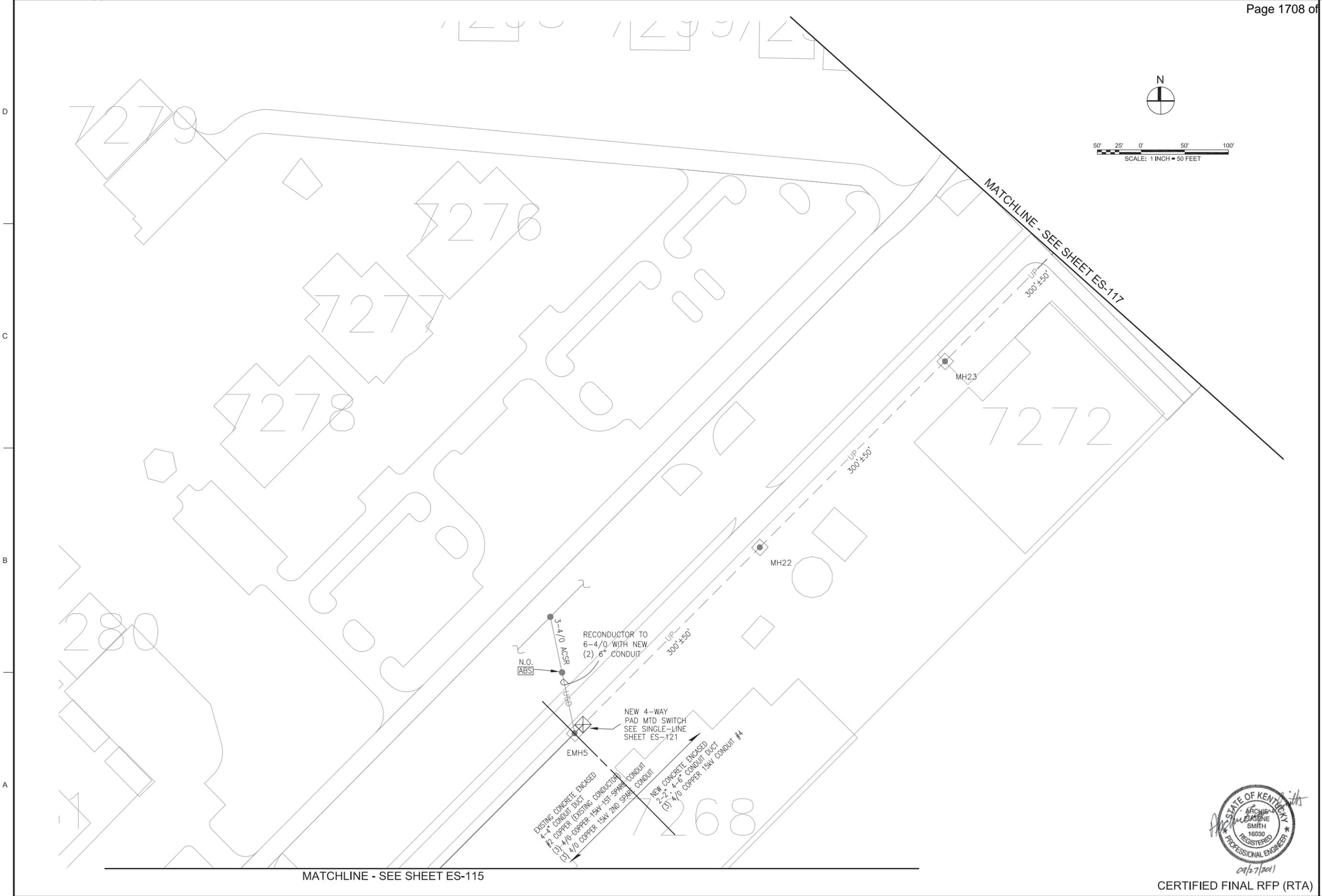


NOTES:

- EXISTING OR NEW EQUIVALENT CONDUCTORS MUST BE INSTALLED IN THE NEW 2-2", 6-6" CONDUIT FROM MH20/ NEW 6-WAY PAD MOUNTED SWITCH TO MAINTAIN SERVICE TO EXISTING 4-WAY PAD MOUNTED SWITCH ADJACENT TO EMH2 AND OTHER EXISTING SERVICES.
- EXISTING CONDUCTOR FROM EMH2 TO EXISTING 4-WAY PAD MOUNTED SWITCH.



