Design-Build Request For Proposal

US Army Corps of Engineers
Louisville District

19th Engineering Battalion Complex
Ft. Knox, Kentucky

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Ready to Advertise RFP Submittal
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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
Unaccompanied Enlisted Personnel Housing (UEPH)	Apartment

Military Facility	Civilian Facility
Battalion/Brigade Headquarters (BH)	Office

Military Facility	Civilian Facility
Company Operations Facility (COF)	Office Warehouse

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. UNACCOMPANIED ENLISTED PERSONNEL HOUSING (UEPH)

Provide Unaccompanied Enlisted Personnel Housing (UEPH) facilities. This project type is to house single soldiers and is intended to be similar both functionally and technically to similar housing in the private sector community surrounding the Installation.

Number of single personnel to be housed is 252

Maximum gross area 94,077 square feet.

2.1. COMPANY OPERATIONS FACILITY (COF)

Provide Company Operations Facilities (COF). This project type is to house Company administrative operations and store and move supplies. It is intended to be similar to office and warehouse type buildings in the private sector community.

The project will include Company Operations Facilities for 5 Companies. The number of unified companies (UNICOF) per battalion and number of personnel per company for this project is as follows:

19th Engineering Battalion (UNICOF)

Company A = 150 Personnel, male/female ratio 80:20

Company B = 150 Personnel, male/female ratio 80:20

Company C = 150 Personnel, male/female ratio 80:20

Company D = 150 Personnel, male/female ratio 80:20

Company E = 250 Personnel, male/female ratio 80:20

The maximum allowable gross area for the Admin Module is 16120 square feet.

The maximum allowable gross area for the Readiness Module is 52692 square feet.

The maximum allowable gross exterior covered Hardstand area is 12954 square feet.

The preferred design approach for this complex is the UNICOF with detached two-story admin layout

A Troop Aid Station to support the Brigade IS required and will be included in the 19th Engineering Battalion Battalion UNICOF. Items identified as H (hospital equipment) on Troop Aid Station Furnishings Appendix.

2.1. BATTALION HEADQUARTERS (Bn HQ)

Provide BATTALION HEADQUARTERS (Bn HQ). This project type is to house Battalion administrative and command operations. It is intended to be similar to office type buildings in the private sector community. Assume 20 percent of personnel are female unless otherwise indicated.

The project will include 0 small (16,000 SF), 0 medium (18,600 SF), and 0 large (20,400 SF) and 1 large (22,600 SF) stand alone Battalion Headquarters buildings for 19th Engineering Battalion. The maximum gross area for the Battalion Headquarters in the project is limited to 22,600 square feet.

2.2. SITE:

Provide all site design and construction within the Headquarters limits of construction necessary to support the new building facilities. Supporting facilities include, but are not limited to, utilities, electric service, exterior and security lighting, fire protection and alarm systems, security fencing and gates, water, gas, sewer, and site improvements. Provide accessibility for individuals with disabilities. Include Antiterrorism/Force Protection measures in the facility design in accordance with applicable criteria.

Maintain the construction site and haul route. Repair/replace damage to existing sidewalks, pavements, curb and gutter, utilities, and/or landscaping within the construction limit, adjacent to the construction site, and along the Contractor's haul route resulting from the Contractor's construction activities at no additional cost to the Government. Prior to construction activities, the Contractor and Contracting Officer Representative shall perform an existing condition survey. At the completion of the Task Order, the Contractor and Contracting Officer representative shall perform a final condition survey to determine repair/replacement requirements.

Approximate area available for this (these) facility(ies) is shown on the drawings.

Provide all site design and construction within the COF limits of construction necessary to support the new building facilities. Supporting facilities include, but are not limited to, utilities, electric service, exterior and security lighting, fire protection and alarm systems, security fencing and gates, water, gas, sewer, oil water separators, storm drainage and site improvements. Include Antiterrorism/Force Protection measures the facility design in accordance with applicable criteria.

Maintain the construction site and haul route. Repair/replace damage to existing sidewalks, pavements, curb and gutter, utilities, and/or landscaping within the construction limit, adjacent to the construction site, and along the Contractor's haul route resulting from the Contractor's construction activities at no additional cost to the Government. Prior to construction activities, the Contractor and Contracting Officer Representative shall perform an existing condition survey. At the completion of the Task Order, the Contractor and Contracting Officer representative shall perform a final condition survey to determine repair/replacement requirements.

Approximate area available for this (these) facility(ies) is shown on the drawings.

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

Approximate area available 18.55 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: There are no additional requirements beyond those identified in Section 01 10 00.

2.4. FURNITURE REQUIREMENTS

A Furniture, Fixtures & Equip design and package is NOT required for this project. However, Structural Interior Design (SID) is required for all facility types regardless of the requirements for the FF&E design and package. The 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 is still required as part of the SID submittal.

2.5. NOT USED

3.0 UNACCOMPANIED ENLISTED PERSONNEL HOUSING (UEPH)

3.1. GENERAL REQUIREMENTS:

3.1.1. FACILITY DESCRIPTION: The Army requires an apartment complex of two-bedroom, one-bath dwelling units with kitchen (1+1E module) similar in features, standards and layout to apartment complexes in the surrounding community. Maximize the space inside the individual dwelling units versus providing additional spaces not listed in the functional requirements in this section. Building circulation is required to be through the use of interior corridors/breezeways or garden style apartments, where circulation is minimized. Exterior egress balconies are prohibited; this does not preclude apartments designed with exterior entry landings. Choice of breezeways and exterior entry landings shall be predicated upon the weather criteria of the specific geographic area. Breezeways and exterior entry landings shall be designed to preclude snow and ice infiltration/accumulation. Building spaces and areas are as indicated in the text below. Coordinate the site design with the building described in this Section. Specific site requirements that affect the design and construction of the site appear in 01 10 00-6.0.

3.1.2. FACILITY RELATIONSHIPS: (NOT USED)

3.1.3. ACCESSIBILITY REQUIREMENTS:

A. GENERAL: Able-bodied soldiers occupy and manage UEPH facilities. The Architectural Barriers Act (ABA) requirements does not apply to UEPH facilities, except as follows:

B. Site Plan Design and Construction

1) Provide ABA compliant access from the parking lot to the building.

2) Provide two (2) ABA compliant vehicle parking stalls for each barracks building for visitor parking.

3) Provide handicapped vehicle parking signage and pavement markings.

C. Facility Design and Construction

1) The main building entrance on the ground level and at least one emergency egress, designed per applicable code, shall be handicapped accessible. Electronic exterior door openers with push button control are required for handicapped accessibility.

2) Provide ABA clearances and door accesses in the building main entry/vestibule being used by visitors.

3) If a lobby is required by the RFP:

a) Provide a handicapped accessible drinking fountain in the lobby.

b) Provide handicapped accessible public toilet(s), which may be unisex, in the lobby area.

3.1.4. BUILDING AREAS:

A. GENERAL: The overall building gross area is based on allocating each occupant 366 gross square feet for buildings up to three stories or 388 gross square feet for buildings over three stories. For Installations in Alaska the overall building gross area is based on allocating each occupant 388 gross square feet for all barracks building, irrespective of building height. The gross square feet per occupant includes the total area of all functional areas required in the building, including all dwelling units, common areas, canopies, and support areas, e.g. stairways, elevators, foyers, corridors, public toilets, janitor's closets, utility room spaces.

B. GROSS AREA:

1) Definition: Gross building area is measured to the outside face of exterior enclosure walls. Gross area includes floor areas, penthouses, mezzanines, and other spaces as follows:

2) Limitations: Maximum authorized gross building areas for each facility is included in this paragraph. Proposals that exceed authorized gross area limitations may be considered non-conforming.

C. HALF SPACE: Areas calculated as half space. Gross building area shall be calculated in accordance with Appendix Q, with the following exceptions in accordance with TI 800-01 Design Criteria – Appendix B, UEPH:

1) All stairs and elevator shafts count as half space for each floor they serve.

D. EXCLUDED SPACE: The following spaces are excluded from gross area calculations: Attic areas where average clear height does not exceed 7 feet, normal roof overhangs and soffits for weather protection, mechanical equipment platforms and catwalks.

E. NET AREA :

1) **Definition:** Net area is measured to the inside face of the room or finish walls.

2) **Net Area Requirements:** Net area requirements for programmed spaces are included in this chapter. If net area requirements are not specified, the space shall be sized to accommodate the required function and to comply with code requirements, overall gross area limitations, and any other requirement of this RFP (for example, area requirements for corridors, stairs, and mechanical rooms will typically be left to the discretion of the offeror).

3.1.5. ADAPT BUILD MODEL: (NOT USED)

3.2. FUNCTIONAL AND OPERATIONAL REQUIREMENTS:

3.2.1. FUNCTIONAL SPACES

A. Primary Spaces

1) Dwelling Units

c) **Bedrooms:** Each dwelling unit shall have two bedrooms, each with a minimum net area of 140 square feet and a maximum net area of 183 square feet. Bedrooms shall be equal in size and similar in configuration. Bedroom shall be able to accommodate one bed, entertainment center, chest of drawers, nightstand, desk and chair with adequate circulation for one occupant: See Section 3.19.1 Furniture List/Charts for more details. Each bedroom shall have a walk-in closet directly adjacent.

(1) **Walk-in-Closets:** Each walk-in closet shall have a net area of 32 square feet, and shall be furnished with hanger rods and shelves see paragraph 3.5.1 Storage Shelving for more details. Each closet door shall be furnished with a robe hook and full length mirror.

d) **Kitchen:** Each dwelling unit shall have a full kitchen with adequate space and circulation to accommodate a full size refrigerator 28 inches wide, a electric oven/range, with a built-in combination vent hood and microwave oven, centered above, wall cabinet system and countertops for food storage and preparation. Provide utility connections and casework to accommodate future installation of a dishwasher and appliances listed in 3.19.2 Residential Appliances. Provide area for recyclables receptacle and kitchen waste receptacle. Provided a minimum of twelve (12) linear feet of standard height base, wall cabinet systems, and countertops for food storage and preparation, linear feet includes required sink. In addition to the twelve (12) linear feet of standard height counter, kitchen layout shall accommodate counter style seating and dining for two people, or provide space for a dining area outside of the kitchen.

e) **Bathroom:** Each dwelling unit shall have one full bath. Including a Tub/shower enclosure and separate vanity with storage below. The tub/shower enclosure shall include a water closet and tub/shower combo. See 3.8 Plumbing Fixtures for details and 3.5.1 Interior Specialties for required toilet accessories.

f) **Dwelling Laundry:** Not Used

B. Common Areas

1) **Lobby:** Lobby shall meet the accessibility requirements stated in 3.1.3 above.

a) CQ Station: CQ station shall be located within the Lobby. CQ Station shall have a net area of 70 square feet and shall consist of a built-in reception ABA compliant counter for visitors with space for a chair.

2) **Toilet(s):** Public toilets, which may be a single, unisex toilet, shall be located adjacent to the Lobby area and shall comply with the ABA accessibility requirements. If either a CQ station or a lobby is provided, a public toilet shall be included.

4) **Vestibule:** Provide an enclosed transition space between the exterior and the lobby or building interior. Provide a minimum of 7 feet clearance between interior and exterior doors.

5) **Corridors:** Corridors shall have a minimum with no less than 5'-0".

6) **Janitor's Closet:** Provide a minimum of one Janitor's Closet per floor. Each Janitor's Closet shall have a minimum area of 30 square feet. Each Janitor closet shall have a mop sink, mop rack, and space for buckets, vacuum and storage for janitorial supplies. See 3.5.1 Interior Specialties for shelving details.

7) **Mechanical, Electrical, and Telecommunications Rooms:** Mechanical rooms shall accommodate space for equipment maintenance/repair access without having to remove other equipment. Mechanical, electrical and telecommunications rooms shall be keyed separately for access by Installation maintenance personnel. Filter changes and preventative maintenance shall be performed without requiring access to the dwelling units. First floor exterior access is required for centralized mechanical and electrical rooms. Telecommunications rooms shall comply with the requirements of ANSI/TIA/EIA-569-B. Refer to Mechanical and Electrical Sections for additional information.

8) **Mail Access Area:** A mail access area shall be designed and constructed as a part of this project. Mail access area shall include one USPS-approved combination lock type mailbox per resident, and a minimum of one USPS-approved two-key parcel locker parcel locker per 40 residents. The numbering sequence shall be coordinated with the user.

9) **Vending Area**: Provide a minimum of one vending area centrally located on the ground floor of each barracks building. For barracks buildings higher than three stories, provide a minimum of one vending area centrally located on the ground floor of each barracks building, and a minimum of one vending area centrally located on every other floor above the ground floor of each barracks building. Each Vending Area shall be sized to accommodate one ice cube machine-dispenser designed for hotel type ice bucket filling and one full-size vending machine per 80 – 100 residents, or space for a minimum of three full-size vending machines, whichever is greater. Locate vending area in a central location that is easily monitored.

10) **Recyclables Storage:** Provide one recyclables storage per building. Locate the recyclables storage on the first floor with access to the complex trash/recyclables dumpster area. Recyclables Storage shall be fully enclosed and ventilated. Recyclables Storage shall be sized to accommodate a minimum of six (6) fifty-gallon barrel sized recyclable containers, with adequate circulation space to allow access to move each container in and out of the Recyclable Storage with a dolly, without having to move the other containers.

11) **Mudroom/Bootwash:** Provide outdoor areas for soldiers to rinse mud off field gear, boots and clothing before laundering. Provide one rinsing station per 30 persons, or a minimum of one boot wash area close to each entrance, whichever is greater. Each rinsing station shall be furnished with a pedestal mounted, hosed cold water faucet or hydrant. Faucet or hydrant shall be non-freeze type.

12) **Centralized Laundry:** Locate a minimum of one laundry room in a centralized location, on each floor of each barracks building. Interior of laundry rooms shall be visible from the corridor through glazed picture windows. Laundry room entry shall provide a clear opening 36 inches wide minimum. Size self-serve laundry facilities to accommodate a combined total of no fewer than one washer per 12 residents

on each floor and one dryer per 8 residents on each floor. Fixed heavy gauge stainless steel clothes folding/hanging tables, stainless steel utility sinks and laundry supplies vending area are required features of centralized laundry facilities. Provide one fixed heavy gauge stainless steel clothes folding/hanging table per 48 residents on each floor.

13) **Activity Room:** Not Used

3.3. SITE FUNCTIONAL REQUIREMENTS

A. PARKING

1) **Privately Owned Vehicle (POV) Parking:** The Contractor shall design and construct the POV parking, within the designated construction area. Base the location and design of the POV parking area(s) on the Installation's site constraints. The Contractor shall ensure that the location of parking complies with UFC 4-010-01. See paragraph 5.2.3, “VEHICLE PAVEMENTS”, for additional information. Provide POV parking spaces for 70 percent of the personnel.

B. ACCESS DRIVES AND LANES

1) **Services Drives:** The Contractor shall provide service drives to each building. Locate the drives in accordance with UFC 4-010-01. Restrict access to the drives, where applicable, as required by UFC 4-010-01. Design the pavements as required by paragraph 5.2.3, “VEHICLE PAVEMENTS”. The minimum access drive width shall be 10 feet. The Contractor shall design and construct drives with curb and gutter when necessary for drainage purposes.

2) **Emergency Vehicle/Fire Access Lanes:** The Contractor shall provide fire access lanes. Drives designed to support emergency vehicle traffic shall be a minimum of 20 feet wide per NFPA requirements. Access must be provided to three sides, minimum and must be within 33 feet of a building’s entrance. Design the fire access lanes in accordance with NFPA 1, UFC-3-600-01, and the installation’s requirements.

3.4. SITE AND LANDSCAPE REQUIREMENTS

A. SITE STRUCTURES

1) **Dumpster Area**: The Contractor shall locate, design, and construct the dumpster enclosure area(s) and screening. Dumpster screening shall be aesthetically and architecturally compatible with the building it serves and shall be designed in accordance with the Installation’s guidelines. Locate the dumpster areas in accordance with UFC 4-010-01 “DoD Minimum Antiterrorism Standards for Buildings”. Position the GFGI dumpsters outside of restricted areas to allow for servicing activities.

B. LANDSCAPING/HARDSCAPTING

1) Non-Vehicular Walks: Construct pedestrian walks within the designated construction area and connect to existing sidewalks, where applicable. Construct walks paralleling buildings beyond the eave drip line and at least 5 feet from the foundation.

a) Pedestrian Sidewalks: Sidewalks shall be a minimum of 6 feet wide. Restrict vehicular access to the sidewalks, as required by UFC 4-010-01. Construct non-vehicular pedestrian sidewalks of Portland cement concrete having a minimum nominal thickness of 4 inches. Design joint patterns uniformly, symmetrical, and in accordance with the American Association of State Highway and Transportation Officials (AASHTO) standards. For joints, do not exceed the length to width ratio of 1.25 for non-reinforced pavements.

2) Shared Troop and Vehicular Walks: Sidewalks designed to support emergency and service vehicle traffic will be considered roadway pavements and shall be designed to meet the AASHTO standards. Construct vehicular supported walks of Portland cement concrete having a minimum nominal thickness of 7 inches. Design joints uniformly, symmetrical, and in accordance with AASHTO standards. Do not exceed the length to width ratio of 1.25 for non-reinforced pavements. Sidewalks designed to

support emergency and service vehicle traffic shall have minimum widths as stated in 3.3 Access Drives and Lanes.

3.5. ARCHITECTURAL REQUIREMENTS

A. GENERAL: Provide durable and easily maintainable materials. Do not use exterior materials that require periodic repainting or similar refinishing processes. Material exposed to weather shall be factory pre-finished, integrally colored or provided with intrinsic weathering finish.

B. WALLS:

1) **Exterior Walls**: Where Exterior Insulation and Finish Systems (EIFS), or any other material except CMU or other Masonry material is used as exterior finish material, it shall be in conjunction with a Masonry wainscot. EIFS shall be “high-impact” type and shall be “drainable” type. Masonry units shall be tested for efflorescence. Efflorescence testing shall conform to the provisions of ASTM C 67. CMU construction shall comply with the provisions of ASTM C 1400.

2) **Mold and Mildew:** The Designer of Record shall provide details in the design analysis and design showing steps taken to mitigate the potential growth of mold and mildew in the facility.

C. ROOF SYSTEMS: Minimum roof slope for membrane roof systems shall be 1/4 inch per foot. Minimum roof slope for pitched roof systems shall be 3 inches per foot. Membrane roof systems shall be fully adhered. Structural standing seam metal roofs shall comply with the requirements of ASTM E 1592. Roof system shall be Underwriters Laboratory (UL 580 Class 90) rated or Factory Mutual Global (FM) I-90 rated. Roof system shall comply with applicable criteria for fire rating.

1) **Roof Mounted Equipment**: For roof mounted equipment, provide permanent access walkways and platforms to protect roof. Roof mounted equipment on pitched roof systems is unacceptable. Roof mounted equipment on membrane roof systems shall be completely screened by the roof parapet.

2) **Roof Access:** Roof access from building exterior is prohibited.

3) **Trim and Flashing:** Gutters, downspouts, and fascia shall be factory pre-finished metal and shall comply with SMACNA Architectural Sheet Metal Manual.

D. OPENINGS:

1) **Storefronts/Curtain Walls & Entrances**:

a) **Storefronts (Main Entrance Doors):** Provide aluminum storefront doors and frames with Architectural Class 1 anodized finish, fully glazed, with medium or wide stile for entry into lobbies or corridors. Provide doors complete with frames, framing members, subframes, transoms, sidelights, trim, applied muntins, and accessories. Framing systems shall have thermal-break design. Storefront systems shall be capable of withstanding area wind loads, thermal and structural movement required by location and project requirements, and shall comply with applicable codes and criteria.

b) **Curtain Wall Systems:** Curtain wall systems shall be capable of withstanding area wind loads, thermal and structural movement required by location and project requirements, and shall comply with applicable codes and criteria.

2) **Windows**: Material and installation shall comply with applicable codes and criteria.

a) **Exterior Windows:** Provide insulated, high efficiency window systems, with thermally broken frames complying with applicable codes and criteria. Each bedroom shall have at least one exterior window. Window shall meet egress requirements of NFPA 101 and International Building Code. Window sills shall be designed to discourage bird nesting. All bedroom windows shall be operable windows. Operable windows shall be furnished with locks, and fiberglass or aluminum insect screens removable from the inside.

b) Interior Windows:

(1) **Laminated Glass:**

(a) **Centralized Laundry:** Picture window glazing shall be laminated glass. Design-Build Contractor may propose an alternate solution that will provide visual monitoring of the laundry room in-lieu of using a picture window.

2) **Doors and Frames**: Fire-rated and Smoke Control Doors and Frames: Comply with applicable codes, criteria and requirements of labeling authority. STC ratings shall be of the sound classification required and shall include the entire door and frame assembly.

a) **Exterior Insulated Hollow Metal Doors & Frames**: Provide insulated hollow metal exterior doors for entry to all spaces other than corridors, lobbies, or reception/waiting rooms. Doors and frames shall comply with applicable codes and criteria. Doors shall be minimum Level 3, physical performance Level A, Model 2. Frames shall be minimum 12-gauge, with continuously welded mitered corners and seamless face joints. Doors and frames shall be A60 galvannealed, shall comply with ASTM A653 and shall be factory primed. Fire-rated openings shall comply with applicable codes, and the requirements of the labeling authority. Door and frame installation shall comply with applicable codes and criteria.

b) **Interior Insulated Metal Doors:** Shall comply with applicable codes and criteria. Doors shall be minimum Level 3, physical performance Level A, Model 2; factory primed.

(1) Provide insulated metal doors at utility rooms, janitor closets, and stairwell doors.

(2) Not Used

c) **Solid Core Wood Doors:** Provide flush solid core wood doors with Grade A hardwood face veneer for transparent finish. Stile edges shall be non-finger jointed hardwood compatible with face veneer.

(1) Provide flush solid core wood doors at doors within dwelling unit.

(2) Provide flush solid core wood doors at dwelling unit entry.

d) **Interior Hollow Metal Frames:** Comply with ANSI A250.8/SDI 100. Frames shall be minimum Level 3, 16 gauge, with continuously welded mitered corners and seamless face joints; factory primed.

(1) **Contractor's Option:** Contractors have the option to furnish knockdown frames for closet and bathroom doors in the dwelling units. Continuously welded frames with mitered corners and seamless face joints at closets and bathroom doors in the dwelling units shall be considered betterments.

4) **Hardware:**

a) **Door Hardware:** All hardware shall be consistent and shall conform to ANSI/BMHA standards for Grade 1. Provide closers for all exterior doors, all doors opening to corridors and as required by codes. Exit devices shall be installed on all building egress doors.

(1) **Finish Hardware (Master Keying System/Cores):** All requirements for hardware keying shall be coordinated with the Contracting Officer. Extension of the existing Installation keying system shall be provided, the Installation keying system is Best Lock. Cores shall have not less than seven pins; cylinders shall have key-removable type cores. Disassembly of knob or lockset shall not be required to remove core from lockset. Locksets for mechanical, electrical and communications rooms only shall be keyed to the existing Installation Master Keying System. HVAC terminal units that are accessed from a central corridor shall have a deadbolt to minimize protrusion into corridor. Plastic cores are unacceptable.

(2) **Fire and Exit Door Labeling:** Hardware for fire doors shall be installed in accordance with the requirements of applicable codes. Exit devices installed on fire doors shall have a visible label bearing the marking "Fire Exit Hardware". Other hardware installed on fire doors, such as locksets, closers, and hinges shall have a visible label or stamp indicating that the hardware items have been approved by an approved testing agency for installation on fire-rated doors. Hardware for smoke-control door assemblies shall be installed in accordance with applicable codes.

(3) **Auxiliary Hardware:** Provide other hardware as necessary for a complete installation

(a) **Door Stops:** Provide wall or floor stops for all exterior doors that do not have overhead holder/stops

(b) **Peep Holes:** Each dwelling unit entry door shall be furnished with a brass peephole door viewer with a viewing angle of 200 degrees minimum.

(c) **Door Latches:** Each closet door shall have a Function (F75), Grade 1 closet latch, and be equipped with padlock eyes so the occupant can provide his/her own padlock. One padlock eye shall be mortised into and screw attached flush with door edge on the latch side of the door and the second padlock eye shall be mortised and welded flush into the inside face of the door frame jamb. Padlock eye shall be fabricated to accommodate padlock shackle up to 1/4" diameter. Padlock eye color shall match door frame color. Locate padlock eye at between 4'-6"' and 5'-6" AFF. Location of padlock eyes shall be at the same height in all modules.

(d) **Robe Hooks:**

1. Closet Doors: Each closet door shall have a Type 304 satin finished, stainless steel, robe hook mounted on the closet side of the door.

2. Dwelling Bathroom Doors: Each bathroom door shall have a Type 304 satin finished, stainless steel double robe hook mounted on inside face of bathroom door.

b) **Electronic Key Card Access System:** A Programmable Electronic Key Card Access System shall be provided on all exterior entry/egress doors, dwelling unit doors, bedroom doors and centralized laundry doors (if centralized laundries are required by RFP). The Installation does not have a single manufacturer established for this equipment at this time. The minimum operability requirement is a key card access system that provides a single key card for the individual soldier, programmable to open all exterior entry/egress doors, the laundry room (if a centralized laundry is provided), the soldier's dwelling unit door, and the soldier's bedroom door. A Programmable Electronic Key Card Access System Manufacturer's Representative shall install all hardware and software necessary for the operation of the Electronic Key Card Access System and program all locksets. Provide six (6) blank key cards for each personnel each building is designed to accommodate. All blank key cards shall be serially numbered and each key card shall have its number permanently inscribed on it. The Design-Build Contractor shall furnish in three-ring binders, one full set of the system manufacturer's system training manual, system maintenance manual, and one training video (in format provided by the system manufacturer), with each system installed. The Programmable Electronic Key Card Access System Manufacturer's Representative shall provide two (2) separate 4-hour classes of training for the user on software use, programming locks, encoding cards and printing reports. Each building shall be furnished with a complete stand-alone key card system package. System shall be capable of being compartmentalized so that each building has only the capability to produce key cards for that building. Provide a two (2) year warranty on the system and all components and locksets. All special tools, software, connecting cables and proprietary equipment necessary for the maintenance, testing, and reprogramming of the system shall be furnished to the Contracting Officer Representative.

c) **Non-Destructive Emergency Access System (KNOX Box):** Non-Destructive Emergency Access System See paragraphs 6.13.3 and 6.13.4 for Fort Knox's Knox Box requirements.

5) **Glass and Glazing**: Material and installation shall comply with applicable codes and criteria.

a) **Mirrors:**

(1) **Walk-in Closets:** Each closet door shall have a 16 inches wide by 70 inches high by ¼ inch thick, select float glass, full length mirror, in a one piece ½ inch by ½ inch by ½ inch Type 304 satin finished, stainless steel frame, with mitered corners, mounted on the bedroom side of the door. Bottom of mirror shall be located at 6 inches above finish floor.

6) Louvers and Vents:

b) **Exterior:** Exterior louvers shall have bird screens and shall be designed to exclude wind-driven rain. Exterior louvers shall be made to withstand wind loads in accordance with the applicable codes. Wall louvers shall bear the Air Movement & Control Association (AMCA) International certified ratings

program seal for air performance and water penetration in accordance with AMCA 500-D and AMCA 511. Louver finish shall be factory applied.

C. EXTERIOR SPECIALITIES:

1) **Bird Habitat Mitigation:** The Contractor shall provide details in the design necessary to eliminate the congregating and nesting of birds at, on, and in the facility.

D. ELEVATORS/CONVEYING SYSTEMS:

1) **Elevators:** Elevators: Provide elevators for buildings that exceed three stories. Provide elevator system that complies with the most current editions of ASME A17.1 and ASME A17.2 in their entirety, and additional requirements specified herein. The first elevator shall be centrally located and shall have a minimum rated load capacity of 3500 lb (1588 kg), with center opening doors and interior dimensions sized to accommodate a fully extended Emergency Medical Services (EMS) gurney and four average size adults. Gurney size shall be based on the “STRYKER Power-PRO XT" gurney. An additional elevator as specified above shall be provided for every additional one hundred (100) persons or fraction thereof, over the first two hundred (200) persons the building is designed to accommodate, unless a traffic analysis determines otherwise. Such traffic analysis shall be included in the Design Analysis.

a) **Elevator Inspector:** The Elevator Inspector shall be certified in accordance with the requirements of the most current editions of ASME A17.1 and ASME QEI-1 and licensed in elevator inspection by the State where project is located. The Certified Elevator Inspector shall inspect the installation of the elevator(s) to assure that the installation conforms with all contract requirements. The Elevator Inspector shall be directly employed by the Prime Contractor and shall be independent of the Elevator System Manufacturer and the Elevator System Installer. The Elevator Inspector shall witness the acceptance inspections and tests, approve all results and sign and certify the successful results. The Elevator Inspector, after completion of the acceptance inspections and tests, shall certify in writing that the installation is in accordance with the contract requirements. The Elevator Inspector shall bring any discrepancy, including any safety related deficiencies, to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

E. POSTAL/MAIL BOX REQUIREMENTS:

1) **Exterior:** Mail access area shall be located on an exterior wall, protected from the elements and shall conform to the requirements of ATFP UFC 4-010-01.

2) **Interior:** Not Used

F. ACOUSTICAL REQUIREMENTS: Exterior walls and roof/floor/ceiling assemblies, doors, windows and interior partitions shall be designed to provide for attenuation of external noise sources such as airfields in accordance with applicable criteria, but no less than the following:

1) Exterior Walls: STC 49

2) Interior Partitions: STC 49

3) Walls/Floors separating Module Spaces: STC 50 / IIC 55

4) Module Entry, Bedroom and Bathroom Doors: STC 25

5) Sound conditions (and levels) for interior spaces, due to the operation of mechanical and electrical systems and devices, shall not exceed levels as recommended by ASHRAE handbook criteria. Provide acoustical treatment for drain lines and other utilities to prevent noise transmission into the interior of dwelling units

G. THERMAL REQUIREMENTS:

1) **Thermal Insulation:** Provide exterior wall, floor, and roof/ceiling assemblies with thermal transmittance (U-values) required to comply with the proposed energy calculations for the facilities.

Insulation shall not be installed directly on top of suspended acoustical panel ceiling systems. See Paragraph 3.12 Energy Conservation for details.

3.5.1. FINISHES AND INTERIOR SPECIALITIES

A. GENERAL: Provide sustainable materials and furnishings that are easily maintained and replaced. Maximize use of day lighting. Provide interior surfaces that are easy to clean and light in color. Design barracks interior with a residential ambience.

B. FINISHES: Designers are not limited to the minimum finishes listed in this paragraph and are encouraged to offer higher quality finishes.

1) **Minimum Finish Requirements:** Wall, ceiling and floor finishes shall conform to the requirements of the IBC, NFPA and UFC 3-600-01. Where code requirements conflict, the most stringent code requirement shall apply.

a) **Walls:** All wall finish shall be minimum 5/8" painted gypsum board, except where stated otherwise. All gypsum board shall achieve a score of 10, the highest level of performance for mold resistance under the ASTM D 3273 test method. All gypsum board shall be transported, handled, stored and installed in accordance with the GYPSUM ASSOCIATION – Guidelines For Prevention Of Mold Growth On Gypsum Board (GA-238-03). Use impact resistant gypsum board in corridors, storage rooms, stairwells and activity rooms and centralized laundries (if centralized laundries are required by RFP).

b) **Ceilings:** All ceiling finishes shall be minimum 5/8" painted gypsum board, except where stated otherwise. All gypsum board shall achieve a score of 10, the highest level of performance for mold resistance under the ASTM D 3273 test method. All gypsum board shall be transported, handled, stored and installed in accordance with the GYPSUM ASSOCIATION – Guidelines For Prevention Of Mold Growth On Gypsum Board (GA-238-03).

c) **Floors:**

(1) **Resilient Flooring):** Resilient flooring shall be a minimum 1/8 inch thick, conforming to ASTM F 1066, Class 2, through-pattern tile, Composition 1, asbestos free, with color and pattern uniformly distributed throughout the thickness of the tile.

(2) **Porcelain/Quarry Tile:**

(3) **Ceramic Tile:**

(4) **Sealed Concrete:**

d) **Counter Tops:** Countertops shall have waterfall front edge. Bathroom, kitchen and public toilet countertops shall have integral coved backsplash.

(1) **Bathroom & Public Toilet(s):** Bathroom and public toilet (if required by RFP) vanity countertop shall be minimum ½ inch thick cast 100 percent acrylic polymer solid surfacing material with waterfall front edge and integral coved backsplash.

(2) Kitchens:

e) **Window Stools:** Window stools shall be minimum ½ inch thick cast 100 percent acrylic polymer solid surfacing material.

f) **Elevator(s) Finishes:** Elevator interior walls, ceiling, doors and fixtures shall have a satin No. 4 stainless steel finish. Floor finish shall be resilient flooring as specified in Paragraph 3.5.1 above. All elevators shall be furnished with removable hanging protective pads and fixed hooks to facilitate conversion to use for moving freight.