CERTIFIED FINAL RFP (RTA)



MATCHLINE - SEE SHEET ES-117

MATCHLINE - SEE SHEET ES-115



MARK	DESCRIPTION	DATE	APPR.

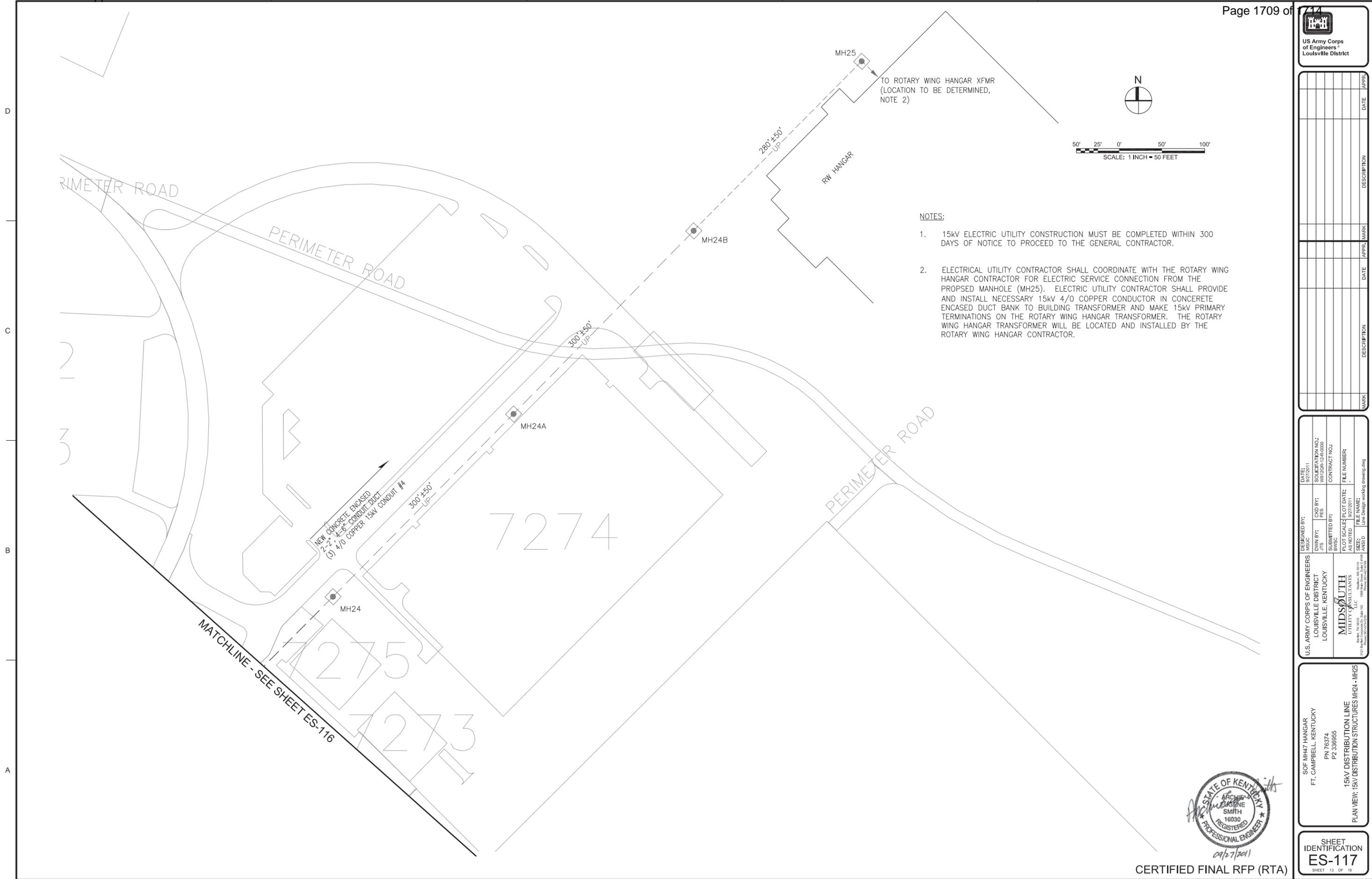
DESIGNED BY: JTS	CHECKED BY: JTS	DATE: 9/27/2011
SUBMITTED BY: BWS	APPROVED BY: JTS	CONTRACT NO.:
PROJECT NO.:	FILE NUMBER:	

SOF MH47 HANGAR
FT. CAMPBELL, KENTUCKY
PN 78374
P2 336955
15KV DISTRIBUTION LINE
PLAN VIEW: 15KV DISTRIBUTION STRUCTURES EMH5 - MH23

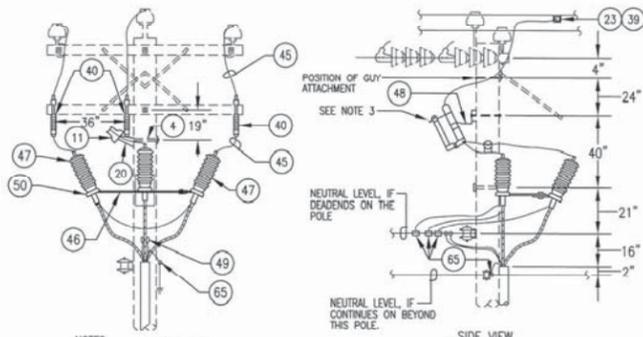


CERTIFIED FINAL RFP (RTA)

SHEET IDENTIFICATION
ES-116
SHEET 12 OF 18



D



- NOTES**
1. MODIFY POSITION OF TERMINAL ON DEADENDS TO BE UNDER THE CONDUCTORS AND THE CUTOUPS ON THE BACKSIDE OF CROSSARM. POLE RISEK MUST BE OFFSET TO CLEAR NEUTRAL CLEVIS BRACKET.
 2. INTERCONNECT CABLE INSULATION SHIELD DRAIN WIRES AND CONDUIT RISER GROUND TO MULTI-GROUNDED NEUTRAL (IF EXISTING) AND POLE GROUND.
 3. CUTOUP PROVIDES A FUSE OR A SOLID BLADE (NON-FUSED) OPTION. COORDINATE WITH SPECIFIC DESIGN REQUIREMENTS PROVIDED.

ruling span 200 poles 19-29b 2acsr
ALUMINUM COMPANY OF AMERICA SAG AND TENSION DATA
Fort Campbell 15kv line

CONDUCTOR SPARROW #2 AWG 6/ 1 STRANDING ACSR

AREA= .0608 SQ. IN.
DATA FROM CHART NO. 1-1023
ENGLISH UNITS

SPAN= 200.0 FEET MEDIUM LOADING
CREEP IS A FACTOR * DESIGN CONDITION

TEMP	ICE			WIND	K	WEIGHT	FINAL		INITIAL	
	IN	PSF	LB/F				SAG	TENSION	SAG	TENSION
15.	.25	4.00	.20	.00	.00	.581	2.51	1159.	2.35	1240.*
0.	.00	.00	.00	.00	.00	.091	.46	985.	.40	1142.
15.	.00	.00	.00	.00	.00	.091	.52	876.	.42	1077.
30.	.00	.00	.00	.00	.00	.091	.59	769.	.45	1008.
60.	.00	.00	.00	.00	.00	.091	.81	561.	.53	861.
90.	.00	.00	.00	.00	.00	.091	1.21	376.	.65	702.
120.	.00	.00	.00	.00	.00	.091	1.64	278.	.86	532.
167.	.00	.00	.00	.00	.00	.091	2.02	226.	1.58	290.
194.	.00	.00	.00	.00	.00	.091	2.27	201.	2.20	208.
212.	.00	.00	.00	.00	.00	.091	2.45	186.	2.37	193.