2) **Minimum Paint Finish Requirements:** All paints used shall be listed on the "Approved product list" of the Master Painters Institute, (MPI). Application criteria shall be as recommended by Master Painters Institute (MPI) guide specifications for the substrate to be painted and the environmental conditions existing at the project site.

a) **Exterior Surfaces:** Except factory pre-finished material or exterior surfaces receiving other finishes shall be painted a minimum of one prime coat and two finish coats. Paints having a lead content over 0.06 percent by weight of nonvolatile content are unacceptable. Paints containing zinc-chromate, strontium-chromate, mercury or mercury compounds, confirmed or suspected human carcinogens shall not be used on this project. Exterior paints and coating products shall be classified as containing low volatile organic compounds (VOCs) in accordance with MPI criteria. Application criteria shall be as recommended by MPI guide specifications. Provide an MPI Gloss Level 5 Finish (Semi-gloss), unless otherwise specified.

b) **Interior Surfaces:** Except factory pre-finished material or interior surfaces receiving other finishes shall be painted a minimum of one prime coat and two finish coats. Paints having a lead content over 0.06 percent by weight of nonvolatile content are unacceptable. Paints containing zinc-chromate, strontium-chromate, mercury or mercury compounds, confirmed or suspected human carcinogens shall not be used on this project. Interior paints and coating products shall contain a maximum level of 150 g/l (grams per liter) of volatile organic compounds (VOCs) for non-flat coatings and 50 g/l of VOCs for flat coatings. Provide an MPI Gloss Level 5 Finish (Semi-gloss) in wet areas and a flat finish in all other areas.

3) **Finish Table:**

MINIMUM INTERIOR FINISHES														
	FLOORS					BASE			WALLS		CEILING			REMARKS
	RESILIENT FLOORING	PORCELAIN OR QUARRY TILE	CERAMIC TILE	RECESSED ENTRY MAT	SEALED CONCRETE	RESILIENT BASE	SANITARY COVE CERAMIC BASE	PORCELAIN OR QUARRY TILE	GYPSUM BOARD PAINT	CERAMIC	GYPSUM BOARD PAINT	ACOUSTICAL CEILING TILE	MINIMUM HEIGHT	
COMMON AREAS														
LOBBY (IF REQUIRED BY RFP)		•						•	•		•	•	9'-0"	SEE NOTE 6
PUBLIC TOILET			•				•		•	•	•		8'-0"	SEE NOTES 2, 3 & 5
VESTIBULES		•		•				•	•		•		9'-0"	
MUDROOM (IF REQUIRED BY RFP)			•				•		•	•	•		8'-0"	SEE NOTES 2 & 5
BOOT WASH (IF REQUIRED BY RFP)					•								-	
ACTIVITY ROOM (IF REQUIRED BY RFP)		•						•	•		•	•	9'-0"	SEE NOTE 6
MAIL ACCESS AREA		•						•	•		•		8'-0"	IF LOCATED WITHIN BUILDING
MAIL ACCESS AREA					•								8'-0"	IF LOCATED OUTSIDE BUILDING SEE NOTE 10
STAIRS	•				•	•			•		•		8'-0"	SEE NOTE 4
CORRIDORS	•					•			•		•	•	9'-0"	SEE NOTE 6
VENDING											•		8'-0"	SEE NOTE 1
RECYCLABLES STORAGE	•					•			•		•		8'-0"	SEE NOTE 1
JANITOR CLOSETS			•				•		•	•	•		8'-0"	SEE NOTES 2 AND 5
MECHANICAL					•	•			•		•		-	SEE NOTES 5 AND 7
ELECTRICAL					•	•			•		•		-	
TELECOMMUNICATIONS					•	•			•		•			SEE NOTE 8
CENTRALIZED LAUNDRY		•						•	•		•		8'-0"	SEE NOTE 5

(IF REQUIRED BY RFP)														
DWELLING UNITS														
KITCHEN	•					•			•		•		8'-0"	SEE NOTE 3
BATHROOM			•				•		•	•	•		8'-0"	SEE NOTES 2, 3 & 11
BEDROOM	•					•			•		•		9'-0"	SEE NOTE 9
CLOSET	•					•			•		•		8'-0"	

1. FINISHES IN VENDING OR RECYCLABLES STORAGE AREA SHALL MATCH FINISHES IN ADJACENT SPACE.
2. ALL WET WALLS SHALL HAVE A 4'-0" HIGH CERAMIC TILE WAINSCOT.
3. ALL KITCHEN AND BATHROOM COUNTERS SHALL HAVE A MINIMUM OF 4" HIGH BACKSPLASH.
4. STAIR LANDING SHALL BE RESILIENT FLOORING OR SEALED CONCRETE. TREADS SHALL BE RESILIENT FLOORING OR SEALED CONCRETE, PROVIDE SLIP RESISTANT NOSING. RISERS SHALL BE PAINTED STEEL OR RESILIENT FINISH AS REQUIRED FOR STAIR CONSTRUCTION TYPE.
5. PROVIDE FLOOR DRAIN IN CENTER OF ROOM. SLOPE FLOOR TO DRAIN IN ALL ROOMS WITH FLOOR DRAIN
6. UP TO 50% OF CEILING AREA MAY BE ACOUSTICAL CEILING TILE. ALL ACOUSTICAL CEILING TILE SHALL BE INSTALLED WITH HOLD DOWN CLIPS TO PREVENT UPWARD MOVEMENT. CEILING LAYOUT SHALL BE A BALANCED MIX OF GYPSUM BOARD AND ACOUSTICAL CEILING TILE, SUCH THAT ONE FINISH MATERIAL IS NOT CONCENTRATED IN OR RESTRICTED TO ONE AREA OF THE CEILING.
7. PROVIDE FLOOR DRAIN IN CENTER OF ROOM. CEILING MAYBE PAINTED EXPOSED STRUCTURE IF ALLOWED BY APPLICABLE CODE AND CRITERIA. THIS NOTE DOES NOT APPLY TO DWELLING UNIT MECHANICAL CLOSETS.
8. COMPLY WITH THE REQUIREMENTS OF ANSI/TIA/EIA-569-B
9. WHERE MASONRY WALLS ARE PROPOSED AS THE BEDROOM WALL FINISH SYSTEM, THE LONGEST WALL IN EACH BEDROOM SHALL BE FINISHED WITH A TACKABLE MATERIAL. TACKABLE MATERIAL SHALL BE GYPSUM BOARD AND SHALL COMPLY WITH THE REQUIREMENTS OF PARAGRAPH 3.5.1 MINIMAL FINISH REQUIREMENTS.
10. CEILING SHALL BE PAINTED EXPOSED STRUCTURE
11. TUB SURROUND SHALL BE FIBERGLASS OR ACRYLIC.
12. CARPET SHALL NOT BE USED AS A FLOOR FINISH ON THIS PROJECT.

C. INTERIOR SPECIALITIES:

1) **Signage & Directories:**

a) **Room Signage:** Room signage shall conform to the Housing Automated Management System, (HOMES4). At each dwelling unit, provide two (one on each side of entry door) dwelling unit/room number and changeable two-line message strip signage. Dwelling units and shall be sequentially numbered. For example, the first unit on the first floor shall be "101", first unit on the second floor shall be "201". Rooms shall be designated using the letters "A and B". The room designation is determined by standing in the corridor facing the entry door of the dwelling unit, the bedroom on the left is "A" and the one on the right is "B". The complete dwelling unit/room numbering shall be as in this example, first unit on the second floor "201A and 201B". Changeable message strip signs shall be of same construction as standard room signs to include a clear sleeve that will accept a paper or plastic insert with identifying changeable text. The insert shall be prepared typeset message photographically enlarged to size and mounted on paper card stock.

b) **Stair Exit Door Signage:** The inside face of each stair exit door on the first floor shall be furnished with a photo-luminescent sign. Photo-luminescent signs shall be manufactured and tested in accordance with the most current versions of ASTM E 2072 and ASTM E 2073. Sign shall be minimum 14-inches wide by 10-inches high, and shall be made of anodized aluminum. Lettering shall be red text on a yellow background. Lettering shall be upper case, and shall read as follows: "EMERGENCY EXIT ONLY" (minimum 4-inches high letters) "SECURITY ALARM WILL SOUND IF DOOR IS OPENED" (minimum 3-inches high letters). Signs shall be mounted centered on interior face of door above exit device.

2) **Visual Display Units/Cases:**

a) **Bulletin Boards:** Provide one bulletin board centrally located on all floors. Bulletin board shall be 4'-0" high and 6'-0" wide. Bulletin boards shall have a header panel and shall have lockable, glazed doors. Glazing shall be laminated glass.

3) **Toilet Accessories:** Furnish and install the items listed below and all other toilet accessories necessary for a complete and usable facility. All toilet accessories shall be Type 304 stainless steel with satin finish.

a) **Public Toilet(s):** Public Toilets (IF REQUIRED BY THE RFP): Toilet accessories shall conform to the requirements of the ABA and shall include, but are not limited to the following:

(1) Glass mirrors on stainless steel frame and shelf – at each lavatory

(2) Liquid soap dispenser – at each lavatory

(3) Combination recessed mounted paper-towel dispenser/waste receptacle

(4) Sanitary napkin disposal at each female\unisex toilet

(5) Recessed mounted lockable double toilet paper holder – at each water closet.

(6) Sanitary toilet seat cover dispenser – a minimum of one per toilet room

(7) Grab bars – as required by ABA

b) **Dwelling Unit/Bedroom Toilet(s):** Shall at a minimum include:

(1) Two heavy duty towel bars – minimum 24 inches wide each

(2) Two recessed mounted mirrored medicine cabinets – at each lavatory.

(a) A minimum of 16-inches wide by 24 inches high with adjustable shelves, mounted on the back wall of the vanity.

(b) Medicine cabinet construction shall be heavy gauge steel, all welded, with a powder-coated finish.

(c) Mirror shall be ¼ inch thick select float glass in a one piece ½ inch by ½ inch by ½ inch Type 304 satin finished, stainless steel frame, with mitered corners.

(3) Two soap dish - at tub/shower

(4) One wall mounted retractable clothesline – across tub/shower

(5) Two combination tumbler holder/toothbrush holder – one at each medicine cabinet

(6) Toilet paper holder – at each water closet.

(7) Curved shower curtain rod - extra heavy duty.

(8) Shower curtain – white anti-bacterial nylon/vinyl fabric shower curtain.

(9) Two soap dish – one at each medicine cabinet.

4) **Wall Protection:**

a) **Chair Rail:** Chair rails shall be installed in areas prone to hi-impact use, such as corridors and lobby.

b) **Corner Guards:** Provide surface mounted, high impact resistant, integral color, snap-on type resilient corner guards, extending from floor to ceiling for wall/column outside corners in high traffic areas. Factory fabricated end closure caps shall be furnished for top and bottom of surface mounted corner guards.

5) **Storage Shelving:**

a) **Janitor's Closet:** Provide a minimum of six linear feet of 18 inch deep, heavy duty, stainless steel shelving for storage of janitorial supplies.

b) **Walk-in-Closets:** Closet shelf shall be capable of supporting a minimum of 30 pounds per linear foot. Closet shelf shall be 15 inches deep and top of shelf shall be set at 70 inches above closet finish floor. Closet rod and bracket system shall be capable of supporting a minimum of 30 pounds per linear foot. Provide a minimum of 78 linear inches of rod and shelf with no rod and shelf being less than 48 inches long.

6) **Fire Extinguisher Cabinets & Mounting Brackets:** Furnish and install fire extinguisher cabinets and fire extinguisher mounting brackets as required by applicable codes and criteria. Furnish a

list of installed fire extinguisher cabinets and mounting brackets (including location, size and type) to the Contracting Office Representative.

3.6. STRUCTURAL REQUIREMENTS:

A. GENERAL: Design and construct as a complete system in accordance with APPLICABLE CRITERIA.

B. DESIGN LOADS:

1) **Live Loads:** Design live loads shall be per the IBC but not lower than the following minimums.

a) **Elevated floors:** 60 pounds per square foot (psf) minimum

b) **Slab on grade:** 150 psf minimum

c) **Centralized laundry area (if required by RFP):** 150 psf, (but not less than actual equipment loads)

3.7. SEE PARAGRAPH 6.7 THERMAL PERFORMANCE – NOT USED

3.8. PLUMBING REQUIREMENTS:

A. DOMESTIC WATER:

1) **Heating System:** Domestic water heating system shall be sized based on 20 gallons of 110 deg. F hot water consumption per occupant during morning peak period. Peak period duration shall be 30 minutes (10 minute duration for shower and lavatory use per occupant per dwelling unit plus a 10 minute transition period). Hot water storage capacity shall be based on 75% usable storage and a storage temperature of 140 deg F. Domestic hot water distribution shall be at 120 deg F from a central system mixing valve. Domestic hot water distribution piping shall be designed to handle up to 180 deg F water temperatures.

2) **Pipe Sizing:** For domestic hot water pipe sizing, peak hot water flow rate shall be based on all showers flowing simultaneously at a rate of 2.0 gpm per shower. Waste stacks, building waste drains, and lift stations (if required) shall be sized with consideration of increased flow rates as well.

B. FIXTURE FLOW RATES:

1) **Water Closets:** Shall have a maximum flow rate of 1.28 gallons per flush or dual flush with an equivalent average flush volume of 1.28 gallons per flush.

2) **Shower heads**: Shall have a maximum flow rate not to exceed 1.5 gpm.

3) **Bathroom Sinks:** Shall have a maximum flow rate not to exceed 0.5 gpm.

4) **Kitchen Sinks**: Shall have a maximum flow rate not to exceed 1.0 gpm.

5) **Janitor Sinks**: Shall have a maximum flow rate not to exceed 2.0 gpm.

C. DRAINS, INTERCEPTORS SEPARATORS & CLEANOUTS:

1) **Interceptors:**

a) **Sand Interceptors:**

(1) **Mudroom/Bootwash:**

b) **Solid Interceptors:**

(1) **Centralized Laundry:** Centralized laundry facilities shall be considered commercial laundries with respect to the IPC and shall be provided with solids interceptor in accordance with the IPC.

2) **Cleanouts:**

a) **Centralized Laundry:** If Dryer vents are manifolded to a common exhaust, provide an easily accessible means of cleanout.

3) **Drains:**

a) **Vending Area:** Provide water and drain connections for ice cube machine-dispensers.

b) **Centralized Laundry:** Provide water and drain connections for all washers.

D. PLUMBING FIXTURES:

1) **Residential Plumbing Fixtures:**

a) **Kitchen Fixtures (Dwelling Unit):**

(1) **Sink:** Furnish and install a single bowl stainless steel kitchen sink. “Minimum bowl inside dimensions shall be 400mm x 400 mm x 180mm deep [16”x16”x7”deep].”

(2) **Faucet:**

b) **Bathroom Fixtures (Dwelling Unit):**

(1) **Water Closet:** Furnish and install an elongated floor mounted flush tank type vitreous china water closet.

(2) **Tub/Shower Head:** Shall be of porcelain enameled cast-iron or enameled steel.

(3) **Vanity Fixture:**

2) **Commercial Plumbing Fixtures:**

a) **Mudroom/Bootwash:**

(1) **Utility Sink:**

(2) **Pedestal Mounted Faucet:**

(3) **Hosed Facet:**

3.9. COMMUNICATIONS AND SECURITY SYSTEMS:

A. TELECOMMUNICATION SYSTEMS: Telecommunications outlets shall be provided per the applicable criteria based on functional purpose of the space within the building.

1) **CATV**: All CATV outlet boxes, connectors, cabling, and cabinets shall conform to applicable criteria unless noted otherwise. All horizontal cabling shall be homerun from the CATV outlet to the nearest telecommunications room unless indicated otherwise. See paragraph 6 for possible additional requirements.

B. SECURITY INFRASTRUCTURE/SYSTEMS:

1) **Door Status/Alarm Monitoring:**

a) **Stair Exit Doors:** Each stair exit door on the first floor shall be furnished with a hard-wired contact switch connected to an alarm system. Alarm system shall sound an alarm at the door location and the CQ Desk when a stair exit door is opened. Switching OFF activated alarm shall be by key at the specific door and remotely at the CQ Desk.

C. MASS NOTIFICATION SYSTEMS: MNS shall be integrated into the installation’s area wide MNS (Giant Voice). See Paragraph 6 for further requirements.

3.10. ELECTRICAL REQUIREMENTS:

A. GENERAL: Select electrical characteristics of the power system to provide a safe, efficient, and economical distribution of power based upon the size and types of loads to be served. Use distribution and utilization voltages of the highest level that is practical for the load to be served. The effect of

nonlinear loads such as computers, other electronic equipment and electronic ballasts shall be considered and accommodated as necessary. Voltage drop shall not exceed the maximum allowed per ASHRAE 90.1. Transient voltage surge protection shall be provided on service equipment. Bedrooms shall be considered to be living and sleeping rooms, therefore they are to be considered to be part of a dwelling unit per NFPA 70 definition.

B. POWER: Power shall be provided for all installed equipment requiring power to include convenience receptacles and government furnished government installed equipment.

1) **Panels:** Panelboards located in accessible areas, shall be lockable and keyed to one master key.

2) **Outlets:**

a) **Dwelling Unit:** In addition to the requirements of NFPA 70 for dwelling units, a duplex receptacle shall be mounted adjacent to the CATV outlet.

b) **Lobby:** Provide a minimum of one 125 volt duplex receptacle in the lobby (if lobby is provided) for housekeeping purposes.

(1) **Lobby–CQ Station:** >Provide two (2) 125 volt, duplex receptacles for CQ workstation. Receptacles shall be on a dedicated circuit.

c) **Corridors:** Provide a minimum of one 125 volt duplex receptacle per corridor for housekeeping. No point along a corridor wall at 18" above finished floor shall be more than 25 feet from a receptacle.

d) **Mechanical & Electrical Room:** Provide a minimum of two 125 volt duplex receptacles in mechanical rooms in addition to those required by NFPA 70. This requirement does not apply to the small mechanical rooms used for individual dwelling units. In addition, provide a minimum of one 125 volt duplex receptacle in each electrical room.

e) **Vending Area:** *<UEPH_VENDING_NOT*>Not UsedProvide power receptacles for vending machines and ice cube machine-dispensers.

f) **Centralized Laundry:** Provide power receptacles for washers, dryers and laundry supplies vending machines. Provide a minimum of one convenience duplex power receptacle on each wall.

g) Electrical service shall be provided for electric dryers regardless of whether or not electric dryers are to be used.

C. LIGHTING LEVELS, FIXTURES & CONTROLS: Interior lighting controls shall be provided in accordance with ASHRAE 90.1. Electronic ballasts for linear florescent lamps shall be the high efficiency programmed start type. Provided lighting levels shall be within +/- 10% of required lighting levels.

1) **Dwelling Units:**

a) **Bedrooms:** Lighting level in bedrooms shall be 15 foot-candles. Lighting shall utilize compact fluorescent fixtures with automatic occupancy sensor detection switching. Switching shall be manual-ON/Automatic OFF.

b) **Dining:**

c) **Kitchen:** Lighting level in kitchen areas shall be 30 foot-candles with automatic occupancy sensor detection switching. Switching shall be manual-ON/Automatic OFF. Counter top task lighting shall be installed under cabinets utilizing fixtures with 2 foot linear T8 fluorescent lamps with manual on/off switching. Task lighting switching shall be separate from general lighting switching.

d) **Walk-in-Closet**: Provide automatic occupancy sensor detection switching in each walk-in closet. Switching shall be manual-ON/Automatic OFF.

2) **Lobby:** Lighting level in lobbies (if required by the RFP) shall be 10 foot-candles. Lighting in common areas such as corridors and lobbies shall have automatic occupancy sensor detection switching.

Sensors in corridors shall be wired such that only the lighting fixtures within the activation range of a particular sensor shall turn on.

a) **Lobby–CQ Station:** Provide additional lighting over CQ station to obtain a 30-footcandle luminance level on desk top.

3) **Centralized Laundry:** >Lighting level in laundry room(s) shall be 30 foot-candles. Lighting shall have automatic occupancy sensor detection switching.

4) **Mechanical, Electrical, and Telecommunication Rooms:** Lighting level in mechanical and electrical rooms shall be 30 foot-candles. Lighting shall utilize fixtures with T8 fluorescent lamps with manual on/off switching.

5) **Mail Access Area:**

6) **Mudroom/Bootwash:**

3.11. HEATING VENTILATING AND AIR CONDITIONING (HVAC) REQUIREMENTS:

A. HVAC DESIGN CRITERIA:

1) **Unit Location and Access:**

a) **Dwelling Unit**: All room/dwelling unit HVAC units shall be located in equipment closets accessible only through a corridor access door with keyed deadbolt. Corridor HVAC access doors shall be sized for ease of service and maintenance of HVAC units. Access for maintenance shall not require entry into the dwelling unit. Air filters shall be located in the equipment closet. All dwelling unit HVAC units shall have piping and duct connections that allow quick and easy removal and replacement of individual units.

2) **Ventilation:**

a) **Dwelling Unit:** Each dwelling unit shall be positively ventilated using dedicated outdoor air units. Dedicated outdoor air units (DOAUs) shall continuously supply dehumidified, tempered air ducted directly to each bedroom from DOAU. DOAU supply air ductwork shall not connect to dwelling unit heating/cooling unit. Supply air conditions from DOAU shall be between 68 and 75 degree F dry bulb and no greater than 48 degree F dew point. Supply quantity shall be 30 cfm per bedroom for a total of 60 cfm per dwelling unit.

b) **Corridors:** Corridors shall be ventilated per ASHRAE 62.1 by supply from the dedicated outdoor air unit.

c) **Vending Area:** Provide additional ventilation/exhaust to maintain vending areas temperature at levels specified for corridors.

3) **Exhaust:**

a) **Dwelling unit**: Dwelling unit exhaust shall be 45 cfm continuous through a bathroom exhaust. (Note: This exceeds ASHRAE 62.1 but provides compliance with IMC chapter 4 and maintains slight building positive pressurization with respect to dwelling unit exhaust rate of 45 cfm). DOAU unit shall be direct expansion (DX) type and cooling/dehumidification shall be available 24/7/365. Refer to chapter 6 for site specific constraints. The number of exhaust fans and DOAUs shall be the same, and exhaust fans and DOAUs shall be arranged for and shall include exhaust air energy recovery. Exhaust and DOAU systems shall be provided with variable frequency drives (VFDs) and shall be provided with a control logic that provides reduced ventilation rates during periods of low interior humidity and still meet minimum ASHRAE 62.1 requirements.

b) **Centralized Laundry**: Dryers shall be vented to exterior according to all applicable criteria and manufacturer's installation instructions. Dryer exhaust vent exterior terminations shall be located no closer than 15 feet from dwelling unit bedroom windows. Provide individual vent connections for all dryers. Locate laundry rooms on exterior wall so that dryer exhaust can be vented directly to the exterior.

4) **Ductwork:**

a) **Kitchen Range Hoods:**

(1) Ductless Type: Not Used

(2) **Ducted Type:** Kitchen range hoods shall be the U.L. listed ducted type to building exterior

B. TEMPERATURE CONTROLS:

1) Dwelling unit room temperature control shall be through the direct digital control (DDC) system. Each dwelling unit shall have a heating/cooling unit with thermostat/temperature control sensor located in common area. Occupant control will include fan selection (on/off) and an occupant temperature set point adjustment mechanism that allows +/- 2 deg F of adjustment from the DDC programmed set points (70 deg F heating, 75 deg F cooling). Additionally, the DDC controls shall monitor each dwelling unit for sub-cooling. The DDC system shall record an alarm event if the space temperature drops below 71 degree F (adjustable) when the outside air is greater than 85 degree F (adjustable). Occupant control shall also include ability to select heating or cooling mode. HVAC system shall be able to provide for year round heating or cooling in individual dwelling units as selected by the occupants. Occupant controller shall not have any provisions for occupant adjustment beyond that stated in this paragraph. Any further adjustments beyond as described shall be by authorized personnel only.

3.12. ENERGY CONSERVATION REQUIREMENTS:

A. ENERGY PERFORMATION: The building, including the building envelope, HVAC systems, service water heating, power, and lighting systems shall be designed to achieve a non-plug load energy consumption that is at least 40% below the consumption of a baseline building meeting the minimum requirements of ANSI/ASHRAE/IESNA Standard 90.1-2007 (see paragraph 5.9 Energy Conservation). (Note: Plug loads shall be included in building energy modeling but are subtracted in the final calculation of Energy Performance. See section “Design After Award” for additional guidance.)

1) **Solar Water Heating:**

B. REQUIRED ENERGY CONSERVATION FEATURES & TABLES: All design features not described below will be in accordance with the minimum requirements of ANSI/ASHRAE/IESNA Standard 90.1-2007 including conformance with paragraph 5.9.2, which requires purchase of Energy Star and FEMP designated products. Additional energy conservation features may be required to meet the above energy performance. The contractor is responsible for determining and providing additional energy conservation features to meet the energy performance requirement.

1) **Energy Conservation Features Table:**

Climate Zone 4A, Energy Conservation Features Table

Item	Component	Minimum Requirements
Roof	Attic	R-50
	Surface reflectance	0.27
Walls	Light Weight Construction	R-20
Exposed Floors	Mass	R-20
Slabs	Unheated	NR (2)
Doors	Swinging	U-0.70
	Non-Swinging	U-1.45
Infiltration		0.25 cfm/ft^2 @ 75 Pa (3)
Vertical Glazing	Window to Wall Ratio (WWR)	10% - 20%

	Thermal transmittance	U-0.45
	Solar heat gain coefficient (SHGC)	0.31
Interior Lighting	Lighting Power Density (LPD)	0.9 W/ft^2
	Ballast	Electronic ballast
HVAC	Air Conditioner	Energy Efficient Heating and Cooling System with Associated Heating and Reheat Coil DOAS with 14 SEER DX coil (3.52 COP), Hot Gas Reheat and Auxiliary Heat/ Reheat Coil
	Gas Furnace	none
	ERV	70% - 75% sensible effectiveness
Economizer		no
Ventilation	Outdoor Air Damper	Motorized control
	Demand Control	NR
	Laundry Room	Decoupled (5)
Ducts	Friction Rate	0.08 in. w.c./100 feet
	Sealing	Seal class B
	Location	Interior only
	Insulation level	R-6 (6)
Service Water Heating	Gas storage	90% E_t

2) Table Notes:

(1) NOT USED

(2) NR means there is no requirement or recommendation for a component in this climate.

(3) Increased Building Air tightness. Building air leakage (measured in cfm/ft2) is the average volume of air(measured in cubic feet per minute) that passes through a unit area of the building envelope (measured in square feet) when the building is maintained at a specified internal pressure (measured in Pascals). Testing requirements are specified in Chapter 5..

(4) Dedicated Outdoor Air System. A central dedicated outdoor air system (DOAS) providing the following:

(a) Outside air for building indoor air quality and humidity control

(b) Make-up air for bathroom and kitchen exhausts

(c) Building pressurization to prevent infiltration which allows for reduction of heating/cooling and moisture loads on the system.

(d) NOTE: The Central DOAS does not provide sensible heating or cooling. Sensible loads are provided by a complementing heating and cooling system

(5) Decoupling exhaust and supply systems for laundry rooms. To reduce unneeded energy use for heating and cooling of the make-up air and for air transportation of supply and exhausted air from the dryers, laundry exhaust and supply systems are separated in the efficient building model from the rest of the building exhaust and supply systems. Laundry exhaust system and corresponding make-up systems operate only when dryers are operating.

(6) The duct and pipe insulation values are from the ASHRAE Advanced Energy Design Guide for Small Offices.

C. COMPLIANCE DOCUMENTATION: The required energy conservation features shown in the following tables contribute to the achievement of the above energy performance and are life cycle cost effective for a UEPH facility. Use of the required energy conservation features does not eliminate the requirement for energy analysis calculations documenting compliance. The D-B contractor must document compliance with the above energy performance utilizing the methodology described in ASHRAE 90.1, Appendix G as discussed in section 01 33 16 Design After Award.

D. LOAD & SET POINT SCHEDULES: The following facility schedules must be used in all facility energy simulations for purposes of documenting compliance with energy performance requirement. The peak values indicated for each schedule shall be used for the baseline energy calculation. The hourly peak fraction values for various load components for each schedule shall be used for both the baseline and proposed design energy calculations.

1) **UEPH Common Area Internal Load Schedules**

Hr	Occupancy			Lighting			Washer/Dryer Use			Washer SHW		
	Wk	Sat	Sun	Wk	Sat	Sun	Wk	Sat	Sun	Wk	Sat	Sun
1-6	0.00	0.00	0.00	0.30	0.30	0.30	0.00	0.00	0.00	0.00	0.00	0.00
7-10	0.20	0.20	0.20	0.30	0.30	0.30	0.00	0.00	0.00	0.00	0.00	0.00
11-18	0.00	0.00	0.00	0.30	0.30	0.30	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.80	0.80	0.80	0.00	0.00	0.00	0.00	0.00	0.00
20-21	0.20	0.20	0.20	0.80	0.80	0.80	0.50	0.50	0.50	0.50	0.50	0.50
22-23	0.40	0.40	0.40	0.80	0.80	0.80	1.00	1.00	1.00	1.00	1.00	1.00
24	0.20	0.20	0.20	0.80	0.80	0.80	0.50	0.50	0.50	0.50	0.50	0.50
Peak	5 occ/floor			1.0 W/ft^2 (10.8 W/m^2)			8.4 kW/floor			53.3 gal/hr/flr (202 L/hr/flr)		

2) **UEPH Apartment Unit Internal Load Schedules**

Hr	Occupancy			Lighting			Plug Loads			Service Hot Water		
	Wk	Sat	Sun	Wk	Sat	Sun	Wk	Sat	Sun	Wk	Sat	Sun
1-5	0.80	0.75	0.75	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.00	0.00
6	0.70	0.65	0.75	0.40	0.30	0.20	0.20	0.20	0.20	0.10	0.10	0.10
7	0.60	0.60	0.70	0.70	0.50	0.30	0.40	0.35	0.20	0.40	0.40	0.40
8	0.50	0.50	1.00	0.50	0.50	0.50	0.40	0.40	0.40	0.20	0.20	0.20
9	0.25	0.25	0.00	0.20	0.20	0.20	0.30	0.40	0.40	0.00	0.00	0.00
10-17	0.20	0.20	0.20	0.20	0.20	0.20	0.30	0.30	0.30	0.00	0.00	0.00
18	0.30	0.30	0.30	0.50	0.50	0.50	0.50	0.50	0.50	0.10	0.10	0.10
19	0.50	0.30	0.30	0.70	0.70	0.70	0.50	0.50	0.50	0.10	0.10	0.10
20	0.50	0.50	0.50	0.70	0.70	0.70	0.60	0.50	0.50	0.10	0.10	0.10
21	0.70	0.50	0.50	0.70	0.70	0.70	0.60	0.50	0.50	0.00	0.00	0.00
22	0.70	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.00	0.00	0.00
23	0.80	0.75	0.75	0.40	0.40	0.40	0.40	0.50	0.50	0.00	0.00	0.00
24	0.80	0.75	0.75	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.00	0.00
Peak	2 occ/unit			1.1 W/ft^2 (10.8 W/m^2)			1.7 W/ft^2 (18 W/m^2)			40 gal/hr/person (114 L/hr/person)		

3) **UEPH Apartment Unit Internal Load Schedules**

Hr	Refrigerator	Range and Oven

Hr	Refrigerator			Range and Oven		
	Wk	Sat	Sun	Wk	Sat	Sun
1-6	1.00	1.00	1.00	0.01	0. 01	0. 01
7-16	1.00	1.00	1.00	0.04	0.04	0.04
17-18	1.00	1.00	1.00	0.05	0.05	0.05
19-20	1.00	1.00	1.00	0.11	0.11	0.11
21-23	1.00	1.00	1.00	0.10	0.10	0.10
24	1.00	1.00	1.00	0.03	0.03	0.03
Peak	76.36 W/unit			68.95 W/unit		

4) **UEPH Apartment Unit Thermostat Set-Point Schedules**

Hr	Heating (°F)			Heating (°C)			Cooling (°F)			Cooling (°C)		
□	Wk	Sat	Sun	Wk	Sat	Sun	Wk	Sat	Sun	Wk	Sat	Sun
1-24	68	68	68	20	20	20	75	75	75	24	24	24

5) **UEPH Unoccupied Zones (ie stairwells, mechanical rooms) Thermostat Set-Point Schedules**

Hr	Heating (°F)			Heating (°C)		
□	Wk	Sat	Sun	Wk	Sat	Sun
1-24	55	55	55	12.8	12.8	12.8

3.13. FIRE PROTECTION REQUIREMENTS

A. FIRE DETECTION AND ALARM SYSTEMS: The fire alarm system installation shall be supervised by a National Institute for Certification of Engineering Technologies (NICET) Level 3 (minimum) technician.

1) **Software:** All software, software locks, special tools and any other proprietary equipment required to maintain, add devices to or delete devices from the system, or test the Fire Alarm system shall become property of the Government and be furnished to the Contracting Officer's Representative prior to final inspection of the system.

2) **Smoke Detectors:** Smoke detectors shall be provided in all bedrooms. Smoke alarm signals shall be transmitted as an alarm signal to the fire department.

3.14. See paragraph 6.14 Sustainable Design – Not Used

3.15. See paragraph 6.15 Environmental – Not Used

3.16. See paragraph 6.16 permits – Not used

3.17. See paragraph 6.17 Demolition – Not used

3.18. See paragraph 6.18 Additional Facilities – Not used

3.19. EQUIPMENT AND FURNITURE REQUIREMENTS

3.19.1. FURNISHINGS

A. FURNITURE LIST/CHARTS:

1) **Dwelling Unit Furniture**:

a) **Bedrooms:** Bedroom shall be able to accommodate the following furniture with adequate circulation for one occupant:

(1) One twin bed with headboard and footboard 40” wide x 85 long”.

(2) One entertainment center 36” wide x 25” deep x 76” high.

(3) One chest of drawers 36” wide x 20” deep.

(4) One nightstand 26” wide x 20” deep.

(5) One desk 60” wide x 26” deep with retractable keyboard tray and overhead study carrel.

(6) One desk chair 19 ½” wide by 18” deep.

b) **Kitchens:** If counter seating/dining is not provided, kitchen layout shall have a dining/seating space which can accommodate the furnishing listed below:

(1) One 36 inch diameter dining table.