STRINGING SAG AT TEMP DEG F

TEMP F >	RULING SPAN = 200.0								
	0.	15.	30.	60.	90.	120.	167.	194.	212.
40.0	.02	.02	.02	.02	.03	.03	.06	.09	.09
50.0	.02	.03	.03	.03	.04	.05	.10	.14	.15
60.0	.04	.04	.04	.05	.06	.08	.14	.20	.21
70.0	.05	.05	.06	.06	.08	.11	.19	.27	.29
80.0	.06	.07	.07	.08	.10	.14	.25	.35	.38
90.0	.08	.09	.09	.11	.13	.17	.32	.45	.48
100.0	.10	.11	.11	.13	.16	.21	.39	.53	.59
110.0	.12	.13	.14	.16	.20	.26	.48	.67	.72
120.0	.14	.15	.16	.19	.23	.31	.57	.79	.85
130.0	.17	.18	.19	.22	.27	.36	.67	.93	1.00
140.0	.20	.21	.22	.26	.32	.42	.77	1.08	1.16
150.0	.22	.24	.25	.30	.37	.48	.89	1.24	1.33
160.0	.26	.27	.29	.34	.42	.55	1.01	1.41	1.52
170.0	.29	.31	.33	.38	.47	.62	1.14	1.59	1.71
180.0	.32	.34	.37	.43	.53	.69	1.28	1.78	1.92
190.0	.36	.38	.41	.48	.59	.77	1.42	1.98	2.14
200.0	.40	.42	.45	.53	.65	.86	1.58	2.20	2.37
210.0	.44	.47	.50	.58	.72	.95	1.74	2.42	2.61
220.0	.48	.51	.55	.64	.79	1.04	1.91	2.66	2.87
230.0	.53	.56	.60	.70	.86	1.13	2.08	2.91	3.13
240.0	.58	.61	.65	.76	.94	1.24	2.27	3.17	3.41
250.0	.62	.66	.71	.83	1.02	1.34	2.46	3.44	3.70
260.0	.68	.72	.77	.90	1.10	1.45	2.66	3.72	4.00

ruling span 200 poles 19-29d
ALUMINUM COMPANY OF AMERICA SAG AND TENSION DATA
Fort Campbell 15kv line

CONDUCTOR CHICKADEE 397.5 KCMIL 18/ 1 STRANDING ACSR

AREA= .3295 SQ. IN.
DATA FROM CHART NO. 1-844
ENGLISH UNITS

SPAN= 200.0 FEET MEDIUM LOADING
CREEP IS A FACTOR * DESIGN CONDITION

TEMP	ICE			WIND	K	WEIGHT	FINAL		INITIAL	
	IN	PSF	LB/F				SAG	TENSION	SAG	TENSION
15.	.25	4.00	.20	.00	.00	1.048	1.70	3083.	1.50	3500.*
0.	.00	.00	.00	.00	.00	.432	.69	3136.	.60	3605.
15.	.00	.00	.00	.00	.00	.432	.83	2603.	.67	3224.
30.	.00	.00	.00	.00	.00	.432	1.03	2103.	.76	2828.
60.	.00	.00	.00	.00	.00	.432	1.65	1308.	1.07	2017.
90.	.00	.00	.00	.00	.00	.432	2.46	876.	1.65	1311.
120.	.00	.00	.00	.00	.00	.432	3.23	668.	2.44	887.
167.	.00	.00	.00	.00	.00	.432	4.15	521.	3.60	601.
194.	.00	.00	.00	.00	.00	.432	4.36	496.	4.17	518.
212.	.00	.00	.00	.00	.00	.432	4.50	481.	4.44	488.

STRINGING SAG AT TEMP DEG F

TEMP F >	RULING SPAN = 200.0								
	0.	15.	30.	60.	90.	120.	167.	194.	212.
40.0	.05	.06	.07	.10	.15	.22	.32	.38	.40
50.0	.07	.08	.09	.13	.20	.30	.44	.51	.54
60.0	.10	.11	.12	.17	.26	.39	.58	.67	.71
70.0	.12	.14	.15	.22	.33	.49	.73	.84	.90
80.0	.15	.17	.19	.27	.41	.61	.90	1.04	1.11
90.0	.18	.20	.23	.32	.50	.74	1.09	1.26	1.34
100.0	.22	.24	.27	.39	.59	.88	1.30	1.50	1.60
110.0	.25	.28	.32	.45	.70	1.03	1.52	1.76	1.87
120.0	.29	.33	.37	.52	.81	1.19	1.76	2.04	2.17
130.0	.34	.38	.43	.60	.93	1.37	2.02	2.35	2.50
140.0	.38	.43	.49	.68	1.05	1.56	2.30	2.67	2.84
150.0	.43	.48	.55	.77	1.19	1.76	2.60	3.01	3.21
160.0	.48	.54	.62	.87	1.33	1.97	2.92	3.38	3.59
170.0	.54	.60	.69	.97	1.49	2.20	3.25	3.77	4.00
180.0	.60	.67	.76	1.07	1.65	2.44	3.60	4.17	4.44
190.0	.66	.74	.84	1.18	1.81	2.69	3.97	4.60	4.89
200.0	.72	.81	.92	1.29	1.99	2.95	4.36	5.05	5.37
210.0	.79	.89	1.01	1.42	2.18	3.22	4.76	5.52	5.87
220.0	.86	.96	1.10	1.54	2.37	3.51	5.18	6.01	6.39
230.0	.94	1.05	1.19	1.67	2.57	3.81	5.63	6.52	6.94
240.0	1.01	1.13	1.29	1.81	2.78	4.12	6.09	7.05	7.50

ruling span 150 poles 1-10
ALUMINUM COMPANY OF AMERICA SAG AND TENSION DATA
Fort Campbell 15kv line

CONDUCTOR CHICKADEE 397.5 KCMIL 18/ 1 STRANDING ACSR

AREA= .3295 SQ. IN.
DATA FROM CHART NO. 1-844
ENGLISH UNITS

SPAN= 150.0 FEET MEDIUM LOADING
CREEP IS A FACTOR * DESIGN CONDITION

TEMP	ICE			WIND	K	WEIGHT	FINAL		INITIAL	
	IN	PSF	LB/F				SAG	TENSION	SAG	TENSION
15.	.25	4.00	.20	.00	.00	1.048	1.02	2893.	.89	3300.*
0.	.00	.00	.00	.00	.00	.432	.39	3129.	.35	3511.
15.	.00	.00	.00	.00	.00	.432	.47	2577.	.39	3120.
30.	.00	.00	.00	.00	.00	.432	.59	2048.	.45	2711.
60.	.00	.00	.00	.00	.00	.432	1.04	1170.	.65	1858.
90.	.00	.00	.00	.00	.00	.432	1.70	714.	1.10	1304.
120.	.00	.00	.00	.00	.00	.432	2.32	523.	1.76	692.
167.	.00	.00	.00	.00	.00	.432	2.86	425.	2.68	454.
194.	.00	.00	.00	.00	.00	.432	3.04	400.	2.98	408.
212.	.00	.00	.00	.00	.00	.432	3.16	385.	3.10	393.

STRINGING SAG AT TEMP DEG F

TEMP F >	RULING SPAN = 150.0								
	0.	15.	30.	60.	90.	120.	167.	194.	212.
40.0	.12	.14	.16	.24	.40	.63	.96	1.07	1.11
50.0	.15	.17	.20	.29	.49	.78	1.19	1.33	1.38
60.0	.19	.21	.24	.35	.59	.94	1.44	1.60	1.67
70.0	.22	.25	.29	.42	.70	1.12	1.71	1.91	1.98
80.0	.26	.29	.34	.49	.83	1.32	2.01	2.24	2.33
90.0	.30	.34	.39	.57	.96	1.53	2.33	2.60	2.70
100.0	.35	.39	.45	.65	1.10	1.76	2.68	2.98	3.10
110.0	.39	.44	.51	.74	1.25	2.00	3.05	3.39	3.52
120.0	.44	.50	.58	.84	1.41	2.26	3.44	3.83	3.98

TYPICAL U.G. TERMINAL (0-25KV)