(2) Two chairs for the dining table.

B. CASEWORK: Provide cabinets complying with AWI Quality Standards.

1) **Dwelling Unit Casework:**

a) **Kitchens:** Provided a minimum of twelve (12) linear feet of base cabinet systems with twelve (12) linear feet of standard height counter and twelve (12) linear feet of wall cabinet systems. Twelve (12) linear feet of standard height counter includes required sink. In addition to the twelve (12) linear feet of standard height counter, kitchen layout shall accommodate a minimum of 36 linear inches of counter style seating and dining for two people, or provide space for dining table outside of the kitchen area. Provide a minimum of two 18 inches wide drawer units in the kitchen base cabinet system. Future dishwasher space shall be furnished with a removable built-in full width shelf dividing it into two equal spaces, and a pair of removable swing doors matching the rest of the kitchen cabinetry.

b) **Vanities:**

C. WINDOW TREATMENTS: Provide horizontal mini blinds at all exterior windows. Uniformity of window covering color and material shall be maintained to the maximum extent possible throughout each building. Blinds in barracks bedrooms shall be room darkening mini blinds.

3.19.2. EQUIPMENT

A. RESIDENTIAL APPLIANCES:

1) **Kitchen Appliances:** Each dwelling unit shall have a full kitchen with adequate space and circulation to accommodate:

a) **Refrigerator:** A full size refrigerator 28 inches wide. Will the REF be CFCI?

b) **Range:** Range shall be GFGI electric oven/range 30 inches wide, with a CFCI built-in combination 30 inch wide vent hood and microwave oven.

c) **Cooktop:**

d) **Garbage Disposer:** Furnish and install a garbage disposer at the kitchen sink.

2) **Dwelling Laundry:** Not Used

B. COMMERCIAL EQUIPMENT:

1) **Laundry Equipment**:

a) **Washer:** Washers shall be GFGI commercial grade.

b) **Dryers:** Dryers shall be GFGI commercial grade.

c) **Fixed Tables:** Each CFCI fixed heavy gauge stainless steel clothes folding/hanging table shall be 2'-0" deep by 5'-0" wide.

d) **Utility Sinks:** Utility sinks shall be CFCI.

2) **Vending and Ice Machine Equipment**:

a) **Vending Machines:** Vending Machines shall be full-size and shall be GFGI.

b) **Ice Machines:** Ice cube machine-dispenser shall be capable of producing a minimum 250 pounds of regular ice cubes in 24 hours, with 180 pound storage capacity and shall be GFGI

3.20. FACILITY SPECIFIC REFERENCES: (NOT USED)

3.0 COMPANY OPERATIONS FACILITY (COF)

3.1. General Requirements:

COFs provide administrative and supply facilities for unit personnel functions and storage of their equipment. These facilities serve as the primary staging, training, and deployment center for personnel and their individualized gear.

3.1.1. Facility Relationships

COFs are typically located within an operations complex along with Tactical Equipment Maintenance Facilities (motor pools) and Battalion/Brigade HQ. The facilities within this complex shall be oriented to support deployment and daily operations, and should also be located within walking distance of associated community facilities such as barracks and dining facilities.

3.1.2. Gross Building Area

Gross areas of facilities shall be computed according to subparagraphs below. 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 are met.

(1) Enclosed Spaces. The gross area includes the total area of all floors, including basements, mezzanines, penthouses, usable attic or sloping spaces used to accommodate mechanical equipment or for storage with an average height of 6'-11" measured from the underside of the structural system and with the perimeter walls measuring a minimum of 4'-11" in height, and other enclosed spaces as determined by the effective outside dimensions of the building. (NOTE: Exterior Covered Hardstand area associated with Company Operations Facilities shall be calculated as enclosed space, i.e. full scope).

(2) One-Half Spaces. One-half of the area will be included in the gross area for balconies and porches; exterior covered loading platforms or facilities, either depressed, ground level, or raised; covered but not enclosed passageways or walks; covered and uncovered but open stairs; and covered ramps.

(3) Excluded Spaces. Crawl spaces; exterior uncovered loading platforms or facilities, either depressed, ground level, or raised; exterior insulation applied to existing buildings; open courtyards; open paved terraces'; roof overhangs and soffits for weather protection; uncovered ramps; uncovered stoops; and utility tunnels and raceways will be excluded from the gross area.

3.1.3. Functional Spaces

Net area requirements for functional spaces are included in the space program table (Table 2). If net area requirements are not specified in the Statement of Work, the space shall be sized to accommodate the required function, comply with code requirements, comply with overall gross area limitations and other requirements of the RFP (for example, area requirements for corridors, stairs, and mechanical rooms will typically be left to the discretion of the Offeror).

3.1.4. Handicapped Access

COFs are intended for use by able-bodied military personnel only, therefore, are not required to meet handicapped accessible requirements.

3.1.5. Site Design and Functional Area

Site features include service yard and service yard drives, utilities, and site improvements.

3.2. FUNCTIONAL AND OPERATIONAL REQUIREMENTS

3.2.1. General

COF functional layout and adjacency requirements are as indicated on drawings. The extent to which the drawings represent required or preferred layouts and the allowable latitude for changes to them is as noted on the drawings. COFs should be easily adaptable to accommodate variations in size and number of companies in the Army's future force. The design objective of the basic battalion level COF complex is to provide a flexible facility suitable to a mix of battalions of varying composition while utilizing a modular approach.

3.2.2. Functional Areas

The COF is comprised of three vertical construction components consisting of an Administrative Module, Readiness Module, and exterior covered hardstand. In conjunction with this, each site-specific project shall include necessary site amenities, such as vehicle service yards, access drives, equipment wash stations, and exterior utilities. These components are more fully described below.

(1) Administration Module. Space shall be provided for the following administration and support functions:

(a) Private offices for the Commander, First Sergeant, Executive Officer and Training Room

(b) Space for printer and fax machines, waste and paper recycling receptacles, and supply closet for storage

(c) Shared office space for platoon leaders and platoon sergeants

(d) Conference space for meetings and/or training

(e) Showers, locker room, and latrines to serve both the administrative personnel assigned to the company and for off post personnel – a place for commuters to shower and change after PT

(f) Consolidated utility spaces to serve the entire facility including a mechanical room, electrical room, telecommunication rooms (including SIPRNet), janitor's closet, vending area to also accommodate recycling receptacles and recycling storage closet. Accommodation for Secure Internet Protocol Routing Network (SIPRNet) shall be constructed in accordance with AR 380-5, Chapter 7.

(2) Readiness Module. Space will be provided for the following operational and supply functions:

(a) Readiness Bays to provide accommodation for individual combat equipment (TA-50) lockers (CFCI) for all unit personnel, plus co-located area for equipment maintenance, training, and pre-deployment preparations. Interior equipment maintenance area will be nominally sized so that up to 50 percent of the unit personnel can layout TA-50 gear simultaneously, based on providing 40 square feet (5-foot by 8-foot plus a circulation factor) for each layout space. Each company area shall accommodate forklift access from the readiness bay to the exterior loading areas. The bay floor shall be capable of supporting forklift movement throughout the area. Slab shall be designed for forklift truck maximum axle load of 5 kips and maximum load capacity of 2 kips. Interior mud wash utility sinks shall be provided in the Readiness Areas. Sinks shall be allocated on the basis of one utility sink for every 50 soldiers in the company.

(b) Supply Bays to provide storage space for company supplies and equipment - Tables of Equipment (TOE) and Common Tables of Allowance (CTA), weapons, and consumable supplies (including items awaiting issue, turn-in, or repair). Also, it provides accommodation for the supply sergeant, supply clerk(s) and the armorer in performing shipping and receiving functions. Specific storage areas included in the supply bay include:

- Weapons vault for storage of arms, ammunition, and explosives (AA&E)
- Secure storage room for non-sensitive items (high value items, other than AA&E, for which accountability is a concern)
- Nuclear, biological, and chemical (NBC) equipment storage
- Communications equipment storage
- Consumable unit storage

(c) Accommodation for overflow/expansion from either admin or storage spaces. This provision shall be accomplished by the utilization of a mezzanine over the entire open area of the Readiness Module, within the area limitations of IBC and NFPA 101. The drawings indicate preferred overflow/expansion arrangements that meet user operability requirements. The expansion space indicated on the drawings shall be provided at the time of initial project construction.

(3) Exterior Covered Hardstand. Outside sheltered space for equipment maintenance, weapons cleaning, and pre-deployment preparation. This area shall be sized in accordance with Paragraph 2.0 SCOPE. The preference is to provide a column free interior to the greatest extent possible to allow for the greatest flexibility in use. The minimum canopy height shall be 14'-0" or such height as required to allow for operational truck access. The minimum clear depth shall be 30'-0".

3.2.3. COF Army Standards

The following items are the Army mandatory features for the COFs.

(1) Battalion Centric Design. Design that consolidates COFs for an entire battalion in a single building. The design standard is intended to create a facility that consolidates between three and eight companies of a battalion in a single building. This single building can be reconfigured internally without changing the footprint of the building if the battalion structure changes.

(2) Open, Flexible Design for Admin and Readiness Modules. Open, flexible design for both admin and readiness modules, easy to reconfigure in response to changes in force structure, equipment, and doctrine. Consistent with the battalion centric focus, both the admin and the readiness (supply) modules will employ design features that are durable but reconfigurable without altering the structural design of the building. The goal is to allow ready adaptability in response to changes in force structure, equipment, and doctrine. The addition of internal load bearing structures that limit design flexibility will not be permitted.

(3) TA-50 Lockers. Individual combat equipment (TA-50) lockers in sufficient quantity to meet the upper limit of the design capacity of the facility (100 percent of maximum personnel in each company). Provide permanently installed, individual steel lockable lockers sized 42” (w) x 24” (d) x 78” (h) to allow each soldier to securely store current TA-50 as well as future Soldier Systems equipment.

(4) Interior Operations and Maintenance Area. The interior space of the readiness module is intended to provide space for equipment maintenance and pre/post-deployment checks, as well as other unit preparatory and training requirements. The space includes the provision for individual TA-50 and other equipment storage, and future fielding of Soldier Systems equipment. The space is to be nominally sized to provide 40 SF layout areas for 50 percent of the upper limit of the design capacity of the facility (50 percent of the maximum personnel). Variations to the locker arrangement shown in the drawings are permitted, but may result in a reduced number of layout spaces. Revised configurations that reduce the available layout area to less than 25 percent of the design capacity of the readiness module will not be permitted. The readiness module will be designed to accommodate the use of fork lifts. In addition to the above, wire mesh cage storage shall be provided for unit supply, NBC, and communications equipment located at the supply bay area .

(5) Exterior Covered Hardstand. Exterior covered hardstand adjacent to the Readiness Module will be provided for each company to accommodate outside equipment maintenance, weapons cleaning, pre/post-deployment preparation, vehicle loading, close formation, etc. This space is to be nominally sized to provide 40 SF layout areas for 25 percent of the upper limit of the design capacity of the facility (25 percent of the maximum personnel). Water, lighting, and electrical connections shall be provided.

(6) Arms Vaults. Arms vaults to accommodate storage of arms, ammunition and explosives (AA&E) shall be provided for each company. These vaults shall be designed in accordance with physical security requirements contained in AR 190-11, Appendix G. An option exists for use of prefabricated, modular vaults conforming to Fed. Spec. AA-V-2737 requirements. 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.

(7) Non-Sensitive Secure Storage (other than AA&E). Intent is to provide secure storage of items with a high dollar value or items for which command accountability is required. The room shall be constructed of material to prevent forcible entry. The minimum acceptable construction is expanded steel

fabric behind impact resistant gypsum board at both walls and ceiling. 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 hasp to accommodate a high security padlock

(8) Consolidated Showers and Latrines. A single set of shower/latrine facilities will be provided for each combined COF (UNICOF). The design layout shall allow adjustment for the ratio of males and females in any unit by repositioning the dividing wall between their facilities at the time of initial construction. The facilities will have Both access to these facilities. Lockers with benches will be provided on a 3:1 ratio of lockers/shower. Minimum locker size shall be 12”(w)x18”(d)x36”(h).

(9) Economy of Construction to Suit Function. Designers shall consider economy of construction to suit the function, i.e. warehouse or light industrial type facilities.

(10) Operational Site Orientation. Operational facility relationships require locating COFs within a complex with direct access to the unit motor pool or other corresponding work areas. The intent is to provide a single battalion centric complex containing facilities to support company operations and vehicle maintenance in a single fenced compound. When site conditions do not permit this configuration, COFs should be placed adjacent to the vehicle maintenance complex to facilitate the movement of personnel and equipment between the two facilities.

3.3. TECHNICAL REQUIREMENTS

3.3.1. Site Design

The following site design requirements are applicable to the design of COFs:

(1) Exterior Covered Hardstand

Provide an exterior covered hardstand adjacent to the readiness module. Provide weatherproof lighting and weatherproof general purposes receptacles with ground fault protection. Lighting control shall be provided with local switches with photocell override. Provide one duplex receptacle for every two columns. The concrete pavement under the Covered Hardstand shall have a slope of no more than 2%.

(2) Service Yard

Provide a rigid concrete pavement for the service yard from the Readiness Module/Exterior Covered Hardstand (depending on site layout) to the project demarcation line. The service yard shall be a minimum of 80’ deep in order to accommodate up to a 35-foot long vehicle with a 45-foot turning radius along the entire length of the Readiness Module/Exterior Covered Hardstand. The service yard shall be sloped to drain away from the Readiness Module/Exterior Covered Hardstand area with a slope of no more than 2%. Provide accommodation for boot/TA-50 gear equipment washing, drainage, and grit removal. Provide one boot/TA-50 gear washing station per company. Each wash station shall include four freeze proof hose bibb and drying rack (handrail).

(3) Entrance Drive into Service Yard

Provide two 28-foot wide rigid concrete pavement entrance drives from the Service Yard to an adjacent roadway. Service drives shall be located on opposite sides of the service yard.

(4) Bollards

Provide 6-inch diameter by 5-foot high, concrete-filled, schedule 80 galvanized steel pipe bollards, 5-foot O.C. spacing, painted safety yellow for each column of the exterior covered hardstand located adjacent to the service yard where frequent vehicle movement increases the risk of damage by vehicle impact. Also, provide bollards 5 feet from the edge of electrical and mechanical equipment, and to protect the corners of Admin/Readiness buildings. Bollard footings shall be designed to withstand vehicular impact.

(5) Privately Owned Vehicles (POV) Parking

POV parking to be provided by others.

3.3.2. Architectural Design

(1) Exterior architectural features of the building shall be designed based on the following and in accordance with the established Installation architectural theme.

(2) The Readiness Module shall be constructed to meet the requirements of a Risk Level II analysis in accordance with AR 190-51 and AR 190-13. In conjunction with this, it has been determined that a minimum exterior wall construction consisting 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. The minimum interior wall construction for dividing walls between company readiness areas shall consist of a stud wall with impact resistant gypsum wall board each side.

(3) Natural Lighting. Provide windows for natural lighting and ventilation in all office areas wherever possible. All operable windows provided shall have locks and insect screens. Preference is for natural lighting to be provided at Readiness Areas to the greatest extent possible.

(4) 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, which are to be solid core wood in a metal frame. In addition to the sound insulation required, conference areas shall meet a Noise Criteria (NC) 30 rating in accordance with ASHRAE Fundamentals Handbook.

(5) Office and Administrative Areas. The preference is to provide maximum flexibility for future change within office and administration areas. The command section offices shall be constructed to provide privacy and sound control in accordance with SOUND INSULATION paragraph above. The intent for these areas is to minimize load-bearing walls to the greatest extent possible so as to accommodate future reconfiguration of spaces. This same construction requirement is also applicable to walls between companies in the readiness areas.

(6) TA-50 Storage Lockers. TA-50 lockers shall be provided as indicated in Paragraph 3.2.3 (3), with size and appearance similar to that shown below. TA-50 lockers shall be single tier, heavy duty, all welded ventilated type and meet the following minimum requirements:

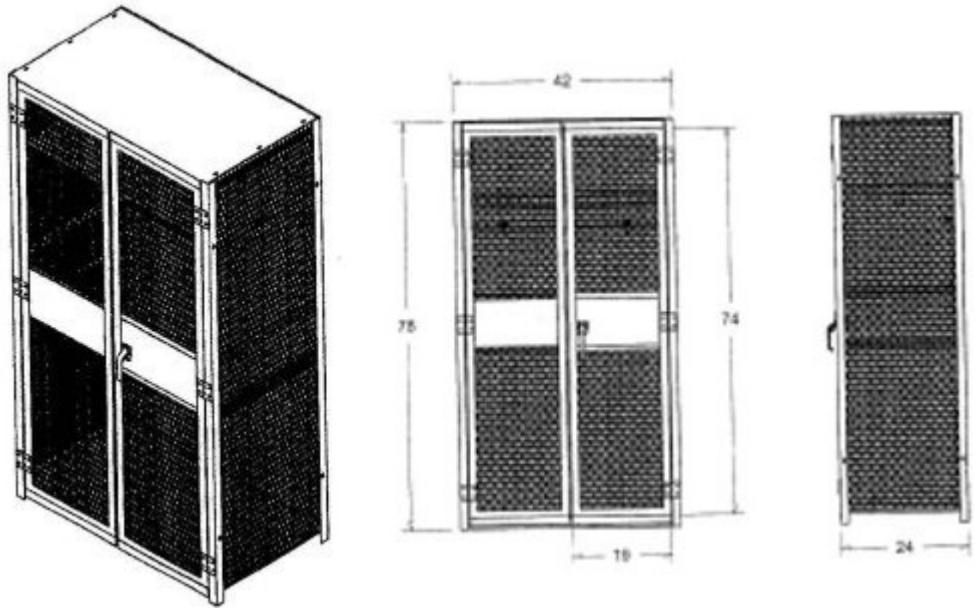
(a) All tops, bottoms and shelves shall be constructed of minimum 16 gauge thick cold rolled sheet steel. All sides, intermediate partitions and backs shall be constructed of minimum 14 gauge flattened expanded metal or perforated metal with a minimum free area of 50%, welded to angle iron frames. Frames 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 hangar 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.

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



3.3.3. Fire Protection

(1) Standards and Codes

All fire protection and life safety features shall be in accordance with UFC 3-600-01 and the criteria referenced therein. COFs shall be classified as mission essential and shall be provided with sprinkler protection.

(2) Fire Protection and Life Safety Analysis

A fire protection and life safety design analysis shall be provided for all buildings in the project. The analysis shall be submitted with the interim design submittal. The analysis shall include classification of occupancy (both per the IBC and NFPA 101); type of construction; height and area limitations (include calculations for allowable area increases); life safety provisions (exit travel distances, common path distances, dead end distances, exit unit width required and provided); building separation or exposure protection; specific compliance with NFPA codes and the IBC; requirements for fire-rated walls, doors, fire dampers, etc.; analysis of automatic suppression systems and protected areas; water supplies; smoke control systems; fire alarm system, including connection to the base-wide system; fire detection system; standpipe systems; fire extinguishers; interior finish ratings; and other pertinent fire protection data. The submittal shall 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 necessary to exhibit compliance with life safety code requirements.

(3) Sprinkler System

Provide complete sprinkler protection for Company Operations Facilities, including both Administrative Modules and Readiness Modules, designed in accordance with UFC 3-600-01 and NFPA 13. Wet pipe sprinkler systems shall be provided in areas that are heated and dry pipe sprinkler systems shall be provided in areas subject to freezing. The Covered Hardstand, if not separated by adequate distance per the IBC, Table 602, shall be considered to be part of the COF facility and shall require sprinkler protection. The sprinkler system design shall be in accordance with UFC 3-600-01 and NFPA 13. The sprinkler hazard classifications shall be in accordance with UFC 3-600-01, NFPA 13, and other applicable criteria. Design densities, design areas and exterior hose streams shall be in accordance with UFC 3-600-01. The sprinkler systems shall be designed and all piping sized with computer generated hydraulic calculations. The exterior hose stream demand shall be included in the hydraulic calculations. A complete sprinkler system design,

including sprinklers, branch lines, floor mains and risers, shall be shown on the drawings. The sprinkler system plans shall include node and pipe identification used in the hydraulic calculations. All sprinkler system drains, including main drains, test drains, and auxiliary drains, shall be routed to a 2-foot by 2-foot splash block at exterior grade.

(a) Sprinkler Service Main and Riser

The sprinkler service main shall be a dedicated line from the distribution main. Sprinkler service and domestic service shall not be combined. The sprinkler service main shall be provided with an exterior post indicator valve with tamper switch reporting to the fire alarm control panel (FACP). The ground floor entry penetration shall be sleeved per NFPA 13 requirements for seismic protection. The sprinkler entry riser shall include a double check backflow preventer, a fire department connection, and a wall hydrant for testing of backflow preventer. The sprinkler system shall include an indicating control valve for each sprinkler system riser, a flow switch reporting to the FACP, and an exterior alarm bell. All control valves shall be OS&Y gate type and shall be provided with tamper switches connected to the FACP. Facilities with multiple floors shall be provided with floor control valves for each floor. The floor control valve assembly shall be in accordance with UFC 3-600-01, Figure 4-1.

(b) Exterior Hose Stream

Exterior hose stream demand shall be in accordance with UFC 3-600-01. Exterior hose stream demand shall be included in the sprinkler system hydraulic calculations.

(c) Backflow Preventer

A double check backflow preventer shall be provided on the fire water main serving each building. This shall be located within the building. An exterior wall hydrant with dual hose connections with OS&Y valve shall be provided to allow testing of backflow preventer at design flow as required by NFPA 13.

(d) Fire Department Connection

A fire department connection shall be provided for each building with sprinkler protection. These shall be located to be directly accessible to the fire department.

(4) System Components and Hardware

Materials for the sprinkler system, fire pump system, and hose standpipe system shall be in accordance with NFPA 13 and NFPA 20.

(5) Protection of Piping Against Earthquake Damage

Sprinkler and fire pump piping systems shall be protected against damage from earthquakes. Seismic protection shall include flexible and rigid couplings, sway bracing, seismic separation assemblies where piping crosses building seismic separation joints, and other features as required by NFPA 13 for protection of piping against damage from earthquakes.

(6) Fire Water Supply

Fire flow test data is provided in Appendix D.

(7) Fire Pump

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 a complete fire pump installation shall be provided for the facility. It shall comply with the requirements of UFC 3-600-01, NFPA 13 and NFPA 20. The Contractor shall submit fire pump design analysis and drawings in the design requirements.

(8) Fire Detection and Alarm

Refer to Paragraph 3.3.7, Electrical and Communication Systems, for requirements.

(9) Building Construction

Construction shall comply with requirements of UFC 3-600-01, the International Building Code and NFPA 101.

(a) Fire Extinguisher Cabinets and Brackets

Fire Extinguisher cabinets and brackets shall be provided when fire extinguishers are required by UFC 3-600-01 and NFPA 101. Placement of cabinets and brackets shall be in accordance with NFPA 10. Semi-recessed cabinets shall be provided in finished areas and brackets shall be provided in non-finished areas (such as utility rooms, storage rooms, shops, and vehicle bays). Fire extinguishers shall not be provided in this contract.

(b) Interior Wall and Ceiling Finishes

Interior wall and ceiling finishes and movable partitions shall conform to the requirements of UFC 3-600-01 and NFPA 101.

3.3.4. Thermal Performance

See Paragraph 5.

3.3.5. Plumbing

(1) Exterior Wall Hydrants

In addition to wall hydrants provided around perimeter of building(s), one additional freeze-proof exterior wall hydrant or wall faucet per company shall be provided at the hardstand.

(2) Domestic Hot Water System

The main water heating equipment shall be located within a mechanical room, and also located on the ground floor level only. Instantaneous water heaters are not allowed to be used for hot water serving all COF areas except Readiness Area. System storage and recovery shall be sized to deliver sufficient capacity for all showers, for a continuous duration of ninety (90) minutes. Usage diversity factor for the showers shall be one. Minimum system total storage of water heater(s) shall be 400 gallons for 1- and 2-company COFs, and 600 gallons for 3-company and larger COFs.

3.3.6. Heating, Ventilating, and Air Conditioning

(1) Administrative Areas

See Paragraph 5 for heating and cooling of administrative areas. The admin building's HVAC system design should include flexibility in zoning to where it can address future changes in occupant densities (e.g., a platoon office suite converted to a conference room). Administrative areas shall be temperature-controlled by the DDC system. Temperature setpoint adjustment shall be accomplished via DDC System by authorized personnel.

(a) 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-space 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.

(2) Readiness Areas

The readiness module shall be heated and air conditioned. Separate air side equipment (heating, ventilation and air conditioning units) shall be provided for each readiness module. Indoor design temperature for heating shall be 55 degrees F, and for cooling the indoor design conditions shall be 80 degrees F dry bulb with a maximum 60 percent relative humidity. Whenever the indoor dry bulb temperature and/or the maximum relative humidity is exceeded, the air conditioning unit shall run, and shall continue to run until the design dry bulb temperature and the relative humidity requirements are satisfied. The air conditioning unit serving the readiness area shall be capable of providing outside air quantities, in accordance with ASHRAE 62.1, for the design people load of the readiness area. Arms vaults shall be cooled to 80 degrees F with room air to be 100% exhausted. Ventilation for Arms Vaults shall be provided in accordance with ASHRAE 62.1 requirements for storage rooms. Communication rooms located in Readiness Building will be served by an independent and dedicated air-handling system and shall be conditioned per Administrative Areas paragraph requirements. Administrative-type areas located within the Readiness Building shall be conditioned per Paragraph 5 requirements.

(3) HVAC Controls

HVAC Controls shall be in accordance with paragraph 5.8.3. See Appendix for HVAC Controls for typical control system points schedules. These schedules identify as a minimum points to be monitored and controlled by the building automation system (BAS). See paragraph 6 for any additional installation specific points. The points schedule drawings convey a great deal of information critical to the design, installation, and subsequent performance of the control system. It includes hardware input/output information, device ranges and settings, ANSI 709.1 communication protocol data, and information about data that is to be used at the operator workstation by the Monitoring and Control software. These schedules are available as an excel spread sheet and as AutoCAD drawings on the Engineering Knowledge Online (EKO) website https://eko.usace.army.mil/fa/bas/. Point schedule of system types not addressed in the appendix shall be developed by the Contractor, and shall be sufficiently detailed to a level consistent to a similar listed system in the appendix. It is recommended that all of the guidance and instruction documents be reviewed prior to using any of the info, as the documents provide necessary and critical information to the use of the website drawings and other information.

3.3.7. Electrical and Communications

See Paragraph 6 for clarifications and additional requirements for the electrical and communication systems.

(1) Interior Electrical and Communications

(a) Electrical

1. Characteristics. Select electrical characteristics of the power system to provide a safe, efficient, and economical distribution of power, based upon the size and types of loads to be served. Use distribution and utilization voltages of the highest level that is practical for the load to be served.

2. Nonlinear Loads. The effect of nonlinear loads such as computers and other electronic devices shall be considered and accommodated as necessary. These loads generate harmonics, which can overload conventionally sized conductors or equipment and thereby cause safety hazards and premature failures. Circuits serving such devices shall be equipped with a separate neutral conductor not shared with other circuits. Panelboards and any dry type transformers shall be rated accordingly.

3. Lightning Protection System and Transient Voltage Surge Protection. Design shall be in accordance with NFPA 780 and other referenced criteria. Provide transient voltage surge protection.

4. Receptacles. Power receptacles shall be provided per NFPA 70 and in conjunction with the proposed equipment and furniture layouts. Provide power connectivity to each workstation. Power poles shall not be used. Provide duplex receptacles adjacent to each duplex (voice/data) outlet and CATV outlet.

(b) Lighting. Lighting and lighting controls shall comply with the recommendations of the Illumination Engineering Society of North America (IESNA) and the requirements of ASHRAE 90.1.

1. Interior Lighting. Interior ambient illumination shall provide a generally glare free, high quality lighting environment and conform to IESNA RP-1-04.

(c) Telecommunication

1. Telecommunications Rooms. Telecommunications Rooms shall be provided for voice and data as shown on the standard design layouts. The telecommunications rooms shall be designed in accordance with the I3A Criteria.

2. Telecommunications Outlets. Telecommunications outlets shall be provided per the I3A Technical Criteria based on functional purpose of the various spaces with the facility as modified by user special operational requirements. All COF workstations\desks shall have voice and data connection capability. All conference rooms shall have voice and data connection capability (minimum four outlets). A wall telephone outlet with a single jack shall be provided in each mechanical room, electrical room, arms vault and communications room and entrances/exits in the Readiness Modules. Provide a duplex outlet (voice/data) for a network printer/copier in the vending area and in the storage room adjacent to each suite. Provide a duplex (voice/data) outlet at the desk in each of the Storage Rooms and Arms Vault in the Readiness Module. Telecommunications infrastructure shall meet the Installation Information Infrastructure Architecture (I3A) Criteria and ANSI/TIA/EIA requirements.

3. Cable Trays. Provide cable tray pathways through-out the facility (Admin and Readiness Modules) to support the systems required for the construction of the facility as well as user's computer networks, video integration system, telecommunication systems and other specialized electronic systems.

4. For Detached Readiness Modules, provide a separate communication room on the mezzanine as shown with the integrated Admin Option of the floor plans. The telecommunications rooms shall be designed in accordance with the I3A Criteria and ANSI/EIA/TIA-569-B. Where copper cable runs exceed 295 feet, provide additional telecommunication rooms on the mezzanine as required. The incoming telephone service (voice and data) shall be from the nearest manhole or from the main telephone communication room in the Admin Module, size the cables and conduits as per I3A Criteria.

5. All copper cabling leaving one building to go to another shall be treated as OSP cable and follow OSP cable requirements as stated in section 3.5.4 of the I3A and I3MP Grounding and Bonding Guide; this includes use of protector blocks and other grounding requirements as necessary to avoid lightning issues resulting in damaging of IT equipment.

6. Option to use fiber cable via OSP cable is authorized from the main TR and will be terminated inside the next building on a fiber distribution panel, rack, or cabinet as required, with a minimum of 6-strands.

(d) SIPRNET

1. SIPRNET for Explosive Ordnance Disposal (EOD) and Military Intelligence (MI) COFs.

a. The SIPRNET room and infrastructure shall be designed and constructed in accordance with the Technical Guide for the Integration of SIPRNET (Secret Internet Protocol Router Network) and 13A Criteria. The SIPRNET building infrastructure design and installation shall be coordinated with the local NEC. As an option the Communication Room and the SIPRNET Room can be combined into a single room if a SIPRNET safe/container can be used. Coordinate this option with the local NEC.

b. In the NSTISSI 7003 and the Technical Guide for Integration of SIPRNET, paragraph “Protective Distribution System”, the word "shall" shall be substituted for the word "should" or “will” in this paragraph.

c. Install one SIPRNET outlet with one drop in the office of each Company Commander (CO CDR), Executive Officer (XO), 1st Sergeant (1SG), and each Platoon Office. Install one SIPRNET outlet with two drops in each unit conference room. The SIPRNET building infrastructure shall use Category 6 UTP copper cables with red cable jacket and red outlet modules unless otherwise directed by the local NEC. Cables shall be terminated in the SPIRNET room and at the outlet in accordance with the I3A Technical Criteria for data cables.

d. SIPRNET draft specifications are located in the SIPRNET Technical Implementation Criteria, version 6, dated October 2010.The surface mounted raceway shall be used instead of the surface mounted conduit unless otherwise indicated by the local NEC.

2. SIPRNET for all other COFs. Only a SIPRNET Room shall be provided for future SIPRNET connectivity. The SIPRNET room shall be designed and constructed in accordance with the Technical Guide for the Integration of SIPRNET (Secret Internet Protocol Router Network) and I3A Criteria. Connection to the main telecommunications room from the SIPRNET room shall be via a 2-inch trade size steel conduit. Provide a communications signal ground bus bar connected to the main communications room signal bus bar via a properly sized ground wire (see MIL-HDBK-419-A). Provide one dedicated standard 20-amp duplex receptacle for a future SIPRNET rack in addition to convenience receptacles in the SIPRNET room.

(e) Cable Television. CATV shall be provided in all offices, conference rooms (minimum two outlets), and one in each of the readiness areas. The cable television system shall consist of cabling, pathways, and outlets. All building CATV systems shall conform to APPLICABLE CRITERIA to include I3A Technical Criteria and the UFC 3-580-01 Telecommunications Bldg Cabling Systems Planning/Design.

(f) Audio/Visual Systems. Provisions (consisting of a power receptacle and conduit for signal wiring) for a Government-furnished Government-installed projector shall be provided in each conference room.

(g) Intrusion Detection System. Contractor shall install the necessary conduit, electrical power, and wiring, to support installation of an ICIDS system in each of the Arms Room and SIPRNET Room. The Government normally installs the signal devices and equipment necessary to activate the system. Contact the Physical Security Office for guidance. If a SIPRNET safe/container is used, ICIIDS may not be required for this room. Contact the Physical Security Office for guidance.

(h) Mass Notification System. A mass notification system shall be provided for each facility and throughout the complex in accordance with UFC 4-010-01. The system shall be fully compatible with and integrated with the local Installation wide Mass Notification System.

(i) Grounding. The ground counterpoise shall be provided around the building perimeter and shall be utilized for grounding incoming service, building steel, telephone service, piping, lightning protection, and internal grounding requirements. Ground straps shall be provided where required by function and will be connected to the building grounding system. Additional grounding may be provided based on project requirements. Systems shall conform to NFPA 70 National Electrical Code, NFPA 780 Lightning Protection Code, local codes, and the US Army I3A Criteria.

(j) Fire Detection and Alarm

1. A fire alarm and detection system shall be provided for this facility. It shall comply with the requirements of UFC 3-600-01 and NFPA 72. The system shall be addressable and fully compatible with and integrated with the local Installation wide Fire Alarm System.