Ruling Span 200 poles 19-29b 2acsr (12.5kV/7.2kV)

Ruling Span 200 poles 19-29d (12.5kV/7.2kV)

Ruling Span 150 poles 1-10 (12.5kV/7.2kV)

SKETCH DATE AUGUST 2011 STYLE OH-31

SKETCH DATE AUGUST 2011 STYLE

SKETCH DATE AUGUST 2011 STYLE

SKETCH DATE AUGUST 2011 STYLE

B

ruling span 230 poles 29d-29i
ALUMINUM COMPANY OF AMERICA SAG AND TENSION DATA
Fort Campbell 15kv line

CONDUCTOR CHICKADEE 397.5 KCMIL 18/ 1 STRANDING ACSR

AREA= .3295 SQ. IN.
DATA FROM CHART NO. 1-844
ENGLISH UNITS

SPAN= 235.0 FEET MEDIUM LOADING
CREEP IS A FACTOR * DESIGN CONDITION

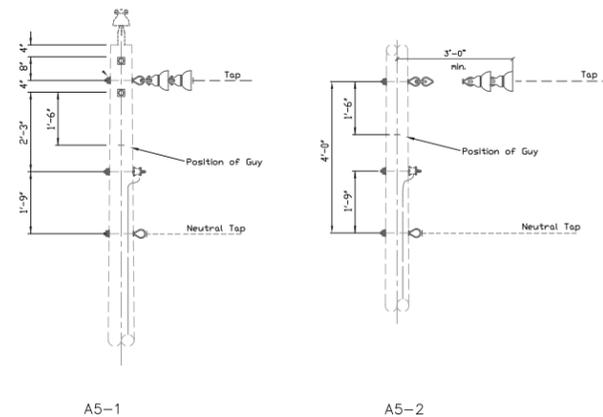
TEMP	ICE			WIND	K	WEIGHT	FINAL		INITIAL	
	IN	PSF	LB/F				SAG	TENSION	SAG	TENSION
15.	.25	4.00	.20	.00	.00	1.048	2.27	3189.	2.01	3600.*
0.	.00	.00	.00	.00	.00	.432	.96	3102.	.82	3621.
15.	.00	.00	.00	.00	.00	.432	1.15	2586.	.92	3246.
30.	.00	.00	.00	.00	.00	.432	1.41	2111.	1.04	2859.
60.	.00	.00	.00	.00	.00	.432	2.17	1377.	1.44	2076.
90.	.00	.00	.00	.00	.00	.432	3.08	969.	2.11	1410.
120.	.00	.00	.00	.00	.00	.432	3.94	758.	2.99	996.
167.	.00	.00	.00	.00	.00	.432	5.09	586.	4.30	694.
194.	.00	.00	.00	.00	.00	.432	5.38	556.	4.96	602.
212.	.00	.00	.00	.00	.00	.432	5.53	540.	5.36	557.

STRING



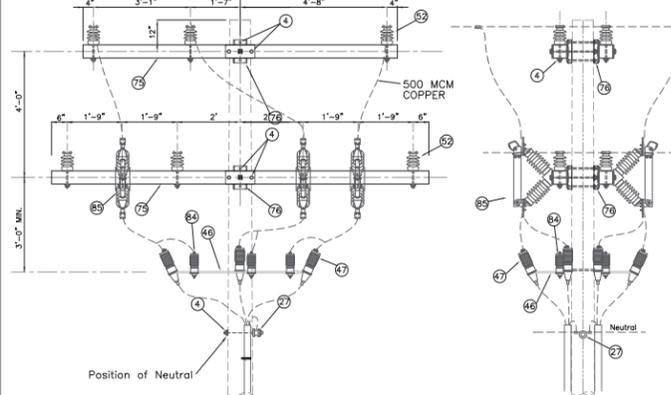
US Army Corps of Engineers Louisville District