2. All initiating devices shall be connected, Class A, Style 6, to signal line circuits (SLC). All alarm appliances shall be connected to notification appliance circuits (NAC), Class A. A looped conduit system shall be provided so that if the conduit and all conductors within are severed at any point, all NAC and SLC shall remain functional.

3. Breakglass manual fire alarm stations shall not be used.

4. Over-voltage and surge protection shall be provided at the input power of all panels.

(k) Future Soldier LAN Warrior System. Provide a disconnect switch (208/120V, 3 phase, 4 wire) in each of the Secure Non-Sensitive Storage Room in the Readiness Module. Size the disconnect switch(s) and the circuit breaker(s), conductors and conduit(s) from a 208 volt, 3 phase, 4 wire distribution panel to the disconnect switch(s) based on a 200 VA continuous demand load for 100 percent of the maximum personnel in each Company Readiness Area. (i.e. 150 man Readiness module x 200 VA= 30,000 VA.)

3.3.8. Energy Conservation

(1) Energy Performance. The building, including the building envelope, HVAC systems, service water heating, power, and lighting systems shall be designed to achieve a non-plug load 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 (see paragraph 5.9 Energy Conservation). (Note:

Plug loads shall be included in building energy modeling but are subtracted in the final calculation of Energy Performance. See section “Design After Award” for additional guidance.)

(2) Required Energy Conservation Features. All items listed in the required energy conservation features table shall be provided as a minimum. Additional energy conservation features may be required to meet the above energy performance. The contractor is responsible for determining and providing additional energy conservation features to meet the energy performance requirements. Where equipment types are indicated, only minimum efficiencies apply.

(3) Compliance Documentation. The required energy conservation features shown in the table above contributes to the achievement of the above energy performance and are life cycle cost effective for a COF. Use of the required energy conservation features does not eliminate the requirement for energy analysis calculations documenting compliance. The D-B contractor must document compliance with the above energy performance utilizing the methodology described in ASHRAE 90.1, Appendix G as discussed in section 01 33 16 Design After Award. The design analysis shall document each of the features selected to achieve the specified energy performance.

(4) Schedules. The following facility schedules must be used in all facility energy simulations for purposes of documenting compliance with energy performance requirements.

COF Climate Zone 4A, Energy Conservation Features Table(8)

Item	Component	Minimum Requirements	
		Assembly Max (2)	**Min R-Value (2)**
Roof	Insulation Entirely Above Deck	U-0.0388	R-25ci
	Attic and Other		R-38
	Solar Reflectance (3)		Cool Roof for Low Slope & Light color all others
Walls	Mass	U-0.0676	R-13
	Steel Framed		R-13 + R-7.5ci
	Wood Framed and Other		R-13 + R-3.8ci
Floors Over Unconditioned Space	Mass	0.0739	R-10.4ci.
	Steel Joist		R-13
	Wood Framed and Other		R-13
Slab-on-Grade	Unheated	F-0.520	R-15.0 for 24 in.
	Heated	F-0.843	R-20.0 for 24 in.
Doors	Swinging	U-0.50	Insulated
	Non-Swinging	U-0.50	Insulated
Infiltration		0.25 cfm/ft^2 @ 75 Pa (5)	
Vertical Glazing	Window to Wall Ratio (WWR)	< 15%	
	Thermal transmittance	U-0.42	
	Solar heat gain coefficient (SHGC)	0.39	
	South Overhangs	Yes; Projection Factor = 0.4	
Interior Lighting	Lighting Power Density (LPD)	See Lighting Power Table Below (6)	
	Occupancy Controls	Manual On/Auto Off (all periodically occupied spaces)	

Item	Component	Minimum Requirements	
		Assembly Max (2)	**Min R-Value (2)**
	Daylighting Controls	NR	
	Plug Load Lighting	Compact Fluorescent (CFL) with electronic ballast	
	All Ballasts	Electronic	
Ducts	Friction rate	0.08 in. w.c./100 feet	
	Sealing	Seal class B	
	Location	Interior only	
	Insulation level	R-6 (7)	
Service Water Heating	Gas hot water storage	90% Et	
	Pipe Insulation(d < 1.5in. / d ≥ 1.5 in.)	1 in. / 1.5 in. (7)	

Notes:

1. **Omitted.**
2. **U-values and R-values** for assemblies and their definitions, requirements, and determinations can be found in ANSI/ASHRAE/IESNA Standard 90.1.
3. **Light colored and cool roofs**: reflect and emit the sun's heat back to the sky instead of transferring it to the building below. "Coolness" is measured by two properties, solar reflectance and thermal emittance. Both properties are measured from 0 to 1 and the higher the value, the "cooler" the roof. A high reflectance keeps much of the sun's energy from being absorbed, while a high thermal emittance radiates away any solar energy that is absorbed, allowing the roof to cool more rapidly. Cool roofs are typically white and have a smooth surface. Commercial roof products that qualify as cool roofs fall into three categories: single-ply, liquid-applied, and metal panels. The solar reflectance and thermal emittance property values represent initial conditions as determined by a laboratory accredited by the Cool Roof Rating Council.

   Cool roofs are cost effective over air-conditioned spaces for buildings located in climate zones 1 - 5. In these locations, a minimum of 75% of the entire roof surface not used for roof penetrations shall be covered with roofing products that comply with one or more of the following:

   - Have a minimum initial SRI of 78 for a low-sloped roof (a slope less than or equal to 2:12) and a minimum initial SRI of 29 for a steep-sloped roof (a slope of more than 2:12).
   - Comply with the criteria for the US EPA's Energy Star Program Requirements for Roof Products – Eligibility Criteria.

   For industrial buildings with only heating and ventilation, cool roofs can improve the comfort conditions (and hence productivity) in the space.

   In order to be considered a cool roof, a solar reflectance of 0.67 when tested in accordance with ASTM C1549, ASTM E903, or ASTM E1918 and, in addition, a minimum thermal emittance of 0.75 when tested in accordance with ASTM C1371 or ASTM E408, or a minimum Solar Reflective Index of 78 when determined in accordance with the Solar Reflectance Index method in ASTM E1980 where standard white is SRI = 100 and standard black has SRI = 0. An SRI can be determined by the following equations:

$$SRI = 123.97 - 141.35(x) + 9.655(x^2)$$

   Where

$$x = \frac{20.797 \times \alpha - 0.603 \times \varepsilon}{9.5205 \times \varepsilon + 12.0}$$

Where α is the solar absorptance (= 1 – solar reflectance) and ε is the thermal emissivity, which were derived from ASTM E1980 assuming a medium wind speed.

The limited color choices available for cool roofs may not be acceptable to the installation. When this conflict cannot be resolved, the designer shall use the highest reflectance available in the roofing type/color acceptable to the installation.

Characteristics of reflective roofing materials.

Roofing Type	Color	New Solar Reflectance	Aged Solar Reflectance	New Thermal Emittance	SRI (ASTM E1980
Roof Coatings	White	0.70 – 0.85	0.50 –0.65	0.85	84 – 106
Roof Coatings	Grey or Tan	0.70	0.50	0.85	84
Roof Coatings	Terra Cotta or Brown	0.40	0.30	0.85	43
Roof Coatings	Aluminized	0.50	0.40	0.50	42
Metal Paint	Red	0.25	0.25	0.83	22
Metal Paint	Terra Cotta	0.35	0.35	0.83	36
Metal Paint	Bright Red	0.35	0.35	0.83	36
Metal Paint	Beige/Off White	0.55	0.55	0.83	63
Metal Paint	Tan	0.45	0.45	0.83	49
Metal Paint	Dark Blue	0.25	0.25	0.83	22
Metal Paint	Medium to Light Blue	0.32	0.32	0.83	32
Metal Paint	Dark Brown	0.25	0.25	0.83	22
Metal Paint	Medium to Light Brown	0.32	0.32	0.83	32
Metal Paint	Dark Green	0.25	0.25	0.83	22
Metal Paint	Medium to Light Green	0.32	0.32	0.83	32
Metal Paint	White	0.65	0.65	0.83	77
Metal Paint	Bright White	0.70	0.70	0.83	84
Metal Paint	Black	0.25	0.25	0.83	22
Metal Paint	Dark Grey	0.25	0.25	0.83	22
Metal Paint	Medium to Light Grey	0.35	0.35	0.83	36
Metal Paint	Pearlescent Colors	0.35	0.35	0.75	32
Galvalume	Unpainted	0.65	0.55	0.05	45
Copper Metal	Unpainted	0.85	0.18	0.03	89
Galvanized Steel	Unpainted	0.40	0.20	0.50	26
EPDM Membrane	Black	0.05	0.10	0.85	0
TPO Membrane	White	0.80	0.60	0.85	99
TPO Membrane	Grey	0.50	0.40	0.85	57
PVC Membrane	White	0.80	0.60	0.85	99
PVC Membrane	Grey	0.50	0.40	0.85	57
Asphalt Shingle	Dark Color	0.10	0.10	0.85	4
Asphalt Shingle	Light Color	0.25	0.25	0.85	23
Modified Bitumen Cap Sheet	Dark Color	0.10	0.10	0.85	4
Modified Bitumen Cap Sheet	Light Color	0.25	0.25	0.85	23
Modified Bitumen Cap Sheet	White	0.50-0.60	0.40 – 0.45	0.85	57 - 71

4. **NR** means there is no requirement or recommendation for a component in this climate zone.

5. **Increased building air tightness**. Building air leakage (measured in cfm/ft^2) is the average volume of air(measured in cubic feet per minute) that passes through a unit area of the building envelope (measured in square feet) when the building is maintained at a specified internal pressure (measured in Pascals). ASHRAE has proposed a building air tightness requirement of 0.4 cfm/ft^2 @ 75 Pa as an addendum to Standard 90.1. ASHRAE has also proposed an approach to complying with the new requirement with a pressurization test to show that the building leakage does not exceed 0.4 cfm/ft^2 at 75 Pa. This air tightness requirement provides a number that can be used for the energy simulations and was assumed to be the baseline leakage rate. The air tightness requirement adopted by the U.S. Army for new construction is more stringent than the one proposed by ASHRAE and requires that the leakage rate must not exceed 0.25 cfm/ft^2 at 75 Pa, and was assumed for the energy efficient building models. To convert the values used for building leakage tests at the pressure difference of 75Pa to the values which can be used to calculate required excessive outdoor air supply rates, the following equation can be used $\Delta Q = Q75 * (5/75)^{0.65} = 0.172 * Q75$. The excessive airflow rate for the building complying with the new ASHRAE 90.1 Standard air leakage requirement is 0.069 cfm/ft^2. Respective number for the building built to the Army model RFP requirement is 0.043cfm/ft^2.

6. Lighting Power Density:

	Baseline		Efficient Model	
Zone	**W/ft^2**	**W**	**W/ft^2**	**W**
Office1	1.00	4,947	0.90	4,452
Office2	1.00	4,947	0.90	4,452
Lockers	0.60	888	0.50	740
Utilities	1.50	2,219	1.00	1,479
Corridor	0.50	1,456	0.40	1,165
ReadiBay (x4)	0.90	4,787	0.70	3,723
Arms (x4)	1.40	765	1.10	601
Storage (x4)	0.90	1,325	0.70	1,031
		41,967.5		**33,710**

7. **Duct and pipe insulation,** values are from the ASHRAE Advanced Energy Design Guide for Small Offices.

8. **Energy Conservation Features Tables**. These tables are applicable to both the integrated and the detached Admin configurations of COFs.

9. **HVAC system**. The recommended PVAV system is for the Admin module. The Readiness building requires a separate HVAC unit for each company's module. High efficiency PSZ units may be used in these areas in lieu of PVAV units.

Schedule	Day of Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
ALWAYS_ON	All	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ALWAYS_OFF	All	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BLDG_LIGHT	WD, SDD	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.5	0.3	0.3	0.2	0.2	0.1	0.1
	Sat, Sun, WDD, Hol	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
BLDG_EQUIP	WD, SDD	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.9	0.9	0.9	0.9	0.8	0.9	0.9	0.9	0.9	0.5	0.3	0.3	0.3	0.3	0.3	0.3
	WDD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sat, Sun, Hol	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
BLDG_OCC	WD	0	0	0	0	0	0	0	0.2	0.9	0.9	0.9	0.9	0.5	0.9	0.9	0.9	0.9	0.3	0	0	0	0	0	0
	SDD	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
	Sat, Sun, WDD, Hol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ReadiBay_OCC	WD	0	0	0	0	0	0	0	0	0.1	0.8	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0
	SDD	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Sat, Sun, WDD, Hol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HVACOperation	WD, SDD	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Sat, WDD	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Sun, Hol	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ExhFan	WD, SDD, WDD	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
	Sat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sun, Hol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ACTIVITY	All	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
WORK_EFF	All	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AIR_VELO	All	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
CLOTHING	All	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	All	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	All	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
INFIL	WD, SDD	1	1	1	1	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	1

Schedule	Day of Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	WDD	1	1	1	1	1	1	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	1	1	1	1	1
	Sat, Sun, Hol	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
PlantOn	All	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
FAN	All	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
BLDG_HTGSETP	WD, WDD	13	13	13	13	13	13	22	22	22	22	22	22	22	22	22	22	22	22	22	13	13	13	13	13
	SDD	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
	Sat	13	13	13	13	13	13	22	22	22	22	22	22	22	13	13	13	13	13	13	13	13	13	13	13
	Sun, Hol	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
BLDG_CLGSETP	WD, SDD	32	32	32	32	32	32	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	32	32
	Sat	32	32	32	32	32	32	24	24	24	24	24	24	24	24	24	24	24	24	32	32	32	32	32	32
	WDD	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
	Sun, Hol	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
ReadiBay_HTGSETP	WD, WDD	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
	SDD	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
	Sat	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
	Sun, Hol	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
ReadiBay_CLGSETP	WD, SDD	32	32	32	32	32	32	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	32	32
	Sat	32	32	32	32	32	32	28	28	28	28	28	28	28	28	28	28	28	28	32	32	32	32	32	32
	WDD	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
	Sun, Hol	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
Humidity Setpoint	WD, SDD	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	Sat, WDD	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	Sun, Hol	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
MinOA	All	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Dual Zone Control Type	All	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
BLDG_SHW	WD, SDD	0	0	0	0	0	0	0	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0	0	0	0	0	0
	Sat, WDD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sun, Hol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SHW Latent fract	All	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Schedule	Day of Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
SHW Sensible fract	All	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
SHW Temp	All	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43
SHW Supply Temp	All	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
Lockers sub cat Latent fract	All	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Lockers sub cat Sensible fract	All	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Lockers sub cat Temp	All	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Lockers sub catHot Supply Temp	All	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
SHWSys1-Loop-Temp	All	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SHWSys1 Water Heater Setpoint	All	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
SHWSys1 Water Heater Ambient	All	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22

3.3.9. Furniture Systems

The following criterion describes the furnishing requirements for all room types. Furnishings, other than installed equipment, are to be Government-furnished and Government-installed (GFGI) unless otherwise specified in this document. The following furnishings list is provided for coordination of room and office layouts to ensure suitability for their intended function.

Table 1: Room Size and Furnishing Chart

Room	Description	NSF	Comments	Furniture Required
CO	Commander	150	PRIVATE OFFICE	U-shaped executive desk with two pedestals, dbl pedestal credenza, hutch, two 4-drawer lateral files, one conference table, four conference chairs, one executive chair.
XO	Executive Officer	150	PRIVATE OFFICE	L-shaped double pedestal desk unit, hutch, two 4-drawer lateral files, two guest chairs, one task chair.
1SG	1st Sergeant	150	PRIVATE OFFICE	L-shaped double pedestal desk unit, double pedestal credenza, hutch, two 4-drawer lateral files, four guest chairs, one executive chair.
TRAINING	Training Room	150	PRIVATE OFFICE	L-shaped double pedestal desk unit, hutch, two 4-drawer lateral files, two guest chairs, one task chair.
PLATOON	Platoon Offices	150x4	SEMI-PRIVATE OFFICES	For each 150 SF office, 2 desks to accommodate computers, 2 task chairs, 2 bookcases for manuals, two 4-drawer file cabinets.
CONF. ROOM	Conference Room	Varies	CONFERENCE ROOM	Conference Table with 10 chairs and 6 side chairs.
ARMS VAULT	Arms Vault	Varies	CONSTRUCTED IN ACCORDANCE WITH AR 190-11, APP G.	1 desk to accommodate a computer, 1 task chair, 1 bookcase for manuals, one 4-drawer file cabinet, and 1 work bench.
UNIT STOR.	Unit Storage	Varies	STORAGE ROOM	1 desk unit consisting of: single pedestal metal desk w/ box, box, file pedestal; 1 ergonomic task chair, 1 three shelf bookcase for manuals, 4 lockable metal cabinets with shelves, two 4-drawer lateral file cabinets.
COMM. STOR.	Communications Storage	Varies	STORAGE ROOM	1 desk unit consisting of: single pedestal metal desk w/ box, box, file pedestal; 1 ergonomic task chair, 1 three shelf bookcase for manuals, 4 lockable metal cabinets with shelves, two 4-drawer lateral file cabinets.
NBC STOR.	NBC Storage	Varies	STORAGE ROOM	1 desk unit consisting of: single pedestal metal desk w/ box, box, file pedestal; 1 ergonomic task chair, one 4-drawer lateral file; and 4 lockable metal cabinets with shelves.
SECURE STOR.	Secure Storage	Varies	STORAGE ROOM	4 lockable metal cabinet with shelves and industrial shelving approximately 5'wx4'dx6'h each - 2 for 1st 100PN, 1 additional for every 50PN thereafter.

Table 1.1: Room Size and Furnishing Chart for Troop Aid Station (TAS)

Room	Description	NSF	Comments	Furniture Required

Room	Description	NSF	Comments	Furniture Required
Waiting Room	Waiting Room	480	Public Area	Seating to accommodate 15 people , magazine rack, brochure rack and end tables, drawer lateral files, one conference table, four conference chairs, one executive chair.
ADMIN./MED RECORDS	Reception, administrative and records storage	152	Reception/check in, private and secure room for safe keeping of medical records. Visual control of waiting room	2 - Countertops, 2 - ergonomic task chairs, 2 - sitting height base cabinets (pullboard above two drawers and file drawer), 3 - two drawer lateral files
SCREENING ROOM	Screening rooms	89 x 2	Private room adjacent to waiting room.	48” work surface with wall mounted overhead cabinet, 1 - mobile general storage cart (42”H x 32”Wx 22”D), 1 - task chair, 1 - guest chair.
EXAM ROOM	Exam rooms	115 x 4	Private room	1 - Cubicle curtain with surface mounted track, 1 - 48” work surface with wall mounted overhead cabinet, 1 - mobile general storage cart (42”H x 32”Wx 22”D), 1 - task chair, 1 - guest chair, 1 - self adjusting stool, 1 - examination / treatment table with cabinet.
PHAR./STOR ./OPT. EXAM ROOM	Medicine and equipment storage – Optional exam for surge situations.	115	Private and secure room, preferably on the interior, with no windows.	1 -Cubicle curtain with surface mounted track, 1 - 48” work surface with wall mounted overhead cabinet, 1 - mobile general storage cart (42”H x 32”Wx 22”D), 1 - task chair, 1 - guest chair, 1 - self adjusting stool, 1 - examination / treatment table with cabinet.

NOTES:

1. All furniture items identified in Table 1.1 above are provided for initial coordination of TAS room layouts to ensure suitability for their intended function. These items are described in detail and located at Appendix entitled TROOP AID STATION FURNISHINGS.

2. Examination/treatment table with cabinet is a hospital equipment item that is specified, purchased and installed by others, i.e. Government Furnished Government (GFGI).

3. Countertops, base cabinets, and cubicle curtain and track are Contractor Furnished Contractor Installed (CFCI) items.

4. Troop Aid Station Furnishings Attachment further clarifies what is: (1) Contractor Furnished Contractor Installed (CFCI); (2) Hospital Equipment (Hosp Equip) – specified, purchased and installed by others, i.e. Government Furnished Government Installed (GFGI): and (3) Furniture, Fixtures and Equipment (FF&E) – designed by AE but purchased and installed by others, i.e. Government Furnished Government Installed (GFGI).

5. Go to http://usahfpa.amedd.army.mil, HFPA Construction and Planning References, Criteria, Space Planning and Guideplates, Military Handbook 1691 for additional information on the joint schedule numbers (JSN), category of logistical responsibility (LOG CAT), and utility requirements (Utl).

3.3.10. References

(1) Army Regulation 190-11 Physical Security of Arms, Ammunition and Explosives

(2) Army Regulation 190–13 The Army Physical Security Program

(3) Army Regulation 190-51, Security of Unclassified Army Property (Sensitive and Nonsensitive)

(4) Army Regulation 380–5 Information Security Program

(5) Army Regulation 380–19 Information Systems Security

(6) Fed Spec AA-V-2737, Modular Vault Systems

(7) Uniform Federal Accessibility Standards (UFAS)

3.4. PROGRAM REQUIREMENTS

The following table (COF Table 2) provides the space allocations for the various standard modules for COFs:

Table 2: Space Criteria for Company Operations Facilities

ADMIN MODULE MINIMUM REQUIRED NET AREAS (REQUIRED PER SPACE)	**ADMIN (TYPICAL)**			
ADMIN MODULE				
Office Areas				
Command/Platoon Storage	40			
XO	150			
1SG	150			
CO	150			
Training Room	150			
Conference Room	310			
Platoon Offices	150			
READINESS MODULE VARIANTS - MINIMUM REQUIRED NET AREAS (BASED ON PERSONNEL PER COMPANY)	**100 PN**	**150 PN**	**200 PN**	**ADD'L 50 PN**
READINESS MODULE				
Supply Bay				
Secure Storage for Non-Sensitive Items	166	306	504	169
Vault	400	500	600	100
NBC Storage	94	152	198	52
Communications Storage	94	152	198	52
Unit Storage	367	595	764	199
Readiness Bay				
TA-50 Lockers/Equipment Layout Area	3,672	5,292	6,912	1,620
Overflow / Expansion Space	1,290	1,833	2,383	547
EXTERIOR COVERED HARDSTAND				
Equipment Maintenance/Layout Space/Weapons Cleaning	1,671	2,328	2,985	657

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AREA NOTES
AREA AS SHOWN:
FIRST FLOOR: 8,272 sq. ft. SECOND FLOOR: 8,121 sq. ft. TOTAL: 16,393 sq. ft. *
MAXIMUM ALLOWABLE AREA: 16,600 sq. ft.
* predicated on an assumed exterior wall thickness of 20 inches for the First Floor and 18 inches for the Second Floor.

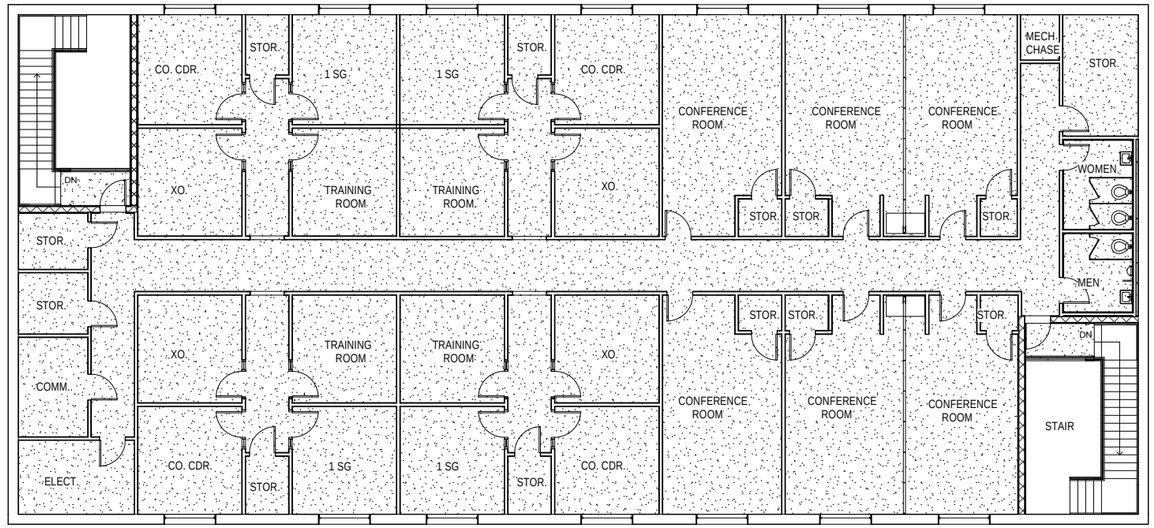
The floor plans indicate the Army Standard Design in schematic form. The designer-of-record (D-O-R) is allowed to make adjustments for the exterior façade/architecture theme, and/or to accommodate specific building engineering systems (structural, mechanical, electrical, fire protection, sustainable design, etc.). These adjustments will be evaluated by the Center of Standardization (CoS) during its compliance review.

The overall building dimensions and the values for the gross building areas indicated are for the standard layouts shown and are predicated on an assumed exterior wall thickness of 18" second floor, 20" first floor. It is understood that the actual gross building area will vary depending on the wall system / material selected for a specific project. A reduced overall gross area is permissible if all net program requirements and adjacencies are satisfied, but in no case may the maximum gross area for the facility be exceeded.

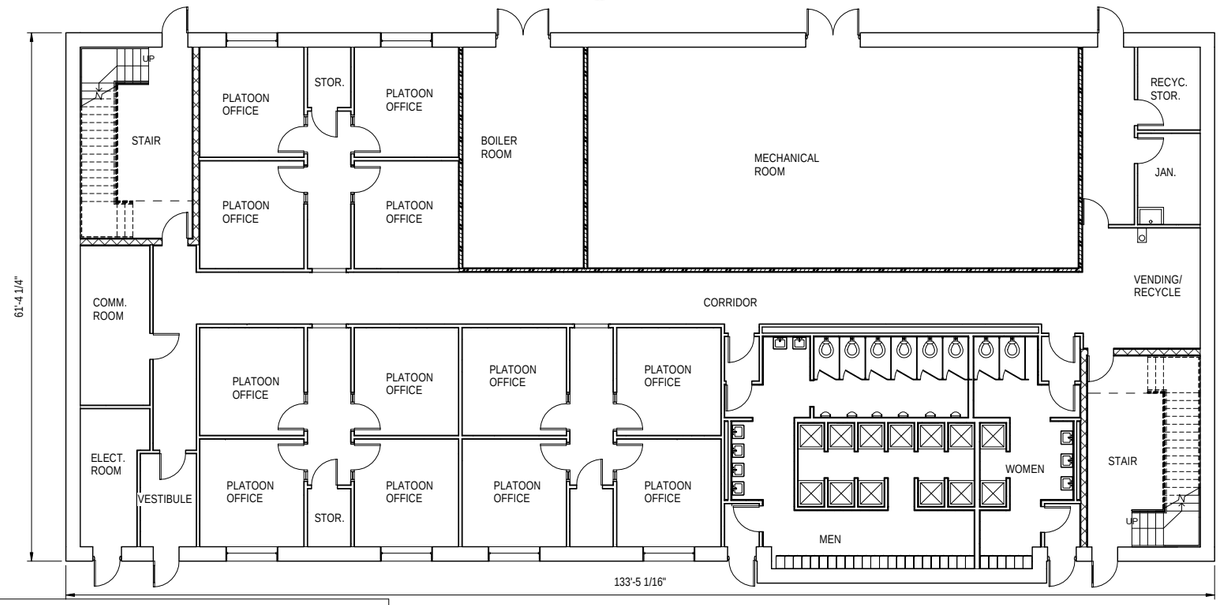
NOTES:

1. PLATOON OFFICES ARE DISPLACED TO READINESS MODULE MEZZANINE WHEN ADMIN MODULE IS CONFIGURED FROM 5 TO 7 COMPANIES TO ACCOMMODATE ADDITIONAL COMMAND SUITES.

2. LARGER CONFIGURATIONS, BASED ON INCREMENTS OF 50 PERSONS, ARE POSSIBLE. EACH 50 PERSON INCREMENTAL INCREASE WILL ADD APPROXIMATELY 30 FEET IN LENGTH TO THE READINESS MODULE. SEE RFP SECTION 01 10 00.

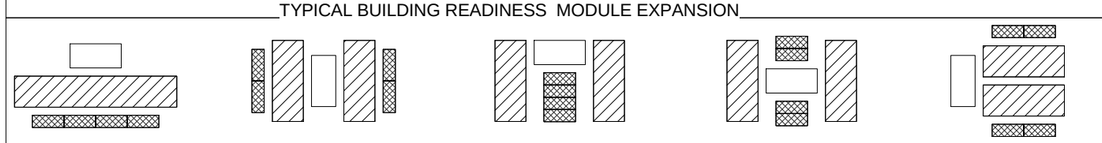


2 02 SECOND FLOOR PLAN
1/8" = 1'-0"



1 02 FIRST FLOOR PLAN
1/8" = 1'-0"

TYPICAL BUILDING READINESS MODULE EXPANSION



ADMIN . MODULE READINESS MODULE EXTERIOR COVERED HARDSTAND

</REV>

US Army Corps of Engineers ®
Savannah District

MARK	DESCRIPTION	DATE	APPD

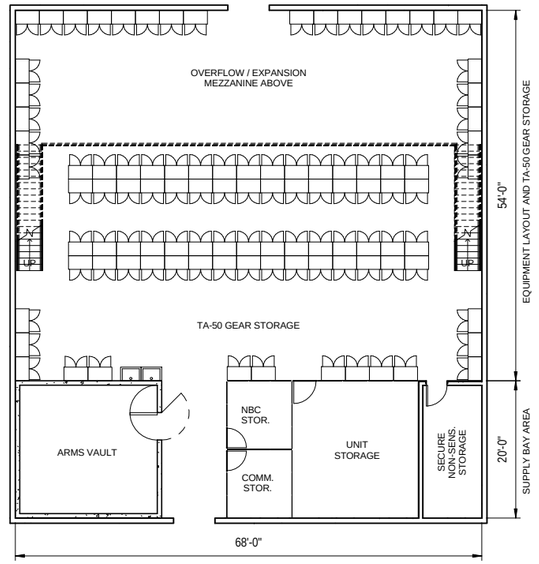
DATE:
SOLICITATION NO.:
CONTRACT NO.:
FILE NUMBER:
DESIGN BY: Designer
DRAWN BY: Author
CHD BY: Checker
PLOT DATE: 12/7/2012 12:15:46 PM
SMM BY: Approver
PLOT SCALE:
FILE NAME:
SIZE: 22" x 34"

US ARMY CORPS OF ENGINEERS
Savannah District

DETACHED ADMINISTRATION BLDG.

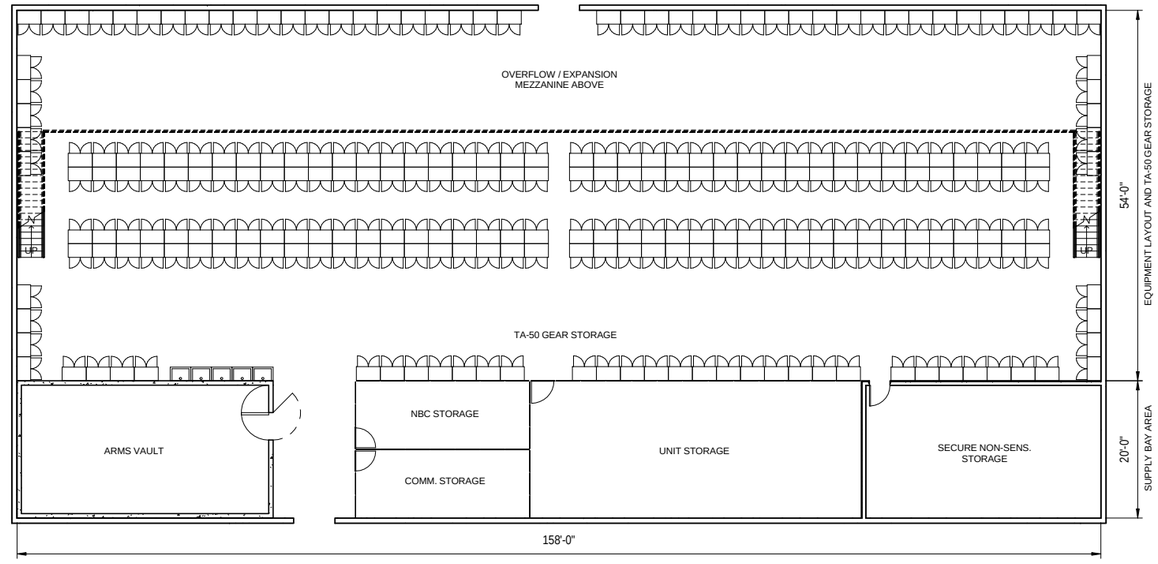
SHEET IDENTIFICATION
02
SHEET OF 0

02-



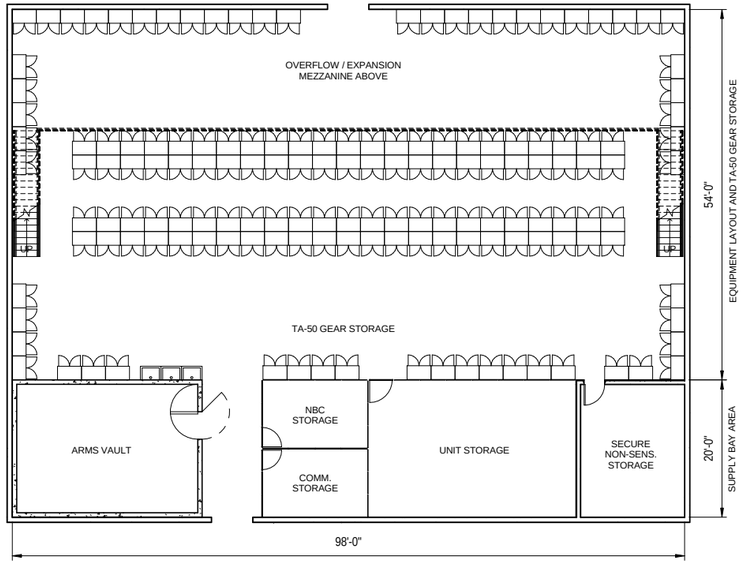
100 PERSON READINESS MODULE

MAX. ALLOWABLE AREA: 6,700 sq. ft.



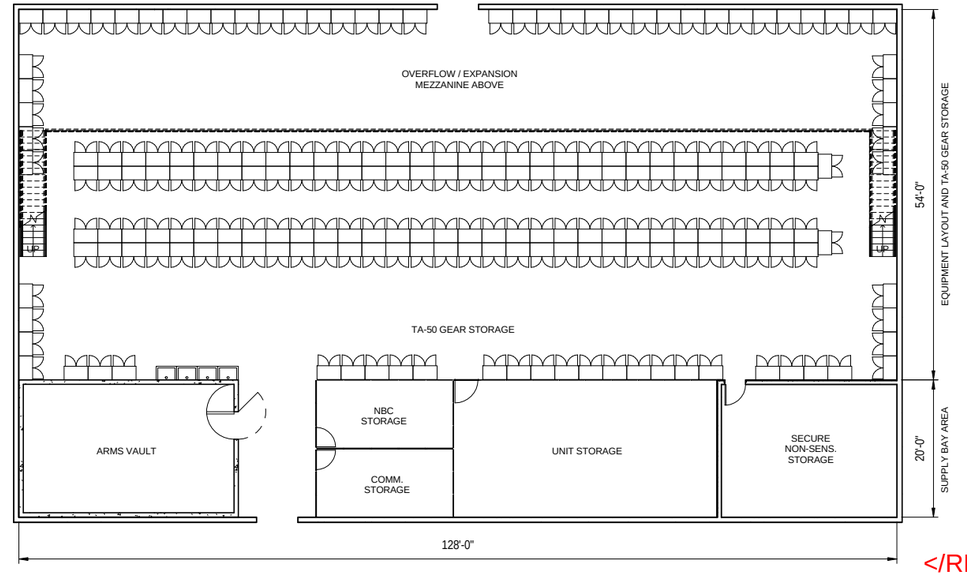
250 PERSON READINESS MODULE

MAX. ALLOWABLE AREA: 15,300 sq. ft.



150 PERSON READINESS MODULE

MAX. ALLOWABLE AREA: 9,600 sq. ft.



</REV>

200 PERSON READINESS MODULE

MAX. ALLOWABLE AREA: 12,400 sq. ft.

NOTES:

1. PLATOON OFFICES ARE DISPLACED TO READINESS MODULE MEZZANINE WHEN ADMIN MODULE IS CONFIGURED FROM 5 TO 7 COMPANIES TO ACCOMMODATE ADDITIONAL COMMAND SUITES.

2. LARGER CONFIGURATIONS, BASED ON INCREMENTS OF 50 PERSONS, ARE POSSIBLE. EACH 50 PERSON INCREMENTAL INCREASE WILL ADD APPROXIMATELY 30 FEET IN LENGTH TO THE READINESS MODULE. SEE RFP SECTION 01 10 00.

The floor plans indicate the Army Standard Design in schematic form. The designer-of-record (D-O-R) is allowed to make adjustments for the exterior façade/architecture theme, and/or to accommodate specific building engineering systems (structural, mechanical, electrical, fire protection, sustainable design, etc.). These adjustments will be evaluated by the Center of Standardization (CoS) during its compliance review.

The overall building dimensions and the values for the gross building areas indicated are for the standard layouts shown and are predicated on an assumed exterior wall thickness of 18 inches. It is understood that the actual gross building area will vary depending on the wall system / material selected for a specific project. A reduced overall gross area is permissible if all net program requirements and adjacencies are satisfied, but in no case may the maximum gross area for the facility be exceeded.

US Army Corps of Engineers ®
Savannah District

MARK	DESCRIPTION	DATE	APPR

US ARMY CORPS OF ENGINEERS
Savannah District

DESIGN BY: Designer
DRAWN BY: SCM
SBMT BY: Approver
PLOT SCALE:
SIZE: 22" x 34"
CKD BY: Checker
PLOT DATE: 1/25/2012 2:21:10 PM
FILE NAME:
DATE:
SOLICITATION NO.:
CONTRACT NO.:
FILE NUMBER:

READINESS MODULE SIZING TEMPLATES

SHEET IDENTIFICATION
01
SHEET OF 0

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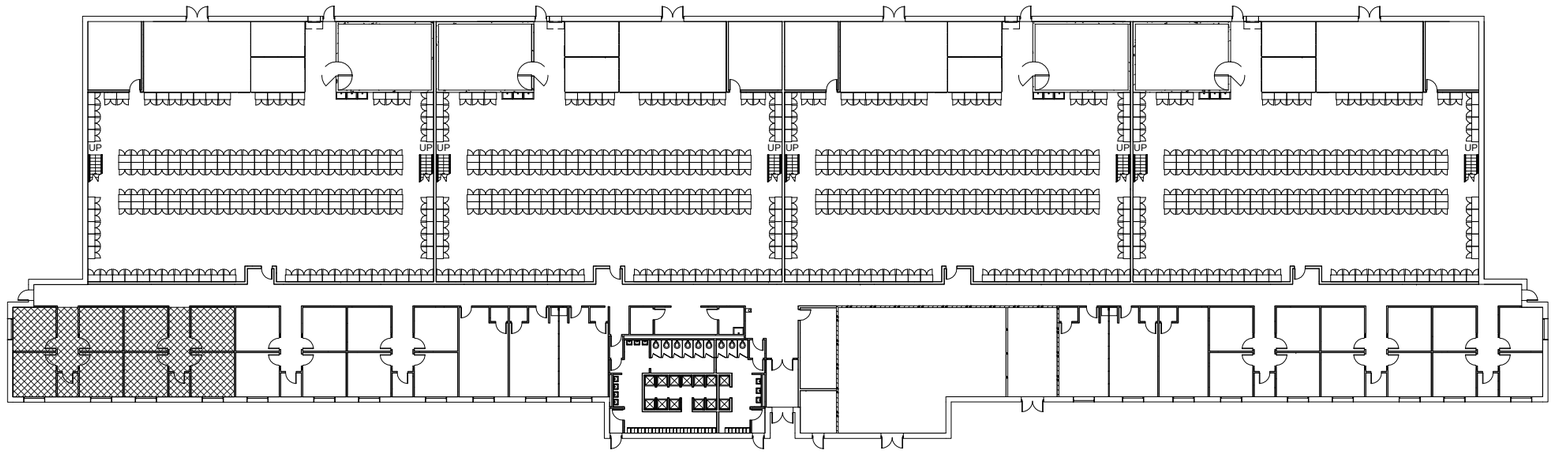
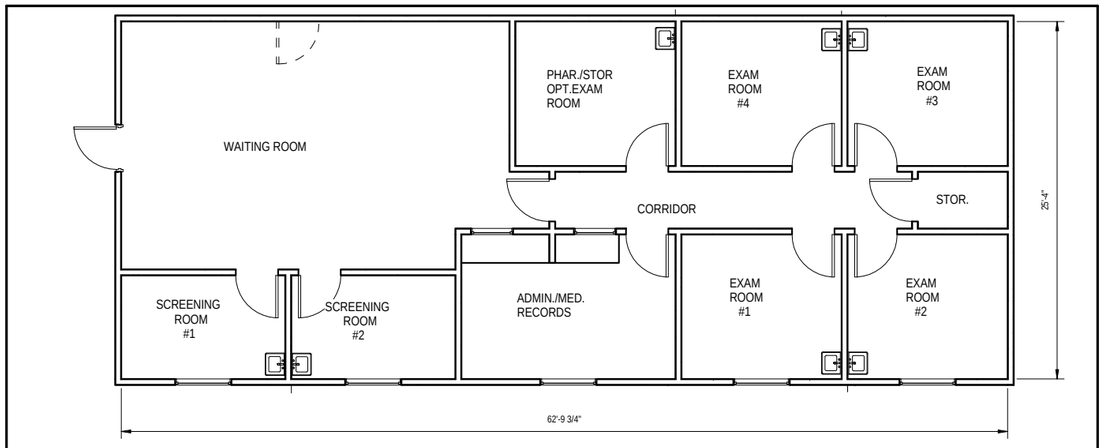
<REV>



PLATOON OFFICES ARE DISPLACED TO READINESS MODULE MEZZANINE WHEN THE ADMIN MODULE IS CONFIGURED TO ACCOMODATE A TROOP AID STATION.

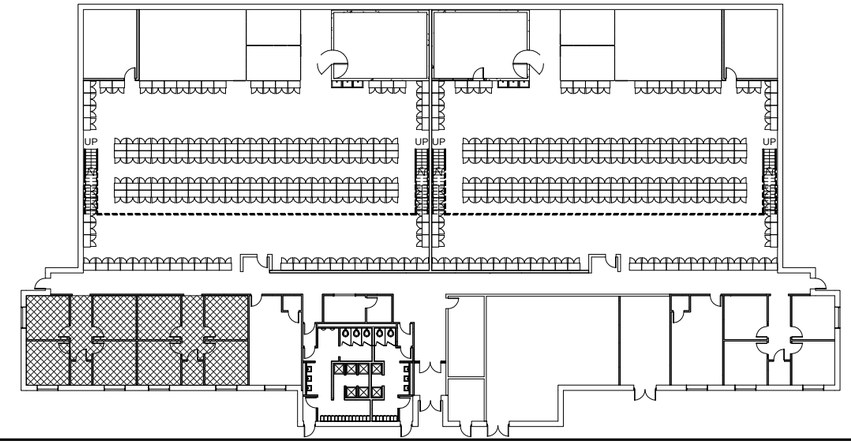
TYPICAL 3-7 COMPANY TROOP AID LOCATION



WHEN REQUIRED, THE TROOP AID STATION SHALL BE IN ACCORDANCE WITH THE FOLLOWING GUIDELINES:

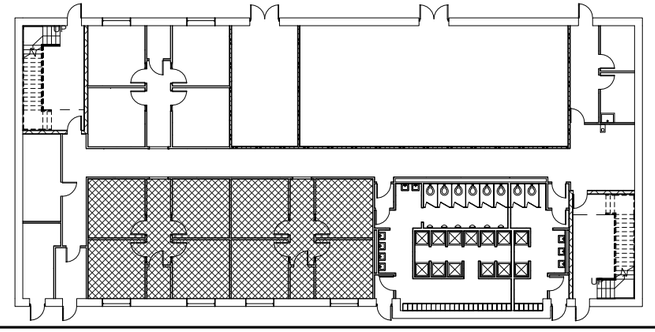
WAITING AREA:
A WAITING AREA SHALL BE PROVIDED TO ACCOMMODATE SEATING FOR A MINIMUM OF 15 PEOPLE.
SCREENING ROOMS:
SCREENING ROOMS SHALL BE PROVIDED ADJACENT TO THE WAITING AREA, MINIMUM NUMBER OF ROOMS SHALL BE TWO.
MINIMUM ROOM SIZE SHALL BE 65 SQUARE FEET. EACH ROOM SHALL HAVE A WALL MOUNTED SINK.
EXAM ROOMS:
A MINIMUM OF FOUR EXAM ROOMS SHALL BE PROVIDED. MINIMUM ROOM SIZE SHALL BE 115 SQUARE FEET. EACH ROOM SHALL HAVE A WALL MOUNTED SINK.
PHARMACY / MEDICAL STORAGE:
THIS AREA IS USED FOR STORAGE OF MEDICINE AND OTHER MEDICAL EQUIPMENT. IT SHALL BE SECURED TO PREVENT BREAK-INS. CONSEQUENTLY, IT IS PREFERRED THAT THIS ROOM BE LOCATED IN THE INTERIOR WITH NO WINDOWS. THIS ROOM CAN ALSO BE USED AS AN ADDITIONAL EXAM ROOM FOR SURGE SITUATIONS. IF ORIGINALLY PLANNED FOR THIS USE, A WALL MOUNTED SINK SHALL BE PROVIDED.
GENERAL STORAGE:
THIS ROOM IS USED FOR STORAGE OF GENERAL ITEMS SUCH AS OFFICE AND CLEANING SUPPLIES.
ADMINISTRATION / MEDICAL RECORDS:
THIS AREA SHALL BE LOCATED ADJACENT TO BOTH THE WAITING AREA FOR CHECK-INS AND THE PRIVATE AREA FOR CHECK-OUTS AND OTHER ADMINISTRATIVE PURPOSES. THIS AREA SHALL BE SECURED FOR SAFE KEEPING OF MEDICAL RECORDS.

TYPICAL DETACHED 3-7 COMPANY TROOP AID LOCATION



TYPICAL 2 COMPANY TROOP AID LOCATION

</REV>



TYPICAL DETACHED 3-7 COMPANY TROOP AID LOCATION

KEY LEGEND

TROOP AID STATION LOCATION (REF. ENLARGED PLAN

The floor plans indicate the Army Standard Design in schematic form. The designer-of-record (D-O-R) is allowed to make adjustments for the exterior façade/architecture theme, and/or to accommodate specific building engineering systems (structural, mechanical, electrical, fire protection, sustainable design, etc.). These adjustments will be evaluated by the Center of Standardization (CoS) during its compliance review.

The overall building dimensions and the values for the gross building areas indicated are for the standard layouts shown and are predicated on an assumed exterior wall thickness of 18" (20" for the first floor of the Detached Admin. Bldg.) It is understood that the actual gross building area will vary depending on the wall system / material selected for a specific project. A reduced overall gross area is permissible if all net program requirements and adjacencies are satisfied, but in no case may the maximum gross area for the facility be exceeded.

US Army Corps of Engineers ®
Savannah District

MARK	DESCRIPTION	DATE	APPR

US ARMY CORPS OF ENGINEERS
Savannah District

DESIGN BY: Designer
DRAWN BY: Author
SBMT BY: Approver
PLOT SCALE:
SIZE: 22" x 34"
CKD BY: Checker
PLOT DATE: 1/26/2012 4:39:45 PM
FILE NAME:
DATE:
SOLICITATION NO.:
CONTRACT NO.:
FILE NUMBER:

PROJECT NAME:
TROOP AID STATION

SHEET IDENTIFICATION
A-102F
SHEET OF 0

A-102F-

COMPANY OPERATIONS FACILITY (COF)

TROOP AID STATION FURNISHINGS APPENDIX

Project Rooms (User Contents Only)

As of 06/08/2005
Page 1
Room Code: EXRG1 Room Qty: 4 Room Area: 115.00 Room Description: EXAM ROOM ARMY

JSN	NOMENCLATURE	Qty	UNIT	LOG	RESPONSIBLE	Utl	Utl	Utl	Utl	Utl	Utl
			ISSUE	CAT	PARTY	1	2	3	4	5	6
Equipment per Room:											
A1066	Mirror, Float Glass, With SS Frame, 36X18	1	EA	A	CFCI	.	.	.	.	.	.
A1132	Rail, Accessory Mounting, Length As Required	2	LF	C	CFCI	.	.	.	.	.	.
A5075	Dispenser, Soap, Disposable	1	EA	C	Hosp Equip	.	.	.	.	.	.
A5080	Dispenser, Paper Towel, SS, Surface Mounted	1	EA	A	CFCI	.	.	.	.	.	.
A5106	Waste Disposal Unit, Sharps w/Glove Dispenser	1	EA	C	Hosp Equip	.	.	.	.	.	.
A5145	Hook, Garment, Double, SS, Surface Mounted	2	EA	A	CFCI	.	.	.	.	.	.
A5180	Track, Cubicle, Surface Mounted, With Curtain	1	FT	A	CFCI	.	.	.	.	.	.
E0210	Worksurface, w/Overhead Cab, Wall Mtd, 48" W	1	EA	C	FF&E	.	A	.	.	.	.
E0948	Cart, General Storage, Mobile, 42"H x 32"W x 22"	1	EA	C	FF&E	.	.	.	.	.	.
F0205	Chair, Side With Arms	1	EA	C	FF&E	.	.	.	.	.	.
F0280	Chair, Swivel, Low Back	1	EA	C	FF&E	.	.	.	.	.	.
F0340	Stool, Self Adjusting	1	EA	C	FF&E	.	.	.	.	.	.
F2000	Basket, Wastepaper, Round, Metal, 18 H x 16 Dia.	2	EA	C	FF&E	.	.	.	.	.	.
F3200	Clock, Battery, 12" Diameter	1	EA	C	Hosp Equip	.	.	.	.	.	.
M1620	Holder, Chart, Patient, Wall or Door Mounted	1	EA	A	FF&E	.	.	.	.	.	.
M1800	Computer, Microprocessing, w/CRT Monitor	1	EA	C	Hosp Equip	.	A	.	.	.	.
M3072	Frame, Infectious Waste Bag w/Lid	1	EA	C	Hosp Equip	.	.	.	.	.	.
M4100	Sphygmomanometer, Aneroid, Wall Mounted	1	EA	C	Hosp Equip	.	.	.	.	.	.
M4200	Otoscope/Ophthalmoscope, Wall Mounted	1	EA	C	Hosp Equip	.	A	.	.	.	.
M7401	Light, Exam, Mobile, Spotlight, Mobile Stand	1	EA	.	Hosp Equip	.	A	.	.	.	.
M9025	Table, Examination/Treatment, With Cabinet	1	EA	C	Hosp Equip	.	A	.	.	.	.
P3100	Lavatory, Vitreous China, Slab Type	1	EA	A	CFCI	D	.	.	.	.	.
X3930	Illuminator, Film, Double, Wall Mounted, 20x29x6	1	EA	C	Hosp Equip	.	A	.	.	.	.
		== == ==									
	GRAND TOTAL	26									

Reference Paragraph 3.3.8 Furniture Systems, Table 1.1, Note 5 for additional information.

Project Rooms (User Contents Only)

06/09/2005
Room Code: EXRG4 Room Qty: 2 Room Area: 89.00 Room Description: EXAM, SCREENING

JSN	NOMENCLATURE	Qty	UNIT	LOG	RESPONSIBLE	Utl	Utl	Utl	Utl
			ISSUE	CAT	PARTY	1	2	3	4
Equipment per Room:									
A1066	Mirror, Float Glass, With SS Frame, 36X18	1	EA	A	CFCI	.	.	.	.
A1132	Rail, Accessory Mounting, Length As Required	1	LF	C	CFCI				
A5075	Dispenser, Soap, Disposable	1	EA	C	HOSP EQUIP	.	.	.	.
A5080	Dispenser, Paper Towel, SS, Surface Mounted	1	EA	A	CFCI	.	.	.	.
A5106	Waste Disposal Unit, Sharps w/Glove Dispenser	1	EA	C	HOSP EQUIP	.	.	.	.
A5145	Hook, Garment, Double, SS, Surface Mounted	1	EA	A	CFCI	.	.	.	.
E0210	Worksurface, w/Overhead Cab, Wall Mtd, 48" W	1	EA	C	FF&E	.	A	.	.
E0948	Cart, General Storage, Mobile, 42"H x 32"W x 22"	1	EA	C	FF&E	.	.	.	.
F0205	Chair, Side With Arms	1	EA	C	FF&E	.	.	.	.
F0300	Chair, Typist, Swivel	1	EA	C	FF&E		. .	.	.
F2000	Basket, Wastepaper, Round, Metal, 18 H x 16 Dia.	1	EA	C	FF&E	.	.	.	.
F3200	Clock, Battery, 12" Diameter	1	EA	C	HOSP EQUIP	.	.	.	.
M1620	Holder, Chart, Patient, Wall or Door Mounted	1	EA	A	FF&E	.	.	.	.
M1800	Computer, Microprocessing, w/CRT Monitor	1	EA	C	HOSP EQUIP	.	A	.	.
M4040	Scale, Weighing, 300 Pound Capacity	1	EA	C	HOSP EQUIP	.	.	.	.
M4100	Sphygmomanometer, Aneroid, Wall Mounted	1	EA	C	HOSP EQUIP	.	.	.	.
M4116	Monitor, Vital Signs	1	EA	C	HOSP EQUIP	.	A	.	.
M4200	Otoscope/Ophthalmoscope, Wall Mounted	1	EA	C	HOSP EQUIP	.	A	.	.
P3100	Lavatory, Vitreous China, Slab Type	1	EA	A	CFCI	D	.	.	.
		======							
	GRAND TOTAL	19							

Reference Paragraph 3.3.8 Furniture Systems, Table 1.1, Note 5 for additional information.

Project Rooms (User Contents Only)

As of 08/23/2005 Page 1

Room Code: RECP1 Room Qty: 1 Room Area: 152.00 Room Description: RECEPTION

JSN	NOMENCLATURE	Qty	UNIT ISSUE	LOG CAT	RESPONSIBLE PARTY	Utl 1	Utl 2	Utl 3	Utl 4	Utl 5	Utl 6
Equipment per Room:											
C0037	Rail, Apron, 4x36x1	1	EA	A	CFCI	.	.	.	.	.	.
C0039	Rail, Apron, 4x48x1	2	EA	A	CFCI	.	.	.	.	.	.
C0045	Frame, Apron, 1 Drawer, 4x36x22	1	EA	A	CFCI	.	.	.	.	.	.
C0046	Frame, Apron, 2 Drawer, 4x48x22	2	EA	A	CFCI	.	.	.	.	.	.
C06M0	Cabinet, U/C/B, 1 PBD, 2 DR, 1 File DR, 30x18x22	2	EA	A	CFCI	.	.	.	.	.	.
CT030	Countertop, High Pressure Laminate	2	LF	A	CFCI	.	.	.	.	.	.
F0280	Chair, Swivel, Low Back	2	EA	C	FF&E	.	.	.	.	.	.
F0420	Cabinet, Filing, Lateral, Half Height	3	EA	C	FF&E	.	.	.	.	.	.
F2000	Basket, Wastepaper, Round, Metal, 18 H x 16 Dia.	2	EA	C	FF&E	.	.	.	.	.	.
F3200	Clock, Battery, 12" Diameter	1	EA	C	HOSP EQUIP	.	.	.	.	.	.
M1605	Holder, Chart, 20 Each	1	EA	C	FF&E	.	.	.	.	.	.
M1800	Computer, Microprocessing, w/CRT Monitor	2	EA	C	HOSP EQUIP	.	A	.	.	.	.
M1820	Imprinter, Data Record, Electric	1	EA	C	HOSP EQUIP	.	A	.	.	.	.
M1825	Printer, Computer	1	EA	C	HOSP EQUIP	.	A	.	.	.	.
M1850	Typewriter, Electric	1	EA	C	HOSP EQUIP	.	A	.	.	.	.
M1855	Facsimile Machine	1	EA	C	HOSP EQUIP	.	A	.	.	.	.
		======									
	GRAND TOTAL	25									

Reference Paragraph 3.3.8 Furniture Systems, Table 1.1, Note 5 for additional information.

3.0 BATTALION HEADQUARTERS

3.1. GENERAL

Provide Battalion Headquarters (HQ) Facility. This project shall provide facilities to accommodate Battalion administrative and command operations. It is intended to be similar to office type buildings in the private sector community. The Battalion Headquarters and its function are more fully described in paragraph 3.2.2 BATTALION HEADQUARTERS - DESIGN REQUIREMENTS. The preferred functional layouts are depicted in the drawings included with this RFP. The extent to which the drawings represent required features and the allowable latitude for changes is as noted on the drawings.

3.1.1. ADAPT-BUILD MODEL

An Adapt-Build Model for a Battalion (HQ) , which contains a fully developed design, including a Building Information Model (BIM), 2-D CADD files, and specifications, can be downloaded from the following FTP site: ftp://ftp.usace.army.mil/pub/sas/BDE-BN_HQ/. This design is provided as a guide that exemplifies a technically suitable product and incorporates mandatory functional/operational requirements for a similar (although perhaps not an exact) facility to be constructed under this solicitation. It will be left to the offerors' discretion if, and how, they will use the sample design provided to satisfy the requirements of this Request for Proposal. This model is not intended to modify or over-ride specific requirements of this RFP and, under all circumstances, it will be incumbent upon the successful offeror to adhere to the site specific scope and functional/operational requirements specified within the RFP. Neither this statement of work, nor the adapt-build model, are intended to diminish the offeror's responsibilities under the clauses titled "Responsibility of the Contractor for Design," "Warranty of Design," and "Construction Role During Design." The successful offeror shall be the designer-of-record and shall be responsible for the final design and construction product, including but not limited to, adherence to the installation architectural theme, building code compliance and suitability of the engineering systems provided. The government assumes no liability for the model design provided and, to the extent it is used by an offeror, the offeror will be responsible for all aspects of the design as designer-of-record.

3.1.2. FACILITY RELATIONSHIPS

Battalion (HQ) Headquarters shall be located within an operations complex along with Company Operations Facilities (COF) and Tactical Equipment Maintenance Facilities (motor pools). The facilities within this complex shall be oriented to support deployment and daily operations, and should also be located within walking distance of associated community facilities such as barracks and dining facilities.

3.1.3. GROSS BUILDING AREA:

Gross areas of facilities shall be computed according to subparagraphs below. 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 are met.

(1) Enclosed Spaces. The gross area includes the total area of all floors, including basements, mezzanines, penthouses, usable attic or sloping spaces used to accommodate mechanical equipment or for storage with an average height of 6'-11" measured from the underside of the structural system and with the perimeter walls measuring a minimum of 4'-11" in height, and other enclosed spaces as determined by the effective outside dimensions of the building.

(2) One-Half Spaces. One-half of the area will be included in the gross area for balconies and porches; exterior covered loading platforms or facilities, either depressed, ground level, or raised; covered but not enclosed passageways or walks; covered and uncovered but open stairs; and covered ramps.

(3) Excluded Spaces. Crawl spaces; exterior uncovered loading platforms or facilities, either depressed, ground level, or raised; exterior insulation applied to existing buildings; open courtyards; open

paved terraces'; roof overhangs and soffits for weather protection; uncovered ramps; uncovered stoops; and utility tunnels and raceways will be excluded from the gross area.

3.1.4. FUNCTIONAL SPACES:

Net area requirements for functional spaces are included in the drawings. If net area requirements are not indicated, the space shall be sized to accommodate the required function, comply with code requirements, comply with overall gross area limitations and other requirements of the RFP (for example, area requirements for corridors, stairs, and mechanical rooms will typically be left to the discretion of the Offeror).

3.1.5. ADMINISTRATIVE FACILITIES:

Provide centralized areas for photocopier, laser printer and fax machine with waste and paper recycling receptacles and supply cabinet for paper storage in each office area. Hours of operation are normal business hours except where indicated otherwise.

3.1.6. HANDICAPPED ACCESS:

Battalion (HQ) Headquarters are to be handicapped accessible.

3.2. FUNCTIONAL AND OPERATIONAL REQUIREMENTS

3.2.1. Omitted

3.2.2. BATTALION HEADQUARTERS - DESIGN REQUIREMENTS

3.2.2.1. General:

The Battalion Headquarters facility is comprised of administration, special functions, and classroom components as described in the paragraph Functional Space Descriptions and Performance Requirements. In conjunction with these, each site-specific project shall include necessary site amenities such as vehicle service yards, access drives, and exterior utilities. Space will be provided for a command section, S-1, S-2, S-3, S-4, S-6, utilities and support services. Private offices will be provided for the commanding officer, executive officer, command sergeant major, S-1 officer, S-2 officer, S-3 officer, S-4 officer, S-6 officer, Human Resources NCO, chaplain, and assistant chaplain. Space will also be provided for clerical and central files, conference room, staff duty station, message center and mail sorting, reception, secure documents room, showers, supplies, toilet facilities, vending, recycle closet, mechanical room, electrical rooms, telecommunication rooms, and classrooms. A staff duty station shall be provided at primary entrances to the building, whether the battalion headquarters is located in a combined Battalion/Brigade HQ or as a stand-alone building. The stand-alone Battalion Headquarters facility is a two story facility with secure zone 1 spaces on the ground floor and secure zone 2 spaces on the second floor. A separate cluster of classrooms is provided on the ground floor, and is segregated from other building components to minimize disruption to normal headquarters activities.

3.2.2.2. Battalion Headquarters Program Requirements

The programmatic requirements for the Battalion Headquarters are as indicated on the drawings. Note that the Battalion Headquarters structure is similar for all army battalions and the main difference is size. See the Room Size and Furnishings Chart for other room information.

3.2.2.3. Battalion Headquarters Adjacency Matrix

BN HQ Adjacency Matrix		Zone 1										Zone 2							
Activity or Element		COMMAND GROUP	G/S1	S1/PAC	G/S4	CHAPLAIN	SURGEON/MEDICAL	PUBLIC AFFAIRS	LEGAL	SAFETY	CLASSROOMS	S2 - INTELLIGENCE	S3 - OPERATIONS	S5 - PLANS	S6 - COMMUNICATIONS	FIRE AND EFFECTS	AIR DEFENSE	CBRNE	ENGINEER
Zone 1	COMMAND GROUP	■	P	A		X		P	P		X								
	S1 - PERSONNEL (note 1)	P	■	P							X								
	S1/PAC (note 2)	A	P	■							X								
	S4 LOGISTICS				■						X								
	CHAPLAIN	X				■					X								
	SURGEON/MEDICAL						■				X								
	PUBLIC AFFAIRS	P						■			X								
	LEGAL	P							■		X								
	SAFETY									■	X								
	CLASSROOMS	X	X	X	X	X	X	X	X	X	■								
Zone 2	S2 - INTELLIGENCE											■							
	S3 - OPERATIONS												■	P		P	P	P	P
	S5 - PLANS (note 3)												P	■					
	S6 - COMMUNICATIONS														■				
	FIRE AND EFFECTS												P			■	A		
	AIR DEFENSE												P			A	■		
	CBRNE (note 4)												P					■	P
	ENGINEER												P					P	■

A = Required Adjacency
P = Proximity Desirable
X = Separation Needed
"blank" no functional relationship or adjacency requ

Security Zone 1	Limited access for physical and personal security
Security Zone 2	Controlled access for operational and information

Battalion Headquarters adjacency matrix notes:

1. Personnel: Combined with S4 as a sustainment section.

2. S1/PAC: Personnel Action Center. Provides customer service. Location should avoid cross traffic with the command group.

3. S5 Plans: combined with S3.

4. Chemical, Biological, Radiological, Nuclear and Explosives: collocated with S3.

5. In the consolidated Battalion/Brigade HQ concept, the staff sections for each battalion headquarters shall be consolidated on a single floor, and the brigade staff sections shall be physically separated from battalion staff sections.

6. Security Zone areas shall be segregated from one another by space separation, physical barriers, or placement of spaces on separate floors of the building.

3.2.3. Functional Space Descriptions and Performance Requirements

Command Section	Zone 1	The command section corresponds to the office of the CEO of a corporation. It needs to be located away from heavy traffic activities and must provide a means for support personnel to control the flow of visitors. It also needs to be located with proximity to the main entrance that allows visitors to have access to the reception area without moving through operational areas of the building such as SCIF, BOC, and the work areas of the S-2 and S-3. The legal staff, public affairs staff and the chaplain are outside the area controlled by the commander's assistants. They need ready access to the commander on a recurring basis, but they also have their own visitors who normally should not come inside the command suite.
S-1	Zone 1	The S-1 office (Human Resources) is equivalent to the human resources department of a corporation. While the S-1 has representatives who support operational activities in the building, they serve a clientele that often does not have a requirement for access to operational areas. While it corresponds to the human resources department, it generally does not provide customer service to individual soldiers. Rather, the S-1 serves human resource specialists from subordinate organizations and agencies. The S-1 section frequently provides the personnel who control access to the commander and so proximity to the command suite is recommended as long as traffic to the S-1 does not invade the privacy of the command suite.
S-2	Zone 2	The S-2 office (Intelligence Surveillance and Reconnaissance) supports the commander in the areas of opposition research, terrain analysis and weather. The activity of the S-2 section involves a variety of secure communications capabilities and much of their workspace is inside of the SCIF (Brigade Headquarters only) portion of the building and requires strict access control. They also require direct access to a secure exterior vehicle compound adjacent to the SCIF. It should be located away from areas that have customer service activities related to other sections.
S-3	Zone 2	The S-3 (Coordinating Staff Office – Operations, Plans and Training) officer's functions are similar to those of the chief of operations officer of a corporation. The S-3 section is responsible for planning, coordinating and supervising the mission functions of the brigade. Because the S-3 integrates the operational functions of the other staff sections as they relate to the mission, it should be as centrally located as possible consistent with other requirements and constraints. The S-3 is responsible for managing the brigade operations center (BOC) (Brigade Headquarters Only), which is a restricted area. Much of the work of the S-3 involves dealing with classified information and communications means and, as such, it should be isolated from activities that generate traffic that is not related to the operational function of that section.