D

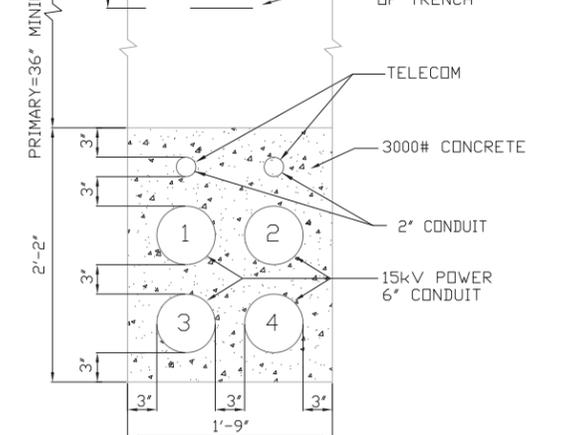


- NOTES:
- 1- Specify items 'ca' and 'cc' from standard drawings AC-10, AC-11, CU-5, and CU-6.
 - 2- Maximum longitudinal load is lesser of 5000 lbs. per conductor or neutral attachment strength.
 - 3- Specify use of polymer suspension insulator in lieu of porcelain suspension insulator by adding the subscript 'P' to the standard number.

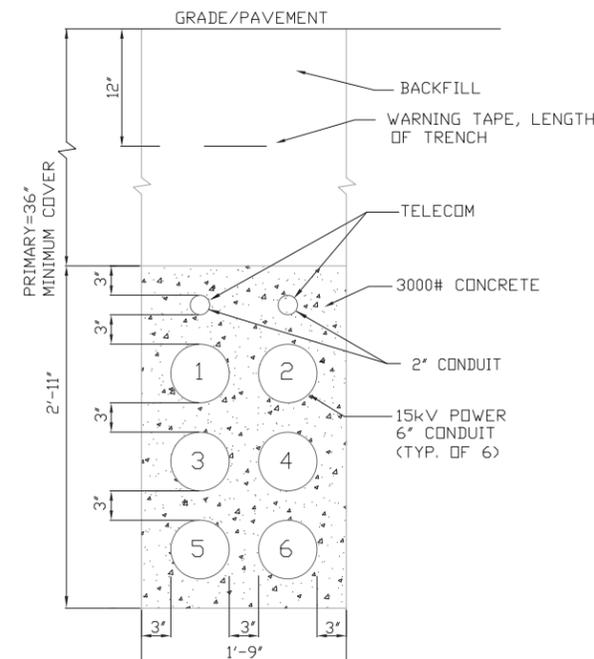
Primary Single Phase Tap



59th street Substation riser pole detail



CONCRETE ENCASED DUCT BANK SECTION (NTS) DUCT BANK 4-WAY



CONCRETE ENCASED DUCT BANK SECTION (NTS) DUCT BANK 6-WAY

C

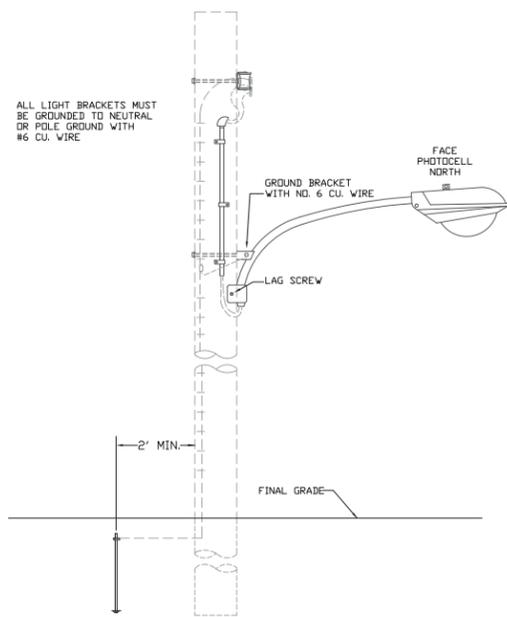
SKETCH DATE AUGUST 2011 STYLE A5-1,A5-2

SKETCH DATE AUGUST 2011 STYLE POLE 1

SKETCH DATE AUGUST 2011 STYLE DUCT BANK 4-WAY

SKETCH DATE AUGUST 2011 STYLE DUCT BANK 6-WAY