S-3	Zone 2	The S-3 Special Staff Office houses a variety of staff elements that are generally autonomous from one another, but which work under the direction of the S-3 office. Each section is aligned with a special function that directly supports the operations of the brigade or battalion and which must be carefully integrated into the S-3 office. Each section is aligned with a special function that directly supports the operations of the headquarters and which must be carefully integrated into the overall operations of the command. When the BOC is active each of these sections provides support staff inside the BOC. Within the section the aviation, fires and effects, and air defense elements have a high degree of interaction. The engineer and chemical elements are more independent of the other sections. Like the S-3 coordinating staff they should be located in a manner that isolates them from activities that generate traffic that is not related to the operational function of that section such as the S-1 and S-4.
S-4	Zone 1	The logistics operations office is responsible for the administration of the logistics, transportation and maintenance functions and programs within the brigade. It does not perform any industrial type functions. It generates traffic that should be excluded from operational areas. It does not provide direct customer service. Most of the traffic it generates will be logistics, transportation and maintenance managers from subordinate organizations.
S-7	Zone 2	The S-7 Information Operations office plans and conducts sensitive operations involving the relationship between the military and the civilian populations when the brigade is deployed. They have a high correlation to the S-3 Operations and Plans officers, the BOC and the SCIF. They should be located away from high traffic areas. The S-7 section needs to have ready access to the SCIF and the BOC. The personnel spaces in this section are from other organizations.
Battalion Headquarters Organizational Classrooms	Zone 1	Classrooms (Battalion Headquarters only) shall be provided for training and other ceremonial and gathering functions for all battalions. Organizational classrooms are authorized for individual battalions when battalion HQs are built as stand-alone or consolidated with a Brigade. There will be a maximum of three classrooms per battalion. The classrooms should be built as a contiguous area with partitions to allow the facility to provide maximum flexibility. When multiple battalion classrooms are consolidated in a single building, i.e. consolidated brigade/battalion headquarters, they shall be reduced in number by 50% since the consolidated headquarters option enables alternating use of classrooms by battalions.

3.3. TECHNICAL REQUIREMENTS

3.3.1. Site Design

The following site design requirements are applicable to the design of the Battalion Headquarters (HQ) Facility. :

(1) Omitted

(2) Exterior Lighting. Sidewalks, service yards and parking areas shall have exterior lighting. See Chapter 6 for additional information and requirements.

(3) Privately Owned Vehicles (POV) Parking. POV parking to be provided by others.

3.3.2. Architecture Design

(1) Exterior architectural features of the building shall be designed based on the following and in accordance with the Installation Design Guide.

(2) Windows. Provide windows for natural lighting in all Security Zone 1 and 2 office areas, ensuring compliance with anti-terrorism/force protection and physical security requirements. Areas where classified material (both physical and electronic format) is handled, stored, processed, or discussed shall be limited to non-operable windows. This prohibition extends to locations with components for SIPRNET and to other devices processing classified data, which includes all private offices and conference rooms. When fixed windows are provided in rooms authorized for SIPRNET, the following potential problem areas must be addressed:

- Ensure TEMPEST is mitigated by using TEMPEST approved equipment and shielded or fiber optic cabling.
- Provide provision for window curtains and/or blinds, or application of a one way film to the window glazing.
- Provide provision for curtains that can be drawn across windows were audio from classified VTC sessions has the potential of being transmitted through window glazing.

(3) Sound Insulation. Provide sound insulation to meet a minimum rating at doors, walls and floor/ceiling assemblies of STC 45 in the Command Conference Room for the Battalion (HQ) Headquarters as required per ASTM E413-04, Classification for Rating Sound Insulation. Provide sound insulation in all other areas of the Battalion (HQ) Headquarters to meet a minimum rating of STC 42 at walls and floor/ceiling assemblies, and a rating of STC 33 for doors, which are to be solid core wood in a metal frame. In addition to the sound insulation required, video teleconferencing areas shall meet a Noise Criteria (NC) 30 rating in accordance with ASHRAE Fundamentals Handbook.

(4) Office and Administrative Areas. The open office areas for staff sections (S-1, and S-2, etc.) in different security zones should be separated from one another by physical separation, walls, or floors. The intent is to provide visual separation between staff sections within a headquarters, with maximum flexibility for future change within open office areas. A similar preference exists for private offices within the staff section, with the exception that they will require doors for privacy. The command section offices shall be constructed to provide privacy and sound control in accordance with SOUND INSULATION paragraph above. The intent for the command section offices is to provide a more permanent type of construction, but still to minimize load-bearing walls so as to accommodate future reconfiguration. This same construction requirement exists for walls between headquarters in a consolidated headquarters facility.

(5) Message Center. Construct the Message Center / Mail Sorting Room to provide adequate security for mail storage and distribution. Structural requirements are as follows: Provide doors with suitable locks and door hinges. Lock shall be a key-operated, mortised, or rim-mounted lock; have a dead bolt throw of one inch; be of double cylinder design; have five pin tumbler cylinders; with two of mushroom or spool-type drive pin design; have 10,000 key changes; have no master key and contain hardened saw resistant steel inserts if the bolt is visible when locked. The strike shall be made of steel. A high security padlock and hasp may be used in lieu of above. Mount the hinges inside to prevent their removal from the outside. Door hinges mounted on the outside shall have non-removable or spot welded pins. Access doors shall be of sheet metal material not less than 16 gauge in thickness, or a solid wooden door covered on the outside with a steel plate not less than 12 gauge in thickness. Ground level windows shall have bars. Cover above ground level windows with wire mesh security screen. Walls and ceilings shall be constructed of material to prevent forcible entry. Minimum requirements shall be to provide expanded steel fabric behind gypsum board walls and ceiling. Provide provisions for ICIDS (Internal Commercial Intrusion Detection System) in facilities that are not operational on a 24-hour basis.

AT/FP requirements for Mail Rooms as specified in UFC 4-010-01 are not applicable for the Message Center / Mail Sorting Room.

3.3.3. Fire Protection

(1) Standards and Codes. All fire protection and life safety features shall be in accordance with UFC 3-600-01 and the criteria referenced therein. Battalion (HQ) Headquarters Facilities shall be classified as mission essential and shall be provided with complete sprinkler protection.

(2) Fire Protection and Life Safety Analysis. A fire protection and life safety design analysis shall be provided for all buildings in the project. The analysis shall be submitted with the interim design submittal. The analysis shall include classification of occupancy (both per the IBC and NFPA 101); type of construction; height and area limitations (include calculations for allowable area increases); life safety provisions (exit travel distances, common path distances, dead end distances, exit unit width required and provided); building separation or exposure protection; specific compliance with NFPA codes and the IBC; requirements for fire-rated walls, doors, fire dampers, etc.; analysis of automatic suppression systems and protected areas; water supplies; smoke control systems; fire alarm system, including connection to the base-wide system; fire detection system; standpipe systems; fire extinguishers; interior finish ratings; and other pertinent fire protection data. The submittal shall 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 necessary to exhibit compliance with life safety code requirements.

(3) Sprinkler System. The Facility shall be fully protected with automatic sprinkler systems. All floors and all areas of the facilities shall be protected. The sprinkler system design shall be in accordance with UFC 3-600-01 and NFPA 13. The sprinkler hazard classifications shall be in accordance with UFC 3-600-01, NFPA 13, and other applicable criteria. Design densities, design areas and exterior hose streams shall be in accordance with UFC 3-600-01. The sprinkler systems shall be designed and all piping sized with computer generated hydraulic calculations. The exterior hose stream demand shall be included in the hydraulic calculations. A complete sprinkler system design, including sprinklers, branch lines, floor mains and risers, shall be shown on the drawings. The sprinkler system plans shall include node and pipe identification used in the hydraulic calculations. All sprinkler system drains, including main drains, test drains, and auxiliary drains, shall be routed to a 2-foot by 2-foot splash block at exterior grade.

(a) Sprinkler Service Main and Riser. The sprinkler service main shall be a dedicated line from the distribution main. Sprinkler service and domestic service shall not be combined. The sprinkler service main shall be provided with an exterior post indicator valve with tamper switch reporting to the fire alarm control panel (FACP). The ground floor entry penetration shall be sleeved per NFPA 13 requirements for seismic protection. The sprinkler entry riser shall include a double check backflow preventer, a fire department connection, and a wall hydrant for testing of backflow preventer. The sprinkler system shall include an indicating control valve for each sprinkler system riser, a flow switch reporting to the FACP, and an exterior alarm bell. All control valves shall be OS&Y gate type and shall be provided with tamper switches connected to the FACP. Facilities with multiple floors shall be provided with floor control valves for each floor. The floor control valve assembly shall be in accordance with UFC 3-600-01, Figure 4-1..

(b) Exterior Hose Stream. Exterior hose stream demand shall be in accordance with UFC 3-600-01. Exterior hose stream demand shall be included in the sprinkler system hydraulic calculations.

(c) Backflow Preventer. A double check backflow preventer shall be provided on the fire water main serving each building. This shall be located within the building. An exterior wall hydrant with dual hose connections with OS&Y valve shall be provided to allow testing of backflow preventer at design flow as required by NFPA 13.

(d) Fire Department Connection. A fire department connection shall be provided for each building with sprinkler protection. These shall be located to be directly accessible to the fire department.

(4) Elevators. The fire protection features of elevators, hoist ways, machine rooms and lobbies shall be in accordance with UFC 3-600-01, ASME A17.1, NFPA 13 and NFPA 72.

(5) System Components and Hardware. Materials for the sprinkler system, fire pump system, and hose standpipe system shall be in accordance with NFPA 13 and NFPA 20.

(6) Protection of Piping Against Earthquake Damage. Sprinkler and fire pump piping systems shall be protected against damage from earthquakes. Seismic protection shall include flexible and rigid couplings, sway bracing, seismic separation assemblies where piping crosses building seismic separation joints, and other features as required by NFPA 13 for protection of piping against damage from earthquakes.

(7) Fire Water Supply. Fire flow test data is provided in Appendix D.

(8) Fire Pump. 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 a complete fire pump installation shall be provided for the facility. It shall comply with the requirements of UFC 3-600-01, NFPA 13 and NFPA 20. The Contractor shall submit fire pump design analysis and drawings in the design requirements.

(9) Fire Alarm and Detection: Refer to 3.3.5, Electrical and Communication Systems, for requirements.

(10) Building Construction. Construction shall comply with requirements of UFC 3-600-01, the International Building Code, NFPA 101, and NFPA 75.

(a) Fire Extinguishers Cabinets and Brackets. Fire Extinguisher cabinets and brackets shall be provided when fire extinguishers are required by UFC 3-600-01 and NFPA 101. Placement of cabinets and brackets shall be in accordance with NFPA 10. Semi-recessed cabinets shall be provided in finished areas and brackets shall be provided in non-finished areas (such as utility rooms, storage rooms, shops, and vehicle bays). Fire extinguishers shall not be provided in this contract.

(b) Interior Wall and Ceiling Finishes. Interior wall and ceiling finishes and movable partitions shall conform to the requirements of UFC 3-600-01 and NFPA 101.

(c) Server rooms and other portions of the facility which house MISSION CRITICAL electronic equipment installations (as defined in section 6-8 of UFC 3-600-01), shall be separated from surrounding occupancies by fire-resistance rated construction in accordance with NFPA 75.

3.3.4. Mechanical

(1) Omitted

(2) Design Data

(a) Actual internal equipment loads (i.e. heat dissipation) for finalized HVAC system sizing purposes shall be acquired from the USER or applicable point-of-contact (POC), and is the responsibility of the Design/Build Contractor. For baseline purposes, estimated internal equipment loads (i.e. heat dissipation) shall be as follows: For Communication-type rooms/areas (Tele/Comm, SIPRNet, etc), use 585 watts. For administrative/office type areas with the exception of the Classroom areas, it shall be assumed that each personnel/workstation area, cubicle, and office space is assigned a personal computer (desktop) for HVAC load calculation purposes. For the Classroom areas, it shall be assumed that each personnel is assigned a laptop computer for HVAC load calculation purposes. The overall quantity of personnel within each Classroom area shall be based on one person per 20 square feet of floor area. The quantity of personnel within each Conference room/area shall also be based on one person per 20 square feet of floor area.

TABLE II: INDOOR DESIGN DATA

Heating	
General Indoor Design Temperature	70°F

Communication Room	72°F
Mechanical Rooms (freeze protection)	40°F
Cooling	
General Indoor Design Temperature	75°F
Communication Room	72°F

(3) HVAC System Requirements for Critical Areas and Classrooms

(b) Omitted.

(c) Communications room will each be served by an independent and dedicated air-handling system. Air handling unit system(s) shall not be floor-space mounted within the actual space served.

(d) Omitted.

(e) Omitted.

(f) Each classroom area shall be individually temperature-controlled by the DDC System. Temperature setpoint adjustment shall be accomplished via DDC System by authorized personnel.

(g) Omitted.

(4) HVAC System Requirements for Administrative Areas

The capability of extending the regularly-scheduled operating hours of the HVAC systems (Administrative and Classroom areas) shall be provided. A pass-word protected control device (i.e. control panel) located within the staff duty station is the preferred design approach and arrangement. A separate, dedicated HVAC unit independent of the main building HVAC system shall be provided for the staff duty station, and shall be scheduled for after-normal hour operation only. Administrative areas shall be temperature-controlled by the DDC System. Temperature setpoint adjustment shall be accomplished via DDC System by authorized personnel.

3.3.5. Electrical and Communication System

See Paragraph 6 for clarifications and additional requirements for the electrical and communication systems.

(1) Omitted

(2) Omitted

(3) Interior Electrical and Communications

(a) Electrical

i. Characteristics. Select electrical characteristics of the power system to provide a safe, efficient, and economical distribution of power, based upon the size and types of loads to be served. Use distribution and utilization voltages of the highest level that is practical for the load to be served.

ii. Nonlinear Loads. The effect of nonlinear loads such as computers and other electronic devices shall be considered and accommodated as necessary. These loads generate harmonics, which can overload conventionally sized conductors or equipment and thereby cause safety hazards and premature failures. Circuits serving such devices shall be equipped with a separate neutral conductor not shared with other circuits. Panelboards and any dry type transformers shall be rated accordingly.

iii. Lightning Protection System and Transient Voltage Surge Protection. Design shall be in accordance with NFPA 780 and other referenced criteria. Provide transient voltage surge protection.

iv. Receptacles. Power receptacles shall be provided per NFPA 70 and in conjunction with the proposed equipment and furniture layouts. Provide power, data and telecommunications connectivity to each workstation. A duplex receptacle shall be accessibly located adjacent to each voice, data and CATV outlet. Power poles shall not be used. The use of furred structural columns or perimeter walls are the preferred method of power and telecommunication distribution to systems furniture workstations. Under-floor conduits shall be used only if no other alternative exists.

v. Omitted

vi. Omitted

vii. Provide a minimum of 20% spare circuit and load capacity at all levels of the power distribution system.

(b) Lighting. Lighting and lighting controls shall comply with the recommendations of the Illumination Engineering Society of North America (IESNA) and the requirements of ASHRAE 90.1. Lighting shall be compatible with security cameras and security requirements.

i. Interior Lighting. Interior ambient illumination shall provide a generally glare free, high quality lighting environment and conform to IESNA RP-1-04.

ii. Interior Lighting Controls. Local manual controls shall supplement automatic controls in offices and specialized areas including all conference rooms. Occupancy sensor controls shall be provided in restrooms, electrical rooms, telecommunications rooms, and similar spaces.

iii. Special Lighting Circuits. All classrooms and conference rooms shall have a circuit for general lighting, a circuit, to focus light on the speaker, and a dimmable circuit to focus light over student desks (or conference table) without glare on audio-video displays. Dimming ballasts shall be capable of dimming to 5 percent. A single lighting system with control capability of meeting all these requirements may be used.

(c) Telecommunications

An acceptable building telecommunications system encompasses, but is not limited to, copper and fiber optic (FO) entrance cable, protectors, termination equipment, racks, cable management, patch panels, copper and fiber backbone cable, conduits, cable tray, cable ladder, copper and/or fiber horizontal distribution cable, outlets, grounding, and labeling. Telecommunications infrastructure shall meet the Installation Information Infrastructure Architecture (I3A) Criteria and ANSI/TIA/EIA requirements

i. Telecommunications Rooms (TR)

Telecommunications rooms and telecommunications entrance facilities shall be provided for the network and voice equipment, and cabling infrastructure. There shall be a minimum of one telecommunications room on each floor, located near the center of the building, and preferably stacked between floors. Additional telecommunication rooms shall be provided as necessary to insure that the horizontal copper cable length does not exceed the 295 foot limitation. The telecommunications rooms shall be designed and provisioned in accordance with I3A and ANSI/TIA/EIA-569-B. A main TR with telecommunications entrance capability shall be provided for each facility, and shall be located on the first floor. The main TR shall serve as the hub for the interior backbone single mode fiber cable and copper riser cable to each of the other TRs. Backbone cabling shall be provided in accordance with I3A.

Each TR shall also have the following requirements:

- Access shall be from a centralized corridor within the building: (No exterior access shall be allowed).
- Door shall be three foot wide opening outward.
- Room shall be a minimum of 8 feet wide to accommodate working clearances around data equipment and racks. Odd shaped TR's (e.g. "L" shaped) that decreases the useable area for backboards, racks, etc. shall be avoided.
- A fire-rated A-C plywood backboard (3/4 inch thick) around interior perimeter.

- Illumination shall be 50 foot-candles (average).

Battalion Headquarters				
	Main TR (1st Floor)		TR (2nd Floor)	
Building	Width Feet (min)	Square Feet (min)	Width Feet (min)	Square Feet (min)
Small	8	90	8	100
Medium	8	125	8	80
Large	8	125	8	80
Extra Large	8	125	8	80

Notes

1. Width is a minimum inside edge of wall to inside edge of wall dimension inside the room. Length shall be greater than or equal to width.

2. Standard Drawings may be adjusted as needed, but the Telecommunications rooms shall not be less than the minimum width and square feet indicated above.

3. Telecommunications rooms shall be rectangular in shape.

ii. Telecommunications Outlets. Telecommunications outlets shall be provided per I3A based on functional purpose of the various spaces with the facility as modified by user special operational requirements and herein. Each headquarters workstation shall have voice and data connection capability. Each conference room and classroom shall have voice capability (minimum one outlet per room) and data connection capability (minimum one outlet per person) in accordance with I3A. A data outlet shall be provided at each copier location. A wall mounted telephone outlet with a single jack shall be provided in each mechanical, electrical, telecommunication rooms, and secure storage rooms. For controlled access areas, provide outlets for wall mounted (GFGI) phones at access points. Additional locations shall be provided based on coordination with the facility user and where required for HVAC, other equipment and as required by I3A.

iii. Telecommunications Distribution. Tele-Poles shall not be used. The uses of existing architectural columns or perimeter walls are the preferred method of power and telecommunications distribution to systems furniture workstations. Under-floor conduits shall be used only if no other alternative exists, and shall be designed and installed IAW TIA/EIA-569-B. Under-floor outlet boxes shall also contain a spare conduit for future expansion.

iv. Cable Trays. Provide cable tray pathways through-out the facility to support the systems required for the construction of the facility as well as user's computer networks, video integration system, telecommunication systems and other specialized electronic systems.

v. Raised Access Flooring. Areas with high concentrations of cabling will have raised access flooring to accommodate flexibility and growth. Signal grounds shall be provided in a grid pattern under all raised floor areas in accordance with MIL-HDBK 419A. Minimum height of raised flooring shall be 6 inches.

(d) Secure Communications

i. Secure Communications Rooms. The SIPNET room(s) shall be designed and constructed in accordance with the "Building SIPRNET Communications Room – New Construction Guidance", paragraph on the Technical Guide for the Integration of the Secret Internet Protocol Router Network (SIPRNET). These rooms shall be separate dedicated rooms (minimum size shall be 6'X6') and shall include a communication signal ground busbar, connected to the main telecom room signal busbar via properly sized ground wire (see MIL-HDBK-419-A), and one dedicated 20-amp circuit for the SIPRNet rack/safe, in addition to convenience outlets. The connection to the main telecommunications room will be via a single 2-inch trade size steel conduit in accordance with the I3A Criteria. As an alternative, the space allocated for the SIPRNET room may be incorporated into the telecommunications room if an approved SIPRNET Information Processing System Security Container (IPS) is provided within the combined SIPRNET/telecommunications room.

ii. Secret Internet Protocol Router Network (SIPRNet). The distribution infrastructure shall be designed and constructed in accordance with the Technical Guide for the Integration of the Secret Internet Protocol Router Network (SIPRNET). The word "shall" shall be substituted for the word "should" or “will” in the paragraph “Protective Distribution System” and the referenced publication NSTISSI 7003. A secure outlet box shall be provided in each private office, conference room, and other areas as directed. A Protective Distribution System (PDS) shall be provided in all limited and uncontrolled access areas. Specifications Section 27 05 28.39, Surface Raceways for Communications Systems shall be incorporated into this project. . (This section can be obtained at the following URL: ftp://ftp.usace.army.mil/pub/sas/Surface_Raceways/). Surface mounted raceway shall be used instead of the surface mounted conduit unless otherwise directed by the local NEC?DOIM or Physical Security Officer. Category 6 UTP copper cables with red cable jacket shall be included and shall be terminated at both ends in accordance with the I3A Technical Guide for data cables. Where cable runs exceed 295 feet, see guidance in SIPRNET Tech Guide, paragraph “Building SIPRNET Communication Room – New Construction Guidance”.

iii. Secure Videoteleconferencing (VTC). Secure VTC capability shall be provided in each . Provisions generally consist of a power connection and two RJ45 SIPRNET outlets (in a secure outlet box).

(e) Cable Television (CATV). CATV shall be provided in all private offices, classrooms, and conference rooms. The cable television system shall consist of cabling, pathways, and outlets. All building CATV systems shall conform to APPLICABLE CRITERIA to include I3A Criteria and the UFC 3-580-01 Telecommunications Bldg Cabling Systems Planning/Design.

(f) Audio/Visual Systems

i. GFGI Projectors. Provisions (consisting of a power receptacle and conduit for signal wiring) for a GFGI projector shall be provided in each conference room and classroom.

ii. Paging systems. A zoned paging system shall be provided throughout eachfacility and integrated with the telephone system.

iii. Video Teleconferencing (VTS) provisions. Video teleconferencing (non-secure) provisions shall be provided in all conference rooms and classrooms. Provisions generally consist of a power connection and two RJ45 data outlets in a double gang outlet faceplate.

(g) Security Infrastructure (Security Equipment NIC). The security infrastructure shall be installed to support Government-furnished equipment including cameras, door alarms, and motion sensors. ICIDS systems, CCTV surveillance systems, and restricted access systems. Provisions shall include dedicated power circuits, communications connections, raceways, and signal wiring for user installed devices. System requirements shall be coordinated with the installation security office.

i. Intrusion Detection and Security Systems. Provision for user provided ICIDS intrusion detection and security systems are required for secure and restricted areas including the Secure Document vaults and the SIPRNet rooms.

ii. TEMPEST Requirements. TEMPEST requirements shall be met on a per site basis dependent on the facility zone type and the equipment NSTISSAM level. All unclassified telecommunications systems and associated infrastructure shall be electrically and physically isolated from all classified telecommunications systems in accordance with NSTISSAM requirements.

(h) Mass Notification System (MNS). A mass notification system shall be provided as required by UFC 4-010-01.

(i) Grounding. The ground counterpoise shall be provided around the building perimeter and shall be utilized for grounding incoming service, building steel, telephone service, piping, lightning protection, and internal grounding requirements. Ground straps shall be provided where required by function and will be connected to the building grounding system. A grounding point shall be provided under each raised access floor. Additional grounding may be provided based on project requirements. Systems shall conform to NFPA 70 National Electrical Code, local codes, and the US Army I3A Criteria.

(j) Fire Detection and Alarm

i. A fire alarm and detection system shall be provided for this facility. It shall comply with the requirements of UFC 3-600-01 and NFPA 72. The system shall be addressable and fully compatible with and integrated with the local installation wide central monitoring system.

ii. Server rooms and other portions of the facility which house MISSION CRITICAL electronic equipment installations (as defined in section 6-8 of UFC 3-600-01), and utilize raised floor systems shall have smoke detectors installed in the space beneath the flooring panels in accordance with NFPA 75. Under-floor detectors shall be connected to the fire alarm system and shall be wired so as to immediately cut power to the electronic equipment in the protected room upon activation.

iii. All initiating devices shall be connected to signal line circuits (SLC), utilizing Class A, Style 6 wiring . All alarm appliances shall be connected to notification appliance circuits (NAC), Class A. A looped conduit system shall be provided so that if the conduit and all conductors within are severed at any point, all NAC and SLC shall remain functional.

iv. Breakglass pull stations shall not be used.

v. Over-voltage and surge protection shall be provided at the input power of all panels.

3.3.6. Structural Design

(1) Structural Floor Load Requirement for Brigade Secure Documents Room. The floor system for the Secure Documents room of the Brigade Headquarters Facility shall be designed to store up to 12 safe/file-cabinets. The empty shipping dead load of the cabinet is approximately 1021 lbs each. The live load of the safe/file-cabinet will be based on the latest approved addition of IBC for a “Heavy Storage” of 250 psf.

3.3.7. Energy Conservation

(1) Energy Performance. The building, including the building envelope, HVAC, ventilation and exhaust systems, service water heating, power, and lighting systems shall be designed 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 (see paragraph 5.9 Energy Conservation). (Note: Plug loads shall be included in building energy modeling but are subtracted in the final calculation of Energy Performance. See section “Design After Award” for additional guidance.)

(2) Required Energy Conservation Features. All items listed in the required energy conservation features table shall be provided as a minimum. Additional energy conservation features may be required to meet the above energy performance. The contractor is responsible for determining and providing additional energy conservation features to meet the energy performance requirement. Where equipment types are indicated, only minimum efficiencies apply.

(3) Compliance Documentation. The required energy conservation features shown in the table above contributes to the achievement of the above energy performance and are life cycle cost effective for a Battalion and Brigade facility. Use of the required energy conservation features does not eliminate the requirement for energy analysis calculations documenting compliance. The D-B contractor must document compliance with the above energy performance utilizing the methodology described in ASHRAE 90.1, Appendix G as discussed in section 01 33 16 Design After Award. The design analysis shall document each of the features selected to achieve the specified energy performance.

BHQ Climate Zone 4A, Energy Conservation Features Table(7)

Item	Component	Minimum Requirements	
		Assembly Max (2)	**Min R-Value (2)**
Roof	Insulation Entirely Above Deck	U-0.0388	R-25ci
	Attic and Other		R-38
	Solar Reflectance (3)		Cool Roof for Low Slope & Light color all others

Item	Component	Minimum Requirements	
		Assembly Max (2)	**Min R-Value (2)**
Walls	Mass	U-0.0676	R-13
	Steel Framed		R-13 + R-7.5ci
	Wood Framed and Other		R-13 + R-3.8ci
Floors Over Unconditioned Space	Mass	0.0739	R-10.4ci.
	Steel Joist		R-13
	Wood Framed and Other		R-13
Slab-on-Grade	Unheated	F-0.520	R-15.0 for 24 in.
Doors	Swinging	U-0.50	Insulated
	Non-Swinging	U-0.50	Insulated
Infiltration		0.25 cfm/ft^2 @ 75 Pa (5)	
Vertical Glazing	Window to Wall Ratio (WWR)	10% to 20% – east/west 10% to 40% – north/south	
	Thermal transmittance	U-0.42	
	Solar heat gain coefficient (SHGC)	0.39	
	South Overhangs	Yes; Projection Factor = 0.4	
Interior Lighting	Lighting Power Density (LPD)	≤ 0.9 W/ft^2	
	Occupancy Controls	Manual On/Auto Off (all periodically occupied spaces)	
	Daylighting Controls	Perimeter Zones	
	Plug Load Lighting	Compact Fluorescent (CFL) with electronic ballast	
	All Ballasts	Electronic	
Ducts	Friction rate	0.08 in. w.c./100 feet	
	Sealing	Seal class B	
	Location	Interior only	
	Insulation level	R-6 (6)	
Service Water Heating	Gas hot water storage	90% Et	
	Pipe Insulation(d < 1.5in. / d ≥ 1.5 in.)	1 in. / 1.5 in. (6)	

Notes:

1. **Omitted.**
2. **U-values and R-values** for assemblies and their definitions, requirements, and determinations can be found in ANSI/ASHRAE/IESNA Standard 90.1.
3. **Light colored and cool roofs**: reflect and emit the sun's heat back to the sky instead of transferring it to the building below. "Coolness" is measured by two properties, solar reflectance and thermal emittance. Both properties are measured from 0 to 1 and the higher the value, the "cooler" the roof. A high reflectance keeps much of the sun's energy from being absorbed, while a high thermal emittance radiates away any solar energy that is absorbed, allowing the roof to cool more rapidly. Cool roofs are typically white and have a smooth surface. Commercial roof products that qualify as cool roofs fall into three categories: single-ply, liquid-applied, and metal panels. The solar reflectance and thermal emittance

property values represent initial conditions as determined by a laboratory accredited by the Cool Roof Rating Council.

Cool roofs are cost effective over air-conditioned spaces for buildings located in climate zones 1 - 5. In these locations, a minimum of 75% of the entire roof surface not used for roof penetrations shall be covered with roofing products that comply with one or more of the following:

- Have a minimum initial SRI of 78 for a low-sloped roof (a slope less than or equal to 2:12) and a minimum initial SRI of 29 for a steep-sloped roof (a slope of more than 2:12).
- Comply with the criteria for the US EPA's Energy Star Program Requirements for Roof Products – Eligibility Criteria.

For industrial buildings with only heating and ventilation, cool roofs can improve the comfort conditions (and hence productivity) in the space.

In order to be considered a cool roof, a solar reflectance of 0.67 when tested in accordance with ASTM C1549, ASTM E903, or ASTM E1918 and, in addition, a minimum thermal emittance of 0.75 when tested in accordance with ASTM C1371 or ASTM E408, or a minimum Solar Reflective Index of 78 when determined in accordance with the Solar Reflectance Index method in ASTM E1980 where standard white is SRI = 100 and standard black has SRI = 0. An SRI can be determined by the following equations:

$$SRI = 123.97 - 141.35(x) + 9.655(x^2)$$

Where

$$x = \frac{20.797 \times \alpha - 0.603 \times \varepsilon}{9.5205 \times \varepsilon + 12.0}$$

Where α is the solar absorptance (= 1 – solar reflectance) and ε is the thermal emissivity, which were derived from ASTM E1980 assuming a medium wind speed.

The limited color choices available for cool roofs may not be acceptable to the installation. When this conflict cannot be resolved, the designer shall use the highest reflectance available in the roofing type/color acceptable to the installation.

Characteristics of reflective roofing materials.

Roofing Type	Color	New Solar Reflectance	Aged Solar Reflectance	New Thermal Emittance	SRI (ASTM E1980
Roof Coatings	White	0.70 – 0.85	0.50 –0.65	0.85	84 – 106
Roof Coatings	Grey or Tan	0.70	0.50	0.85	84
Roof Coatings	Terra Cotta or Brown	0.40	0.30	0.85	43
Roof Coatings	Aluminized	0.50	0.40	0.50	42
Metal Paint	Red	0.25	0.25	0.83	22
Metal Paint	Terra Cotta	0.35	0.35	0.83	36
Metal Paint	Bright Red	0.35	0.35	0.83	36
Metal Paint	Beige/Off White	0.55	0.55	0.83	63
Metal Paint	Tan	0.45	0.45	0.83	49
Metal Paint	Dark Blue	0.25	0.25	0.83	22
Metal Paint	Medium to Light Blue	0.32	0.32	0.83	32
Metal Paint	Dark Brown	0.25	0.25	0.83	22

Roofing Type	Color	New Solar Reflectance	Aged Solar Reflectance	New Thermal Emittance	SRI (ASTM E1980
Metal Paint	Medium to Light Brown	0.32	0.32	0.83	32
Metal Paint	Dark Green	0.25	0.25	0.83	22
Metal Paint	Medium to Light Green	0.32	0.32	0.83	32
Metal Paint	White	0.65	0.65	0.83	77
Metal Paint	Bright White	0.70	0.70	0.83	84
Metal Paint	Black	0.25	0.25	0.83	22
Metal Paint	Dark Grey	0.25	0.25	0.83	22
Metal Paint	Medium to Light Grey	0.35	0.35	0.83	36
Metal Paint	Pearlescent Colors	0.35	0.35	0.75	32
Galvalume	Unpainted	0.65	0.55	0.05	45
Copper Metal	Unpainted	0.85	0.18	0.03	89
Galvanized Steel	Unpainted	0.40	0.20	0.50	26
EPDM Membrane	Black	0.05	0.10	0.85	0
TPO Membrane	White	0.80	0.60	0.85	99
TPO Membrane	Grey	0.50	0.40	0.85	57
PVC Membrane	White	0.80	0.60	0.85	99
PVC Membrane	Grey	0.50	0.40	0.85	57
Asphalt Shingle	Dark Color	0.10	0.10	0.85	4
Asphalt Shingle	Light Color	0.25	0.25	0.85	23
Modified Bitumen Cap Sheet	Dark Color	0.10	0.10	0.85	4
Modified Bitumen Cap Sheet	Light Color	0.25	0.25	0.85	23
Modified Bitumen Cap Sheet	White	0.50-0.60	0.40 – 0.45	0.85	57 - 71

4. **NR** means there is no requirement or recommendation for a component in this climate zone.
5. **Increased Building Air tightness**. Building air leakage (measured in cfm/ft^2) is the average volume of air(measured in cubic feet per minute) that passes through a unit area of the building envelope (measured in square feet) when the building is maintained at a specified internal pressure (measured in Pascals). ASHRAE has proposed a building air tightness requirement of 0.4 cfm/ft^2 @ 75 Pa as an addendum to Standard 90.1-2004. ASHRAE has also proposed an approach to complying with the new requirement with a pressurization test to show that the building leakage does not exceed 0.4 cfm/ft^2 at 75 Pa. This air tightness requirement provides a number that can be used for the energy simulations and was assumed to be the baseline leakage rate. The air tightness requirement adopted by the U.S. Army for new construction is more stringent than the one proposed by ASHRAE and requires that the leakage rate must not exceed 0.25 cfm/ft^2 at 75 Pa, and was assumed for the energy efficient building models. To convert the values used for building leakage tests at the pressure difference of 75Pa to the values which can be used to calculate required excessive outdoor air supply rates, the following equation can be used $\Delta Q = Q75 * (5/75)^{0.65} = 0.172 * Q75$. The excessive airflow rate for the building complying with the new ASHRAE 90.1 Standard air leakage requirement is 0.069 cfm/ft^2. Respective number for the building built to the Army model RFP requirement is 0.043cfm/ft^2.
6. **Duct and pipe insulation,** values are from the ASHRAE Advanced Energy Design Guide for Small Offices.
7. **Energy Conservation Features tables.** The tables above apply to Battalion and Brigade Headquarters buildings.
8. Schedules. The following facility schedules must be used in all facility energy simulations for purposes of documenting compliance with energy performance requirement.

Battalion and Brigade Headquarters Internal Load Schedules

Hr	Occupancy			Lighting			Plug Loads			Service Hot Water		
	Wk	Sat	Sun	Wk	Sat	Sun	Wk	Sat	Sun	Wk	Sat	Sun
1	0.00	0.00	0.00	0.05	0.05	0.05	0.30	0.30	0.30	0.00	0.00	0.00
2	0.00	0.00	0.00	0.05	0.05	0.05	0.30	0.30	0.30	0.00	0.00	0.00
3	0.00	0.00	0.00	0.05	0.05	0.05	0.30	0.30	0.30	0.00	0.00	0.00
4	0.00	0.00	0.00	0.05	0.05	0.05	0.30	0.30	0.30	0.00	0.00	0.00
5	0.00	0.00	0.00	0.05	0.05	0.05	0.30	0.30	0.30	0.00	0.00	0.00
6	0.00	0.00	0.00	0.05	0.05	0.05	0.30	0.30	0.30	0.00	0.00	0.00
7	0.00	0.00	0.00	0.10	0.05	0.05	0.30	0.30	0.30	0.00	0.00	0.00
8	0.20	0.00	0.00	0.30	0.05	0.05	0.30	0.30	0.30	0.00	0.00	0.00
9	0.95	0.00	0.00	0.90	0.05	0.05	0.90	0.30	0.30	0.00	0.00	0.00
10	0.95	0.00	0.00	0.90	0.05	0.05	0.90	0.30	0.30	0.00	0.00	0.00
11	0.95	0.00	0.00	0.90	0.05	0.05	0.90	0.30	0.30	0.00	0.00	0.00
12	0.95	0.00	0.00	0.90	0.05	0.05	0.90	0.30	0.30	0.00	0.00	0.00
13	0.50	0.00	0.00	0.90	0.05	0.05	0.80	0.30	0.30	0.00	0.00	0.00
14	0.95	0.00	0.00	0.90	0.05	0.05	0.90	0.30	0.30	0.00	0.00	0.00
15	0.95	0.00	0.00	0.90	0.05	0.05	0.90	0.30	0.30	0.00	0.00	0.00
16	0.95	0.00	0.00	0.90	0.05	0.05	0.90	0.30	0.30	0.00	0.00	0.00
17	0.95	0.00	0.00	0.90	0.05	0.05	0.90	0.30	0.30	0.00	0.00	0.00
18	0.30	0.00	0.00	0.50	0.05	0.05	0.50	0.30	0.30	0.00	0.00	0.00
19	0.00	0.00	0.00	0.30	0.05	0.05	0.30	0.30	0.30	0.00	0.00	0.00
20	0.00	0.00	0.00	0.30	0.05	0.05	0.30	0.30	0.30	0.00	0.00	0.00
21	0.00	0.00	0.00	0.20	0.05	0.05	0.30	0.30	0.30	0.00	0.00	0.00
22	0.00	0.00	0.00	0.20	0.05	0.05	0.30	0.30	0.30	0.00	0.00	0.00
23	0.00	0.00	0.00	0.10	0.05	0.05	0.30	0.30	0.30	0.00	0.00	0.00
24	0.00	0.00	0.00	0.05	0.05	0.05	0.30	0.30	0.30	0.00	0.00	0.00
Peak	See Note 1 Below for occupancy info			1.0 W/ft^2 (10.8 W/m^2)			0.75 W/ft^2 (8.1 W/m^2)			0 gal/hr (0 L/hr)		

Note 1: See “Standard Design Program Areas & Unit costs” table at the COS Website for staff (i.e. occupancy quantities) based on applicable facility sizes.

Battalion Headquarters West Zone Internal Load Schedules
(2 occupants continuously)

Hr	Occupancy			Lighting			Plug Loads			Service Hot Water		
	Wk	Sat	Sun	Wk	Sat	Sun	Wk	Sat	Sun	Wk	Sat	Sun

Hr	Occupancy			Lighting			Plug Loads			Service Hot Water		
1	0.417	0.417	0.417	0.50	0.50	0.50	0.30	0.30	0.30	0.00	0.00	0.00
2	0.417	0.417	0.417	0.50	0.50	0.50	0.30	0.30	0.30	0.00	0.00	0.00
3	0.417	0.417	0.417	0.50	0.50	0.50	0.30	0.30	0.30	0.00	0.00	0.00
4	0.417	0.417	0.417	0.50	0.50	0.50	0.30	0.30	0.30	0.00	0.00	0.00
5	0.417	0.417	0.417	0.50	0.50	0.50	0.30	0.30	0.30	0.00	0.00	0.00
6	0.417	0.417	0.417	0.50	0.50	0.50	0.30	0.30	0.30	0.10	0.10	0.10
7	0.417	0.417	0.417	0.50	0.50	0.50	0.30	0.30	0.30	0.40	0.40	0.40
8	0.417	0.417	0.417	0.50	0.50	0.50	0.30	0.30	0.30	0.20	0.20	0.20
9	0.95	0.417	0.417	0.90	0.50	0.50	0.90	0.30	0.30	0.00	0.00	0.00
10	0.95	0.417	0.417	0.90	0.50	0.50	0.90	0.30	0.30	0.00	0.00	0.00
11	0.95	0.417	0.417	0.90	0.50	0.50	0.90	0.30	0.30	0.00	0.00	0.00
12	0.95	0.417	0.417	0.90	0.50	0.50	0.90	0.30	0.30	0.00	0.00	0.00
13	0.50	0.417	0.417	0.90	0.50	0.50	0.80	0.30	0.30	0.00	0.00	0.00
14	0.95	0.417	0.417	0.90	0.50	0.50	0.90	0.30	0.30	0.00	0.00	0.00
15	0.95	0.417	0.417	0.90	0.50	0.50	0.90	0.30	0.30	0.00	0.00	0.00
16	0.95	0.417	0.417	0.90	0.50	0.50	0.90	0.30	0.30	0.00	0.00	0.00
17	0.95	0.417	0.417	0.90	0.50	0.50	0.90	0.30	0.30	0.00	0.00	0.00
18	0.417	0.417	0.417	0.50	0.50	0.50	0.50	0.30	0.30	0.10	0.10	0.10
19	0.417	0.417	0.417	0.50	0.50	0.50	0.30	0.30	0.30	0.10	0.10	0.10
20	0.417	0.417	0.417	0.50	0.50	0.50	0.30	0.30	0.30	0.10	0.10	0.10
21	0.417	0.417	0.417	0.50	0.50	0.50	0.30	0.30	0.30	0.00	0.00	0.00
22	0.417	0.417	0.417	0.50	0.50	0.50	0.30	0.30	0.30	0.00	0.00	0.00
23	0.417	0.417	0.417	0.50	0.50	0.50	0.30	0.30	0.30	0.00	0.00	0.00
24	0.417	0.417	0.417	0.50	0.50	0.50	0.30	0.30	0.30	0.00	0.00	0.00
Peak	5 occupants			1.0 W/ft^2 (10.8 W/m^2)			0.75 W/ft^2 (8.1 W/m^2)			6.4 gal/hr (24 L/hr)		

3.4. BATTALION HEADQUARTERS BUILDINGS – FURNITURE REQUIREMENTS

3.4.1. Furniture Systems

The criterion contained on the following pages describes the furnishing requirements for all room types and for all headquarters building(s). Furnishings, other than installed equipment, are to be GFGI unless otherwise specified in this document. The following furnishings list is provided for coordination of room and office layouts to ensure suitability for their intended function. Large interior spaces such as open office areas can be subdivided into smaller areas by using office partitions, storage units and file cabinets or similar devices. In general, the interior design shall provide a comfortable, efficient and flexible work environment. All open office workstations in the headquarters are predicated on 6-foot by 8-foot cubicles.

3.4.2. Room Size and Furnishings Chart

Room Size and Furnishings Chart			
ROOM TYPE	**MIN. SF**	**COMMENTS**	**FURNITURE REQUIRED**
Senior Executive Office	200	Private Office	U-shaped desk unit executive single pedestal desk w/ center drawer, box/box/file pedestal, full modesty panel; executive bridge 42” min.; credenza unit w/ two drawer lateral file and hutch unit w/ door storage, 4-

Room Size and Furnishings Chart			
ROOM TYPE	**MIN. SF**	**COMMENTS**	**FURNITURE REQUIRED**
			drawer lateral files, one conference table, four conference chairs, two guest chairs, one executive chair.
Executive Office	150	Private Office	L-shaped executive desk unit with single pedestal desk w/ center drawer and storage pedestal w/ box/box/file configuration, full modesty panel; executive return with storage pedestal box/box/file configuration, two 4-drawer lateral files, two guest chairs, one executive chair.
Office	110	Private Office	L-shaped executive desk unit with single pedestal desk w/ center drawer and storage pedestal w/ box/box/file configuration, full modesty panel; executive return with storage pedestal box/box/file configuration, one 4-drawer lateral file, one guest chairs, one task chair.
Open Workstation	48	Open Workstation	Systems furniture workstation, approx. 48 SF, with work surfaces, file drawers and overhead storage.
Brigade Command Conference Room	600		Conference table with 18 chairs and 18 side chairs.
Battalion Command Conference Room	330		Conference table with 14 chairs and 8 side chairs.
Medium Conference Room	300 - 200		Conference table with 12 chairs and 4 side chairs.
Small Conference Room	180 - 110		Conference table with 8 chairs and 2 side chairs.
Reception Area	Varies	Executive Reception Area	Systems furniture open office area for one staff member and 5 visitors (5 guest chairs).
Classroom	Varies		1 desk and chair for each 20 SF. Provide movable partitions to divide large classroom space into three equally-sized spaces.
Lobby	Varies	Building Reception Area	Lounge seating if space allows. Provide one recessed building directory near each main entrance, and in a multiple-story building, provide one recessed building directory near elevators doors above the first floor. Provide one 4'-0" x 6'-0" wall mounted bulletin board for each headquarters unit. Provide one glass front 4'-0" wide min. built in display cabinet for unit memorabilia, awards, trophies, etc.
Message Center	Varies		Provide 24" deep counter equivalent to the length of the room.
File Room	Varies		Minimum of 1 linear foot of 4-drawer lateral file cabinet for every 4 SF of room (250 SF room = min 62.5 LF 4-drawer horizontal base files; (1) 36"(w), 4-drawer file cabinet = 12 LF)

Room Size and Furnishings Chart			
ROOM TYPE	**MIN. SF**	**COMMENTS**	**FURNITURE REQUIRED**
Break Room	Varies		Contractor furnished, contractor installed minimum 20 LF base and wall cabinets, dishwasher and space for a full size refrigerator with ice-maker. Note that in BG HQ- S-1 Break Room also supports Command group. Provide recessed space for two vending machines per building (machines are not in the contract) not in view of the lobby.
Shower	Varies		Contractor furnished, contractor installed lockers with benches will be provided on a 3:1 ration of lockers/shower. Minimum locker size shall be 12”(w) x 18”(d) x 36”(h).
Secured Documents Room	Varies	Secure Documents Room conforming to requirements in AR 380-5	2 four drawer safes per authorized company within each battalion secure document room. 2 four drawer safes per coordinating staff section within each battalion and/or brigade secure documents room, not to exceed a total of 12 safes per the battalion document room.
BOC	Varies	Brigade Operations Center	Provision for Government-Furnished, Government-Installed television monitors (wall of knowledge). Systems furniture workstations, 30"D x 60"W, with 42"-48"H powered panels, and one stationary box/box/file pedestal and task chair per workstation as indicated on standard floor plans. Modular conference tables and chairs for 10 persons (with side chairs as space allows) at conference room. Contractor furnished, contractor installed raised flooring.
SCIF	Varies	Sensitive Compartmented Information Facility conforming to DCID Manual 6/9 and Office of the Director of National Intelligence – DRAFT Intelligence Community Standard (ICS) 705	50 - 52 total systems furniture workstations, 30"D x 60"W, with 42"-48"H powered panels, and one stationary box/box/file pedestal and task chair per workstation as indicated on standard floor plans. Modular conference tables and chairs for 12 persons (with side chairs as space allows) at conference room. Contractor furnished, contractor installed raised flooring to accommodate weight of 7 four drawer safes. Primary entry vestibule (interior) shall accommodate (1) 24” D x 36” W standing height table. Provide (1) cell phone storage locker to accommodate 50 individual phones adjacent to primary SCIF entry at corridor side.
NOC	Varies	Network Operations Center	Systems furniture workstation, approx. 48 SF, with work surfaces, file drawers and overhead storage as indicated on standard floor plans. Space for GFGI communication racks, equipment, and 3 each work benches in server room. Contractor furnished, contractor installed raised flooring.

3.5. REFERENCES

(1) Applicable Industry Criteria

American National Standards Institute (ANSI/Telecommunications Industry Association (TIA/Electronic Industry Association (EIA)

ANSI/EIA/TIA 568A Commercial Building Telecommunications Cabling Standard and all applicable Addendums)

EIA/TIA 568-B Commercial Building Telecommunications Cabling Standards (Addendums 561-B.1, 568-B.2, 568-B.2-1)

ANSI/EIA/TIA 606A Administration Standard for Commercial Telecommunications Infrastructure

ASHRAE 55 Thermal Environmental Conditions for Human Occupancy

ASHRAE Hdbk-IP Handbook, Refrigeration I-P Edition

ASHRAE Hdbk-IP Handbook, HVAC Applications I-P Edition

ASHRAE Hdbk-IP Handbook, HVAC Systems and Equipment I-P Edition

ASME B31.1 Power Piping

ASHRAE Underfloor Air Distribution (UFAD) Design Guide, 2003

ASTM E413-04, Classification for Rating Sound Insulation

Clean Air Act Amendment of 1990

Discount Factors for Life-Cycle Cost Analysis, Annual Supplement to NIST Handbook 135

Memorandum of Agreement (MOA) on Criteria/Standards for Economic Analyses/Life Cycle

Costing for MILCON Design (March 1996)

NIST Handbook 135 (with the annual supplement of discount factors)

SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems

Testing and Balancing Bureau (TABB)

Underwriters Laboratories (UL)

UL 1440 Transient Voltage Surge Suppressors

(2) Applicable Military Criteria

Army Regulation (AR)

AR 190-51, Security of Unclassified Army Property (Sensitive and Nonsensitive), 30 September 1993

AR 380-381 Special Access Programs (SAPS) and Sensitive Activities

AR 380–5, Information Security Program

Department Of Defense (DOD)

DOD MIL-HDBK-419A Grounding, Bonding, and Shielding for Electronic Equipment and Facilities

DoD Regulation 5200.1-R, Information Security Program, dated January 1997, Appendix 7 –Physical Security for Vault and Secure Room Construction Standards

Information Systems Engineering Command (ISEC)

National Security Telecommunications and Information Systems Security (NSTISS)

NSTISSAM Tempest 2-95 Red/Black Installation Guidance

NSTISSI 7003 Protective Distribution Systems (PDS)

Office of the Director of National Intelligence – DRAFT Intelligence Community Standard Number 2009-705-1

Technical Guide for the Integration of Secret Internet Protocol Router Network (SIPRNet)

Unified Facilities Criteria UFC

UFC 3-580-01 Telecommunications Bldg Cabling Systems Planning/Design Manual 22 June 2007

UFC 4-140-01, Brigade Operations Complex, Brigade and Battalion Headquarters

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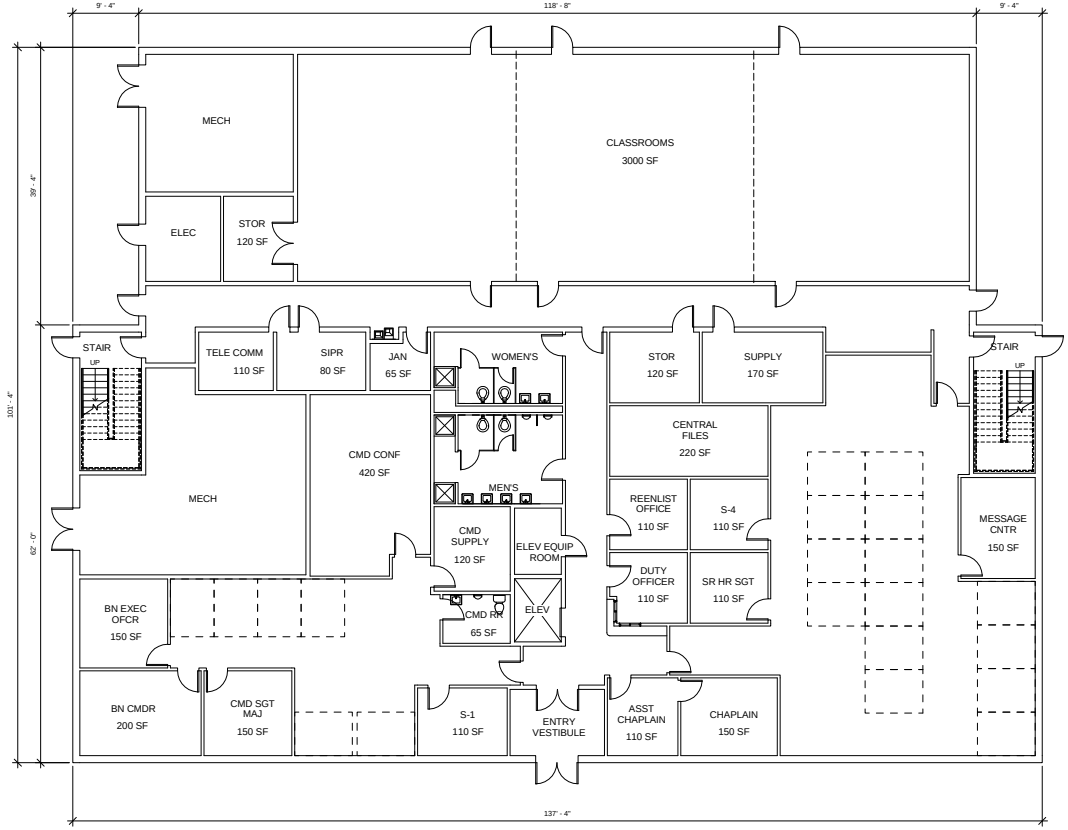

1 EXTRA LARGE BATTALION FIRST FLOOR PLAN
1/8" = 1'-0"

FIRST FLOOR	13182 GSF
SECOND FLOOR	8493 GSF
TOTAL SF SHOWN	21675 GSF
MAX ALLOWABLE	22600 GSF

THE FLOOR PLAN INDICATES THE ARMY STANDARD DESIGN IN SCHEMATIC FORM. THE DESIGNER-OF-RECORD (DOR) IS ALLOWED TO MAKE ADJUSTMENTS FOR EXTERIOR FACADE/ARCHITECTURAL THEME, AND/OR TO ACCOMMODATE SPECIFIC BUILDING ENGINEERING SYSTEMS (STRUCTURAL, MECHANICAL, ELECTRICAL, FIRE PROTECTION, SUSTAINABLE DESIGN, ETC.). THESE ADJUSTMENTS WILL BE EVALUATED BY THE CENTER OF STANDARDIZATION (COS) DURING ITS COMPLIANCE REVIEW.

THE OVERALL BUILDING DIMENSIONS AND THE VALUES FOR THE GROSS BUILDING AREAS INDICATED ARE FOR THE STANDARD LAYOUTS SHOWN AND ARE PREDICATED ON AN ASSUMED EXTERIOR WALL THICKNESS OF 20 INCHES. IT IS UNDERSTOOD THAT THE ACTUAL GROSS BUILDING AREA WILL VARY DEPENDING ON THE WALL SYSTEM/MATERIAL SELECTED FOR A SPECIFIC PROJECT. A REDUCED OVERALL GROSS AREA IS PERMISSIBLE IF ALL NET PROGRAM REQUIREMENTS AND ADJACENCIES ARE SATISFIED, BUT IN NO CASE MAY THE MAXIMUM GROSS AREA FOR THE FACILITY BE EXCEEDED.

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US Army Corps of Engineers ®

SYMBOL | DESCRIPTION | DATE | BY

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS

DESIGN BY: Designer
DRAWN BY: Author
SHMT BY: Approver
PLOT SCALE: As indicated
SIZE: D 22" x 34"
DATE:
CKD BY: Chk'dwr
PLOT DATE: 1/27/2012 11:52:29 AM
FILE NAME:
SOLICITATION NO.:
CONTRACT NO.:
CATEGORY CODE:

Project Name

FIRST FLOOR PLAN

PLATE REFERENCE NUMBER
A101
SHEET

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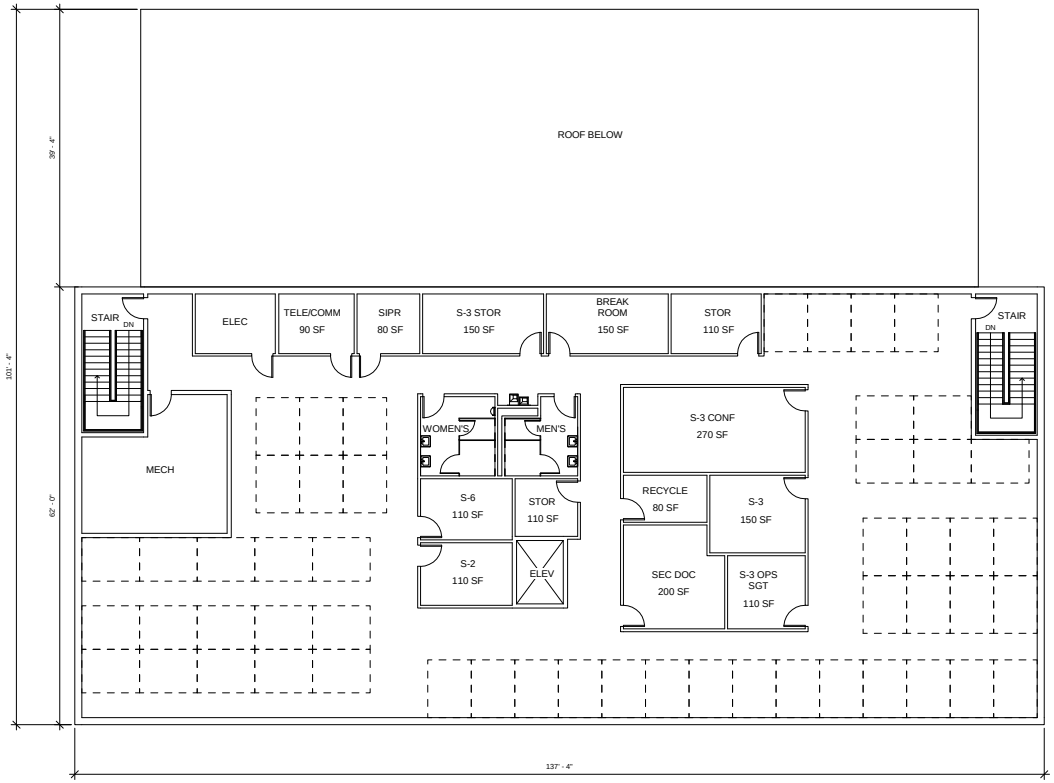

1 EXTRA LARGE BATTALION SECOND FLOOR PLAN
1/8" = 1'-0"

FIRST FLOOR	13182 GSF
SECOND FLOOR	8493 GSF
TOTAL SF SHOWN	21675 GSF
MAX ALLOWABLE	22600 GSF

THE FLOOR PLAN INDICATES THE ARMY STANDARD DESIGN IN SCHEMATIC FORM. THE DESIGNER-OF-RECORD (DOR) IS ALLOWED TO MAKE ADJUSTMENTS FOR EXTERIOR FACADE/ARCHITECTURAL THEME, AND/OR TO ACCOMMODATE SPECIFIC BUILDING ENGINEERING SYSTEMS (STRUCTURAL, MECHANICAL, ELECTRICAL, FIRE PROTECTION, SUSTAINABLE DESIGN, ETC.). THESE ADJUSTMENTS WILL BE EVALUATED BY THE CENTER OF STANDARDIZATION (COS) DURING ITS COMPLIANCE REVIEW.

THE OVERALL BUILDING DIMENSIONS AND THE VALUES FOR THE GROSS BUILDING AREAS INDICATED ARE FOR THE STANDARD LAYOUTS SHOWN AND ARE PREDICATED ON AN ASSUMED EXTERIOR WALL THICKNESS OF 20 INCHES. IT IS UNDERSTOOD THAT THE ACTUAL GROSS BUILDING AREA WILL VARY DEPENDING ON THE WALL SYSTEM/MATERIAL SELECTED FOR A SPECIFIC PROJECT. A REDUCED OVERALL GROSS AREA IS PERMISSIBLE IF ALL NET PROGRAM REQUIREMENTS AND ADJACENCIES ARE SATISFIED, BUT IN NO CASE MAY THE MAXIMUM GROSS AREA FOR THE FACILITY BE EXCEEDED.

US Army Corps of Engineers ®

U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS

Project Name

SECOND FLOOR PLAN

PLATE REFERENCE NUMBER
A102
SHEET

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 – 13th 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 189.1-2009	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	International Building Code Note: All references in the International Building Code to the International Electrical Code shall be considered to be references to NFPA 70. 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. All references in the International Building Code to the International Fire

	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, Liquified 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	ABA Accessibility Standard for DoD Facilities Derived from the ADA and ABA Accessibility Guidelines: Specifically includes: ABA Chapters 1 and 2 and Chapters 3 through 10. Use this reference in lieu of IBC Chapter 11. Excluded are: (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). (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).
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. Energy Independence and Security Act of 2007- “EISA” (applies only to the extent specifically implemented in the contract)

4.2.3. 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.

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

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

4.2.6. UFC 3-101-0 Architectural Design, (Applies only to the extent specifically implemented herein).

4.2.7. UFC 3-210-10, Low Impact Development, applicable only to the extent specified herein.

4.2.8. 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.

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

4.2.10. 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.

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

4.2.12. UFC 3-420-01, Plumbing Systems, (Applicable only to the extent specifically implemented herein).

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

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

4.2.14. 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.

4.2.14.1. 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. References to ASHRAE Standard 189.1 are to ASHRAE Standard 189.1-2009 unless otherwise specified in this Paragraph.

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 SELECTION: Meet the allowable site requirements of ASHRAE Standard 189.1, Section 5.3, Manadatory Provisions, and either Section 5.4, Prescriptive Option, or Section 5.5, Performance Option; and ASHRAE Standard 189.1, Section 10.3.2.1.1, unless otherwise specified by the current Department of Defense Minimum Antiterrorism Standards for Buildings, UFC 4-010-01.

5.1.3. 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.

5.1.3.1. Enclosures and Visual Screens: 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.

5.1.3.2. Dumpster Pads: 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.

5.1.3.3. 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.

5.1.3.4. Emergency Vehicle Access: 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.

5.1.3.5. Stormwater Management and Low Impact Design: Employ design and construction strategies (Best Management Practices, or BMPs) that reduce stormwater runoff, reduce discharges of polluted

water offsite and maintain or restore predevelopment hydrology with respect to temperature, rate, volume, quality and duration of flow. See “Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act (EISA)” (http://www.epa.gov/owow/NPS/lid/section438/pdf/final_sec438_eisa.pdf) and Paragraph 6, PROJECT SPECIFIC requirements for additional information. BMPs used to treat runoff must be capable of removing 80% of the average annual postdevelopment total suspended solids (TSS) load based on existing monitoring reports. BMPs are considered to meet these criteria if:

- They are designed in accordance with standards and specifications from a state or local program that has adopted these performance standards.

OR

- There exists infield performance monitoring data demonstrating compliance with the criteria. Data must conform to accepted protocol (e.g., Technology Acceptance Reciprocity Partnership [TARP], Washington State Department of Ecology) for BMP monitoring.

In addition, meet the requirements of ASHRAE Standard 189.1, Section 5.3, and either Section 5.4, Prescriptive Option or Section 5.5 Performance Option for Site Development and UFC 3-210-10. If any of the requirements in this subsection are prohibited by state law, state law shall take precedence but only as to those requirements found to be in conflict.

5.1.3.6. Erosion and Sedimentation Control: Meet the requirements of ASHRAE Standard 189.1, Section 10.3.1.3.

5.1.4. EXTERIOR SIGNAGE: Provide exterior signage in accordance with Appendix H, Exterior Signage. Provide exterior NO SMOKING signage that conveys building and grounds smoking policy. Meet the requirements of ASHRAE Standard 189.1, Section 8.3.1.4 (a).

5.1.5. 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. Subsurface Conditions Report: 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. Geotechnical Evaluation Report: 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. Pavement Requirements: Except in Department of Energy (DOE) Climate Zones 6, 7, and 8, meet ASHRAE Standard 189.1, Section 5.3.2.1. If the project is located in DOE Climate Zones 6, 7, or 8, 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. Provide underdrain systems for pavement designs over cohesive soil subgrades. 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 expectance 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 in all DOE Climate Zones shall comply with the Installation requirements and with the Manual on Uniform Traffic Control Devices. Develop a Transportation Management Plan that meets the requirements of ASHRAE Standard 189.1, Section 10.3.2.4.1.

5.2.3.2. Parking Requirements. This subsection is applicable only to parking lots/areas that permit POV parking:

5.2.3.2.1 General Parking Requirements:

5.2.3.2.1.1 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.

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

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

5.2.3.2.2 Preferred Parking:

5.2.3.2.3 Low-Emitting and Fuel Efficient 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. In addition, meet the requirements of ASHRAE Standard 189.1, Section 5.3.2.1.

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 Paragraph 5.9.3.5 below for utility metering requirements.

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 and irrigation systems, if provided, shall comply with ASHRAE Standard 189.1, Section 6.3, Mandatory Provisions, and either Section 6.4, Prescriptive Option, or Section 6.5, Performance Option. In addition, meet the requirements of ASHRAE Standard 189.1, Standard 10.3.2.

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

5.3. COMMISSIONING: Execute total building commissioning practices in order to verify performance of building components and systems and ensure that Owner Project Requirements (OPR) are met. Adopt and follow the requirements of ASHRAE Standard 189.1 Section 10.3.1.2, ASHRAE Guideline 0, ASHRAE Guideline 1.1, LEED Energy and Atmosphere (EA) Prerequisite 1 and LEED EA Credit 3. 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. Commissioning activities shall be consistent with the Pre-Design Phase, Design Phase, Construction Phase and Occupancy and Operations Phase. Perform and document a post occupancy system monitoring and inspection to review building operation within 12 months after beneficial occupancy. Post occupancy system monitoring and inspection results will be used to verify compliance with the Owner's Project Requirements (OPR), to revise and update the Systems Manual and for completion of the Final Commissioning Report.

5.3.1. Plan Development: Meet the requirements for the development of the Maintenance Plan and Service Life Plan in ASHRAE Standard 189.1, Section 10.3.2.

5.4. ARCHITECTURE AND INTERIOR DESIGN.

5.4.1. STANDARDS AND CODES: The architecture and interior design shall conform to APPLICABLE CRITERIA.

5.4.2. GENERAL: Overall architectural goal is to provide a functional, quality, meet expected usable life standards, and visually appealing facility that is a source of pride for the installation and delivered within the available budget and schedule.

5.4.3. MATERIALS AND RESOURCES: Meet ASHRAE Standard 189.1, Section 9.3, Mandatory Provisions, and either Section 9.4, Prescriptive Option, or Section 9.5, Performance Option.

5.4.3.1. Construction and Demolition (C&D) Waste Management: Meet the requirements of ASHRAE Standard 189.1, Section 9.3.1. A waste management plan and waste diversion reports are required, as detailed in Section 01 57 20.00 10, ENVIRONMENTAL PROTECTION.

5.4.4. COMPUTATION OF AREAS: See APPENDIX Q of this RFP for how to compute gross and net areas of the facility(ies).

5.4.5. BUILDING EXTERIOR: Design buildings to enhance or compliment the visual environment of the Installation and reflect a human scale to the facility. Building entrance should be architecturally defined and easily seen. 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 materials colors shall conform to the Installation requirements and if brick or stone, have color that is throughout the material. See Paragraph 6 for project specific requirements.

5.4.5.1. 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 of this RFP.

5.4.5.2. Roofs and Exterior Walls: Meet the requirements of ASHRAE Standard 189.1, Section 5.3, Mandatory Provisions, and Section 5.4, Prescriptive Option, or Section 5.5, Performance Option. In addition, if a green roof is considered for this project, meet the requirements of ASHRAE Standard 6.2, Mandatory Provisions, and Section 6.3, Prescriptive Option, or Section 6.4, Performance Option.

5.4.6. BUILDING INTERIOR

5.4.6.1. Daylighting and Low Emitting Materials: Meet the requirements of ASHRAE Standard 189.1, Section 8.3, Mandatory Provisions, and either Section 8.4, Prescriptive Option, or 8.5, Performance Option. In addition, meet the daylighting requirements of ASHRAE Standard 189.1, Section 7.3, Mandatory Provisions, and either Section 7.4, Prescriptive Option, or Section 7.5, Prescriptive Option.

5.4.6.2. Surfaces and Color:

5.4.6.2.1. 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. In daylit zones, meet the requirements of ASHRAE Standard 189.1 section 8.4.1.