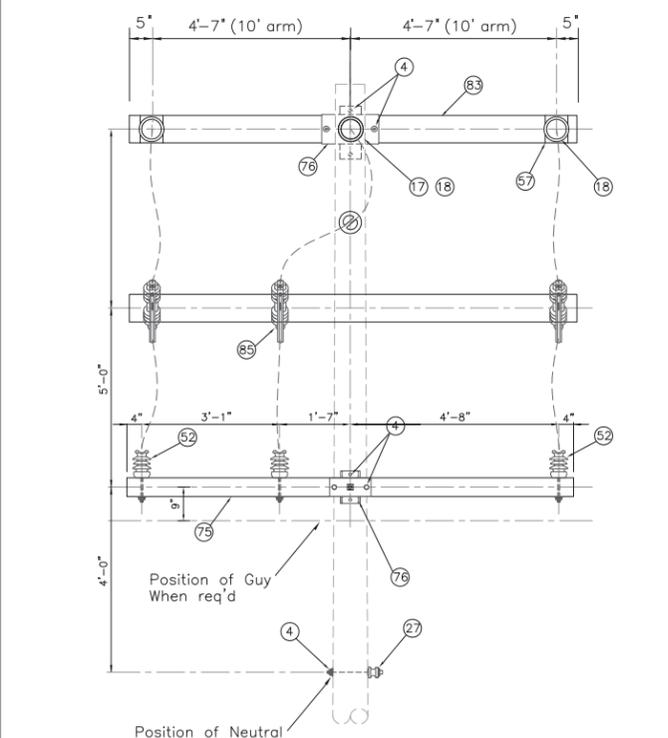
B



STL (Typical)

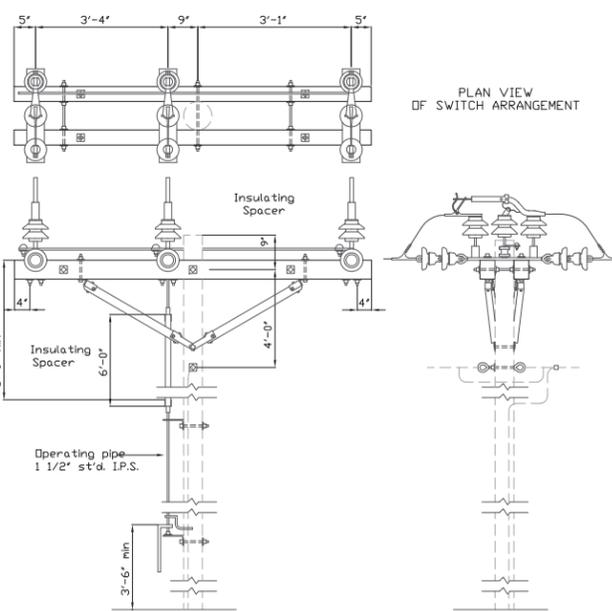
Note: Existing street lighting to be reinstalled to match existing conditions

SKETCH DATE AUGUST 2011 STYLE STL



3 PHASE DOUBLE CIRCUIT TIE

SKETCH DATE AUGUST 2011 STYLE POLE 1A



TYPICAL SECTIONALIZING AIR BREAK SWITCH (NTS)

SKETCH DATE AUGUST 2011 STYLE M3-15

A



CERTIFIED FINAL RFP (RTA)

DATE: 9/27/2011	DESIGNED BY: PFS	U.S. ARMY CORPS OF ENGINEERS
SUBMITTAL NO.: 12-0015-N/A	CHK BY: PFS	LOUISVILLE DISTRICT
CONTRACT NO.:	APP BY: BWS	LOUISVILLE, KENTUCKY
FILE NUMBER:	AS NOTED	MIDSOUTH UTILITY CONSULTANTS LLC
	9/27/2011	Franklin, TN 37019
	FILE NAME: SOF_MHH-G-BSD1.dgn	Phone: 615-522-2278
	ANSI D	1211

SOF M447 HANGAR
 FT. CAMPBELL, KENTUCKY
 PN 78374
 P2 336955
 15KV DISTRIBUTION LINE
 ELECTRICAL DETAILS #5

SHEET IDENTIFICATION
ES-122
 SHEET 18 OF 18