5.4.6.2.2. 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 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.) to the ceiling color.

5.4.6.3. Builidng Entrance: Meet the requirements of ASHRAE Standard189.1, Section 8.3.1.5.

5.4.6.4. 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.

5.4.7. COMPREHENSIVE INTERIOR DESIGN

5.4.7.1. SID and FF&E: 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.

5.4.7.2. FF&E Package: 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.

5.5. STRUCTURAL DESIGN

5.5.1. STANDARDS AND CODES: The structural design shall conform to APPLICABLE CRITERIA.

5.5.2. 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.

5.5.3. 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.

5.5.4. TERMITE TREATMENT AND GREEN CLEANING: (Except Alaska) Provide termite prevention treatment in accordance with Installation and local building code requirements, using licensed chemicals

and licensed applicator firm. In all States, meet the requirements of ASHRAE Standard 189.1, Section 10.3.2, regarding the building Green Cleaning Plan.

5.6. THERMAL PERFORMANCE

5.6.1. STANDARDS AND CODES: Building construction and thermal insulation for mechanical systems shall conform to APPLICABLE CRITERIA.

5.6.2. 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 that shall meet the requirements of ASHRAE Standard 189.1, Section 7.3, Mandatory Provisions, and either Section 7.4, Prescriptive Option, or 7.5, Performance Option. In addition, meet the requirements of ASHRAE Standard 189.1, Sections 10.3.1.4, 10.3.1.5, 10.3.1.6, and 10.3.2 as well as UFC 3-101-0, Section 3-6. 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.

5.6.2.1. Air Barrier: The air barrier must be durable to last the anticipated service life of the assembly. 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.

5.6.2.2. Thermal Bridge. A Thermal Bridge (or cold bridge) occurs when a thermally conductive material (such as a metal stud, steel frame or concrete beam, slab or column) penetrates or bypasses the exterior insulation system. Design the building envelope to align all insulating elements, ie, the continuous wall insulation, insulated glazing, insulated doors from top of footing to bottom of roof deck. Wrap insulation around roof overhangs. Disconnect window and door sills from interior construction. Utilize thermally broken window and door frames. Provide details to eliminate thermal bridges particularly at floor slabs, roof/wall intersections, steel lintels and relief angles, metal through-wall flashings and at building corners.

5.6.2.3. Damper and Control: 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.

5.6.2.4. Garages: Compartmentalize garages under buildings by providing air-tight vestibules at building access points.

5.6.2.5. Spaces Under Negative Pressure: Compartmentalize spaces under negative pressure such as boiler rooms and provide make-up air for combustion.

5.6.2.6. 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.

5.6.2.7. Performance Criteria and Substantiation: Test the completed building for air tightness in accordance with UFC 3-101-0, Section 3-6.3. 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) Air Barrier Quality Control Plan: 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) Notification of Testing: 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.

5.7. PLUMBING AND WATER CONSUMING EQUIPMENT

5.7.1. STANDARDS AND CODES: The plumbing system and water consuming equipment shall conform to APPLICABLE CRITERIA and ASHRAE Standard 189.1, Section 6.3, Mandatory Provisions, and either Section 6.4, Prescriptive Option, or Section 6.5, Performance Option. In addition, meet the requirements of ASHRAE Standard 189.1, Section 10.3.2.

5.7.2. 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.

5.7.3. HOT WATER SYSTEMS: For hot water heating and supply systems, meet the requirements in UFC 3-420-01 and amendments, and the service water heating requirements of ASHRAE 189.1, Section 7.4.4.

5.7.4. SIZING HOT WATER SYSTEMS: Unless otherwise specified or directed in Paragraph 3, design in accordance with ASHRAE Handbook HVAC Applications, Chapter 49, “Service Water Heating,” UFC 3-420-01 and amendments, and ASHRAE 189.1, Section 7.4.3. Size and place equipment so that it is easily accessible and removable for repair or replacement.

5.7.5. 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).

5.7.6. 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.

5.7.7. WATER EFFICIENT PLUMBING FIXTURES: Indoor plumbing fixture equipment shall comply with the following criteria: ASHRAE 189.1, Section 6.3, Mandatory Provisions, and either Section 6.4, Prescriptive Option, or Section 6.5, Performance Option.

5.7.7.1. Water Closets (Toilets): ASHRAE 189.1, Sections 6.3.2.1.a and b. requirements for water closets (toilets) shall be as follows: Flushometer valve type: For single flush, maximum flush volume shall be determined in accordance with ASME A112.19.2/CSA B45.1 and shall be 1.28 gal (4.8 L). For dual-flush, the effective flush volume shall be determined in accordance with ASME A112.19.14 and shall be 1.28 gal (4.8 L). Water closets (toilets)—tank-type: Tank-type water closets shall be certified to the performance criteria of the U.S. EPA WaterSense Tank-Type High-Efficiency Toilet Specification and shall have a maximum flush volume of 1.28 gal (4.8 L).

5.7.7.2. URINALS: As required by ASHRAE 189.1, Section 6.3.2.1.c, maximum flush volume when determined in accordance with ASME A112.19.2/CSA B45.1 shall be 0.5 gal (1.9 L). Non-water urinals shall comply with ASME A112.19.19 (vitreous china) or IAPMO Z124.9 (plastic) as appropriate.

5.7.7.3. PUBLIC LAVATORY FAUCETS: Lavatory faucets in a public setting shall have a maximum flow rate of 0.5 gallons per minute and be in accordance with ASME A112.18.1/CSA B125.1.

5.7.7.4. PUBLIC METERING SELF-CLOSING FAUCETS: Faucets in a public setting that supply a specific amount of water over a given period shall have a maximum water use of 0.25 gallons per cycle and be in accordance with ASME A112.18.1/CSA B125.1.

5.7.7.5. PRIVATE LAVATORY FAUCETS: Faucets in a private setting such as barracks, family housing, or hospitals shall have a maximum flow rate of 1.5 gallons per minute and be in accordance with ASME A112.18.1/CSA B125.1 and shall comply with the performance requirements of the US EPA WaterSense High-Efficiency Lavatory Faucet Specification.

5.7.7.6. KITCHEN FAUCETS: Kitchen faucets shall have a maximum flow rate of 2.2 gallons per minute and be in accordance with ASME A112.18.1/CSA B125.1.

5.7.7.7. Cooling Towers: In addition to the requirements of Subsection 5.7.1. above, conduct a one-time potable water analysis, measuring at least the following control parameters, in ppm or mg/l: calcium (Ca); total alkalinity; silica (Si); chloride (Cl); and conductivity . Calculate the number of cooling tower cycles by dividing the amount of each parameter in the condenser water by the amount in the potable makeup water. The maximum acceptable levels of the parameters in the condenser water are: Ca (as $CaCO_3$) and Total alkalinity – 1000 ppm; SiO_2 –100 ppm; Cl – 250 ppm; Conductivity – 3500 µS/ml. Limit cooling tower cycles to avoid exceeding maximum values for any of these parameters. AND Complete the following: A system to monitor and control microbiological growth is recommended; Meter the potable makeup water to the cooling tower and blowdown from the cooling; Blowdown must be controlled with a conductivity meter; Report monthly results of the amount of potable water used, microbiological levels, blowdown, and corrosion; On cooling towers, install drift eliminators that achieve minimum efficiencies of 0.2% for counter-flow systems or 0.5% for cross-flow systems.

5.7.7.8. Drainage Systems: Do not use engineered vent or Sovent® type drainage systems.

5.7.7.9. Pipe Location and Insulation: Where the seasonal design temperature of the cold water entering a building is below the seasonal design dew point of the indoor ambient air 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. Meet pipe insulation requirements of ASHRAE 189.1, Section 7.4.3.11 and Table C-11 of Normative Appendix C.

5.7.7.10. Pipe Protection During Construction: Cover all drain, waste and vent piping to prevent mortar or other debris during such construction activities.

5.8. ELECTRICAL AND TELECOMMUNICATIONS SYSTEMS

5.8.1. STANDARDS AND CODES: The electrical systems for all facilities shall conform to APPLICABLE CRITERIA.

5.8.2. 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.

5.8.3. 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.

5.8.3.1. Space Capacity: Provide 10% space for future circuit breakers in all panelboards serving residential areas of buildings and 15% spaces in all other panelboards.

5.8.4. 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.

5.8.5. LIGHTING: Comply with the recommendations of the Illumination Engineering Society (IES) and requirements of EPAct-2005 and Federal Energy Management Program (FEMP) for lighting products.

5.8.5.1. Interior Lighting:

(a) Reflective Surfaces: Coordinate daylighting requirements and interior architectural space surfaces and colors with the lighting systems to provide the most energy-efficient workable combinations.

(1) Fluorescent Lighting: Fluorescent lighting systems shall utilize NEMA premium electronic ballasts and high performance fluorescent lamps with a Correlated Color Temperature (CCT) of 4100 Kelvin (K) to 5000 K. Linear fluorescent and compact fluorescent lamps shall have a Color Rendering Index (CRI) of ≥ 82. All fluorescent lamps (compact and linear) shall be reclaimed through a process that captures and properly disposes of or recycles the mercury content. Do not use surface mounted luminaires on acoustical tile ceilings. Provide outside each building emergency egress door an un-switched emergency egress luminaire controlled by photocell or astronomical time clock. All other emergency egress luminaires shall be controlled the same as non-emergency luminaires in a shared space during normal (non-emergency) operation.

(2) Solid-State Lighting: Fixtures shall have a lumen maintenance life expectancy (L_{70}) of ≥ 36,000 hours, a CRI of ≥ 82, and a CCT of 4100 K to 5000 K. Each solid-state fixture model shall be tested in accordance with IES LM-79. Test reports shall verify the fixture performance (lumen output, lumen maintenance, power consumption, efficacy and color) meets or exceeds the fixture manufactures published data. Laboratory testing shall be completed by a National Voluntary Laboratory Accreditation Program laboratory. Provide a five year warranty for fixtures.

(3) Light Level Tuning: Light level tuning is a closed-loop feedback system that measures the illumination level in a space and dims the luminaires when the measured level exceeds the target level, thereby saving the energy that otherwise would be used to compensate for future light depreciation. Provide a life-cycle cost-benefit analysis (LCCA) of light level tuning for all spaces where the general lighting luminaires are equipped with dimming ballasts or LED drivers. The LCCA shall follow the methodology contained in 10 CFR 436. Provide light level tuning where the LCCA shows it to be life cycle cost effective.

(4) Lighting Systems and Controls: Lighting systems (including lighting controls, daylighting controls, and lighting power density limits) shall comply with the requirements of Section 7.4.6 of ASHRAE

Standard 189.1 and Section 9 of ANSI/ASHRAE/IES 90.1-2007. Lighting designs shall follow the recommended practices of the IES and shall target the recommended illumination levels of the IES.

(5) Occupancy or Vacancy Sensors: Use occupancy or vacancy sensors to automatically turn off lighting a specified time after all occupants leave the space. The off time shall be user adjustable to 5, 15, or 30 minutes. Selection of the sensor type (single or dual technology, wired or wireless) shall be based on the space configuration, user functionality and life-cycle cost-benefit analysis. Single technology solutions shall incorporate signal processing technology that distinguishes between background noise and actual motion without automatically changing their sensitivity.

(6) Automated Shading: Automated shading shall be considered in spaces utilizing daylight harvesting to maximize the energy savings of the daylighting 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 :

i. For ease of use and space aesthetics, incorporate the automated shades with the lighting control system.

ii. 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.

iii. For maximum design flexibility and ease of installation, shade system should have the capability to address and control each shade individually.

iv. The shading system shall have a manual override that allows the occupant to temporarily adjust the shades to any desired position. The system shall revert back to automatic control after a specified period of time.

(b) Provide a life-cycle cost-benefit analysis (LCCA) of automated shading for all spaces where daylight harvesting is provided. The LCCA shall follow the methodology contained in 10 CFR 436. Provide automated shading where the LCCA shows it to be economical.

(1) Scene-Based Dimming: 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).

(2) Personal Lighting Control: Personal lighting controls exceeding ASHRAE requirements shall be considered. Personal lighting controls allow users 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 light emitting diode (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).

(3) Wireless and Plug-and-Play Controls: Wireless and plug-and-play lighting controls shall be considered for all installations where flexibility is paramount. To avoid interference, wireless products shall communicate in an FCC frequency band that does not allow continuous transmissions.

(4) Testing Agent: An independent agent with no less than three years experience in testing of complex lighting control systems shall be hired 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 Standard 189.1, ANSI/ASHRAE/IES Standard 90.1-2007, 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.

(5) 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.

5.8.5.2. Exterior Lighting Requirements: These requirements apply to exterior lighting illuminating any building, site, property, structure, gate, sign, roadway, parking lot, pathway, sidewalk, landscape, structure, etc. that is owned, operated by, or constructed to be leased to the Department of the Army. This includes all Sustainment, Restoration, and Modernization (SRM) and Military Construction activities within the United States, its territories, and overseas on permanent Active Army installations, Army Reserve Centers, Army National Guard Readiness Facilities, and Armed Forces Reserve Centers, regardless of funds source. See Paragraph 6.9 for site specific information, if any, on exterior lighting systems.

5.8.5.2.1 General: Exterior lighting technology should be selected based on a balance of energy performance and quality of light, while remaining life-cycle cost effective and environmentally responsible. Exterior lighting systems or luminaires selected for use should have demonstrated adherence to quality standards by being recognized by the DesignLights Consortium (reference e), the ENERGY STAR Program, the FEMP or other third-party qualifier appropriate to the technology. Manufacturers should also stand behind their products by providing a Luminaire warranty for at least five years or more. Design teams should carefully consider the occupancy and purpose of the lighting requirements and incorporate energy-saving controls, sensors, and the use of bi-level fixtures to provide exterior lighting levels only as appropriate and only during the hours of night needed. Other energy-saving and lighting quality design considerations include ensuring better uniformity of lighting distribution to required levels to reduce over-lighted hotspots and control light trespass outside the area of intended coverage.

5.8.5.2.2 Exterior Lighting Performance by Application: Exterior lighting systems should meet, at a minimum, the better of the standards below in Table 1 or the DLC Product Qualification Criteria (reference e) or current ENERGY STAR qualification or FEMP designation requirements.

5.8.5.2.3 General Exterior Lighting: Typically lighting to provide visibility for security and people moving along established circulation pathways through an illuminated area to or from a destination. Examples include roadways, parking lots, parking structures, sidewalks, tarmacs, service areas, and secondary exits from buildings.

5.8.5.2.4 Architectural Lighting: Lighting in use where exterior spaces are occupied at night for a functional purpose, such as plazas, gas stations, pavilions, or amphitheaters. Also, for use where a higher quality of light is desired, such as building entrances, wall-wash luminaires, illumination of architectural or landscaping features, sculpture, displays, exhibits, flags, gates, primary signage, etc.

5.8.5.2.5 Exceptions: Where a non-white light color is specifically desired by aesthetic design or a color-specific functional requirement (e.g. water feature lighting, entertainment, signal lights, airfield lights, marine wildlife protection, etc.), the CRI and CCT range values indicated may not apply. Specialized lighting, such as lighting for monitoring systems designed to use non-visible spectrum light, are also exempt from the minimum CRI and CCT standards as well. Luminaires primarily powered by on-site renewable energy (e.g. solar and/or wind) are also exempt from the requirements herein.

Table 1 – Minimum Exterior Lighting Performance by Application. These values represent minimum standards and do not supersede higher standards that may also be applicable or specified by design.

Application	Luminaire Efficacy	CRI	Nominal CCT Ranges	Lamp Life
General Exterior Lighting	65	65	3000-5700	50,000
Architectural Lighting	50	75	3500-5000	50,000

Units:

Luminaire Efficacy (with complete fixture load including ballast/driver loads) is in lumens per watt
CRI (Color Rendering Index) is a value without units
CCT (Correlated Color Temperature) Range is in Kelvin Temperature
Minimum Lamp Life is in Rated Hours per TM-21

5.8.5.2.5.1 Life-Cycle Cost Analysis (LCCA) and Renewable Energy Opportunities. On-site renewable or alternative energy power system cost over a 25-year life-cycle should be compared to the cost of the conventional grid-connection infrastructure, operation and maintenance costs thereof, proper time-of-use grid energy cost with line losses and price escalation. Renewable or alternative energy systems should be used wherever the payback period less than or equal to the life cycle period. Design team selections and Value Engineering evaluations are to prioritize a reduced total cost of ownership during the full life-cycle period over the first costs of design and construction. The LCCA shall follow the methodology contained in 10 CFR 436.

5.8.5.2.5.2 Sustainability and Environmental Impact Reduction. To meet the mercury-use reduction intent of EISA 2007 (Reference c) and other sustainability goals, lighting systems should not contain added mercury in excess of 5mg per lamp or 80 picograms per Lumen Hour. Whenever two or more viable lighting technologies are substantially equal in life-cycle cost and performance, preference should be given to the technology with the lowest mercury content per Lumen Hour.

5.8.6. 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.

5.8.6.1. Testing: 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 5.9.2.5 for design of environmental systems for Telecommunications Rooms.

5.8.6.2. Installation: 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.

5.8.6.3. End to End Test: 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.

5.8.7. LIGHTNING PROTECTION SYSTEM: Provide a lightning protection system where recommended by the Lightning Risk Assessment of NFPA 780, Annex L.

5.9. HEATING, VENTILATING, AND AIR CONDITIONING

5.9.1. STANDARDS AND CODES: The HVAC system shall conform to APPLICABLE CRITERIA.

5.9.2. DESIGN CONDITIONS:

5.9.2.1. Outdoor and Indoor Calculations and Requirements: Indoor design conditions and load calculations 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 62.1-2007. Outdoor design conditions are in UFC 3-410-01FA except that weather data is specified in paragraph 6, rather than at the URL (web link) listed in the UFC.

5.9.2.2. Indoor Air Quality: Buildings indoor air quality sytems, thermal comfort, acoustical control, equipment, calculation procedures, construction and start-up shall comply with ASHRAE Standard 189.1, Section 8.3, Mandatory Provisions, and Section 8.4, Prescriptive Option, and either Section 8.5, Performance Option unless otherwise specified in this subsection.

5.9.2.3. Outdoor Air Delivery Monitoring: Spaces Ventilated by Mechanical Systems. Reference Sections 7.4.3.2, 8.3.1.2.1, and 10.3.2, of ASHRAE Standard 189.1. A densely occupied space is defined as those spaces with a design occupant density greater than or equal to 25 people per 1000 ft^2 (100m^2).

5.9.2.4. Environmental Tobacco Smoke: a. Smoking shall not be allowed inside the building. Signage stating such shall be posted within 10 ft (3 m) of each building entrance. b. Any exterior designated smoking areas shall be located a minimum of 50 ft (7.5 m) away from *building entrances*, *outdoor air* intakes, and operable windows. c. Section 6.2.9 of ANSI/ASHRAE Standard 62.1 shall not apply.

5.9.2.5. 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.

5.9.2.6. Controls Maintenance: Locate all equipment so that service, adjustment and replacement of controls or internal components are readily accessible for easy maintenance.

5.9.2.7. 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 19. 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.

5.9.2.8. 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.

5.9.3 Utility Meters: Measurement devices with remote communication capability shall be provided to collect energy and water consumption data for each energy supply source and water supply source to each facility, including gas, water (potable, reclaimed and rainwater), electricity, and distributed energy that exceeds the thresholds listed in ASHRAE Standard 189.1. Meet the requirements of ASHRAE Standard 189.1, Sections 6.3.3, 7.3.3, 10.3.2 and AR 420-1, Chapter 22. For Government owned utilities, install meters with remote communication capability as well as have a continuous manual reading option. Water meters shall provide daily data and shall record hourly consumption. 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 to a meter data management system 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. Exception: Renovation or energy projects with programmed costs less than $200,000 shall incorporate lower-cost energy monitors when cost effective over the life-cycle of the building following the monitoring guidance as detailed in ASHRAE Standard 189.1 Section 7.3.3.

5.9.3.1 Data Storage and Retrieval. The meter data management system shall be capable of electronically storing water meter and sub-meter data and creating user reports showing calculated hourly, daily, monthly and annual water consumption for each meter and sub-meter and provide alarming notification capabilities as needed. In addition, verification of meter operation will be conducted at installation.

5.9.3.2 Evaporative Cooling Sub-metering: For buildings that use evaporative cooling, cooling tower(s), hot water makeup systems, or automatic landscape irrigation system(s), separate submeters shall be provided for each such application. Water use data shall be collected at each source (e.g. *potable water*, reclaimed water, rainwater) for any source that exceeds the thresholds of: Potable water- 3,800 L/day (1,000 gal/day); Municipally reclaimed water - 3,800 L/day (1,000 gal/day); and Alternate sources of water - 1,900 L/day (500 gal/day).

5.9.3.3 Water Sub-metering: Sub-metering shall also be provided to collect water use data for each of following building subsystems, if they are sized above the threshold levels: Cooling towers – Primary flow > 30 L/s (500 gpm); Evaportative Coolers – Makeup water > 0.04 L/s (0.6 gpm); Steam and hot water boilers - > 50 kW (500,000 Btu/h) input; Irrigated landscape area with controllers - > 2500 m2 (25,000 ft2); Any large water using process – Consumption > 3,800 L/day (1000 gal/day).

5.9.3.4 Outdoor Irrigation: Outdoor irrigation shall have smart controllers that will shut off when rainfall is sensed (ASHRAE Standard 189.1 paragraph 6.3.1.3 (2011 version)). Outdoor irrigation shall be used only to temporarily for plant establishment and shall be removed within a period not to exceed 18 months of installation.

5.9.3.5 Energy Metering: Meters with remote metering capability or automatic meter reading (AMR) capability shall be provided to collect energy use data for each supply energy source (e.g. gas, electricity, district steam) to the building that exceed thresholds of: Electrical service - > 200 kVA; On-site renewable electric power – All systems > 1 kVA (peak); Gas and steam service - >300 kW (1,000,000 Btu/h); Geothermal - >300 kW (1,000,000 Btu/h0 heating; Solar thermal - >10 kW (30,000 Btu/h). Utility company service entrance/interval meters are allowed to be used provided they are configured for automatic meter reading (AMR) capability. Sub-metering with remote metering capability shall be provided to collect energy use data for each subsystem component that meet the following thresholds: Chillers/heat pumps - >70 kW (240,000 Btu/h) cooling capacity; Packaged AC units - > 70 kW (240,000 Btu/h) cooling; Fans - > 15 kW (20 hp); Pumps - > 15 kW (20 hp); Cooling towers - > 15 kW (20 hp); Boilers and other heating equipment - >300 kW (1,000,000 Btu/h) input; General lighting circuits - > 100 kVA; Miscellaneous electric loads - > 100 kVA).

5.9.4 BUILDING AUTOMATION SYSTEM. Provide a Building Automation System consisting of a building control network , 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 the heating, ventilating and air conditioning (HVAC) systems as specified herein. 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.

5.9.4.1 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.

5.9.4.2 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.

5.9.4.3 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.

5.9.4.4 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.

5.9.4.5 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.

5.9.4.6 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.

5.9.4.7 Gateways may be used provided that each gateway communicates with and performs protocol translation for control hardware controlling one and only one package unit.

5.9.4.8 Not Used

5.9.4.9 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.

5.9.4.10 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:_____		

5.9.4.11 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.

5.9.4.12 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.

5.9.4.13 Provide training at the project site on the installed building system, including all commissioned systems and equipment (ASHRAE Standard 189.1, Section 10.3.1.2), . 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.

5.10 ENERGY CONSERVATION

5.10.1 ENERGY EFFICIENCY: The building(s), including the envelope(s), HVAC systems, service water heating, power, and lighting systems, shall meet, at a minimum, the Mandatory Provisions in Section 7.3 and either the Prescriptive Option in Section 7.4 or the Performance Option in Section 7.5 of ASHRAE Standard 189.1. ASHRAE 189.1 is the minimum requirement that incorporates by reference the requirements of ASHRAE Standard 90.1-2007 and shall be used as the project baseline for life-cycle cost comparisons. A LCCA is not required on the baseline project. Substantiation requirements are defined in Section 01 33 16, Design After Award and ASHRAE Standard 189.1, Section 10.3.2. Exception 1: The on-site renewable energy systems included in ASHRAE Standard 189.1, Section 7.4.1.1 are not required.

5.10.1.1 Minimum Energy Consumption: The building, including the building envelope, HVAC systems, service water heating, power, lighting systems and process and plug loads shall achieve an energy consumption that is a minimum of 30% below the consumption of a baseline building meeting the minimum requirements of ANSI/ASHRAE/IESNA Standard 90.1-2007 and that is life cycle cost effective. Energy calculation methodologies and substantiation requirements are defined in Section 01 33 16, Design After Award. A LCCA is required.

5.10.1.2 EISA 2007 Requirement: Design the building to achieve the maximum possible fossil fuel-generated energy consumption reduction based on the requirements of EISA 2007 Section 433 that is life cycle cost effective. A LCCA is required.

5.10.1.3 LCCA: Where a LCCA is required, an incremental LCCA shall be completed for all energy efficiency or conservation features provided in excess of the baseline to ensure the payback period is no greater than the lesser of 40 years or the projected life of the facility. Equipment procurement, fuel, maintenance, repair, replacement, and any other quantifiable benefits and costs are to be included in the LCCA. The LCCA will be documented and made part of the design analysis. The LCCA shall follow the methodology contained in 10 CFR 436.

5.10.2 EnergyStar AND FEMP PRODUCTS: The heating, ventilation, and air conditioning shall comply with Section 6 of ANSI/ASHRAE/IESNA 90.1-2007 and Section 7.4.2.1.b of ASHRAE Standard 189.1, including the Normative Appendix C of ASHRAE Standard 189.1 with the following modification: Purchase Energy Star products, except use FEMP designated products where FEMP is applicable to the product type. The term “Energy Star” means a product that is rated for energy efficiency under an Energy Star program. The term “FEMP designated” 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. For projects located OCONUS the products listed in ASHRAE Standard 189.1, Section 7.4.7, shall have an equipment efficiency that is equivalent or greater than the criteria required to achieve the ENERGY STAR label or meets or exceeds the equivalent of FEMP designated efficiency requirements.

5.10.3 SOLAR HOT WATER HEATING: Design and construct all new construction projects with an average daily non-industrial hot water requirement of 50 gallons or more, and located in an area shown on the NREL solar radiation maps (http://www.nrel.gov.gis.solar.html) as receiving an annual average of 4kWh/m2/day or more to provide a minimum of 30 percent of the facility’s hot water demand by solar water heating. Waste heat harvesting, integrated co-generation systems, or a combination thereof may be used in lieu of solar water heating where they achieve equivalent energy savings, as documented in the project’s design analysis and commissioning analysis.

5.10.4 WATER USED FOR HEATING AND COOLING: Meet the requirements of ASHRAE 189.1 Section 6.3.2.3 – HVAC Systems and Equipment and Section 6.4.2.1 – Cooling Towers. When potable water is used to improve a building’s energy efficiency, employ life-cycle cost effective water conservation measures per requirements of EPAct 2005 Section 109. This includes potable water used for both domestic and process purposes.

5.10.5 RENEWABLE ENERGY: See Paragraph 6, PROJECT SPECIFIC REQUIREMENTS for renewable energy requirements for this project.

5.10.6 FUNDAMENTAL REFRIGERANT MANAGEMENT: Meet the requirements of ASHRAE Standard 189.1, Section 9.3.3.

5.11 FIRE PROTECTION

5.11.2 STANDARDS AND CODES Provide the fire protection system conforming to APPLICABLE CRITERIA.

5.11.3 INSPECTION AND TESTING: 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.

5.11.4 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.

5.11.5 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.

5.11.6 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".

5.11.7 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.

5.12 SUSTAINABLE DESIGN

5.12.2 STANDARDS: Sustainable design shall conform to APPLICABLE CRITERIA. See Paragraph 6, PROJECT-SPECIFIC REQUIREMENTS for which version of LEED applies to this project, however, this project shall achieve a minimum of LEED Silver Certification by Green Building Certification Institute (GBCI). Each building must individually comply with the requirements of paragraphs ENERGY CONSERVATION and PLUMBING AND WATER CONSUMING EQUIPMENT. The project must earn the points associated with compliance with paragraph 5.10, ENERGY CONSERVATION,of this RFP.

5.12.3 In accordance with the National Defense Appropriations Acto fo 2012, Section 2830, the contractor will not be compensated for any expenses associated with the express intent to obtain LEED certification above the SILVER level. It is recognized that competitive best balue proposal details and requirements cited else where in this document and supporting documents may provide for features which allow for a certification higher than SILVER to be obtained. Whether to achieve a future marketing advantage or for toher purposes, the contractor may obtain LEED GOLD or PLATINUM certification(s) provided that achieving such certification imposes no additional cost to the government.

5.12.4 LEED INNOVATION AND DESIGN AND REGIONAL PRIORITY 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 and RP 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.

5.12.5 DOCUMENTATION FOR CERTIFICATION: All LEED Prerequisite and Credit documentation shall be provided to GBCI and the Owner (if requested) in addition to any other documentation requirements Online documentation shall be uploaded to GBCI and updated at each phase of the project.

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

6.1. GENERAL

The requirements of this paragraph augment the requirements indicated in Paragraphs 3 through 5.

6.2. APPROVED DEVIATIONS

The following are approved deviations from the requirements stated in Paragraphs 3 through 5 that only apply to this project.

6.2.1. Revise the first sentence, 2nd paragraph ofr 2.1 Battalion Headquarters (Bn HQ) to read as follows: The project will include 0 small (16,000 SF), 0 medium (18,600), and 0 large (20,400 SF) and ~~0~~ 1 extra large (22,600 SF) stand alone Battalion Headquarters for the 19th Engineering Battalion.

6.2.2. Revise the maximum allowable gross area for the Company Operations Facility (COF) Admin Module indicated in paragraph 2.1 to 16,600 square feet.

6.2.3. Revise the maximum allowable gross area for the Company Operations Facility (COF) Readiness Module indicated in paragraph 2.1 to 53,756 square feet.

6.2.4. The maximum allowable gross area for the sum of the Company Operations Facility (COF) Admin Module and Company Operations Facility (COF) Readiness Modules indicated in paragraph 2.1 shall not exceed 70,198 square feet.

6.2.5. Revise the first sentence of 4th sub-paragraph in paragraph 2.2 to read as follows: Provide all site design and construction within the ~~COF~~ limits of construction necessary to support the new building facilities.

6.2.6. Revise the first sentence of paragraph 2.4 to read as follows: A Furniture, Fixture and Equip design and package is ~~NOT~~ required for ~~this project~~ for the COF and Bn HQ buildings only.

6.2.7. Revise the last sentence of the UEPH paragraph 3.3.3, sub-paragraph (a) to read: ~~Provide POV parking spaces for 70 percent of the personnel.~~ Provide POV parking spaces as shown on the drawings in Appendix J.

6.2.8. Revise COF paragraph 3.3.1, sub-paragraph 5 to read: ~~POV parking to be provided by others.~~ Provide POV parking spaces as shown on the drawings in Appendix J.

6.2.9. Revise Bn HQ paragraph 3.3.1, sub-paragraph 3 to read: ~~POV parking to be provided by others.~~ Provide POV parking spaces as shown on the drawings in Appendix J.

6.2.10. Revise Bn HQ paragraph 3.3.5, sub-paragraph (d), iii. to read as follows: Secure Videoteleconferencing (VTC). Secure VTC capability shall be provided in each classroom (but not team rooms). Provisions generally consist of power connection and two RJ45 SIPRNET outlets (in a secure outlet box).

6.3. SITE PLANNING AND DESIGN

6.3.1. General:

6.3.1.1. General

The drawings included in Appendix J and specifications included in Appendix AA of this RFP are nearly fully developed for construction and shall be considered prescriptive in nature. The design build contractor shall complete the design and construct all site elements as shown on these construction drawings. Deviations from these drawings are discouraged unless absolutely necessary. Should the design-build contractor choose to modify the site layout, grading, stormwater, utilities or any other information included in Appendix J Drawings or Appendix AA Technical Specifications, he or she shall do so at no additional cost to the Government. In general, the designs are complete for the following systems described herein and comply with the referenced requirements:

- Stormwater Management (SWM) Systems (see paragraph 6.3.3.1)
- Erosion and Sediment Control (see paragraph 6.3.3.2). Refer to paragraph 6.16.6.
- Vehicle Circulation (see paragraph 6.3.3.3)
- Existing Topographic Conditions (see paragraph 6.4.1)

6.3.1.2. The new 19th Engineering Battalion Complex is located in Fort Knox, Kentucky and within close proximity to the existing 19th Engineering Battalion's facilities. The project complex is bound to the north by Hurley Tank Motor Park, to the west by St. John Tank Motor Park and to the east by the existing POV parking lot along Spearhead Loop Road and to the south by the existing POV parking lot for the IBCT Barracks (buildings 2338, 2339, 2840 and 2841). The Burke Tank Motor Park is located to the east of Spearhead Loop Road. The Dining Facility (building 2835) is located at the southwest corner of the proposed complex.

The new Engineering Battalion Complex will include the construction of a detached Company Operations Facility (COF) comprising two Company Operations Facility Readiness buildings with covered hardstands and a Company Operations Facility Administration building; a Battalion Headquarters Facility (Bn HQ); and a Barracks (UEPH) Facility. The design and construction of the new complex will be accomplished through a single design-build Request for Proposal (RFP). The RFP includes the site and utility work for all three facilities including POV parking, pedestrian and vehicular circulation, access and stormwater management as shown on drawings in Appendix J.

6.3.2. Site Structures and Amenities

6.3.2.1. Refer to Appendix J Drawings for dumpster and mechanical equipment enclosures and utility pads.

6.3.2.2. Provide Visual Screens with lockable access gates for Dumpsters and Mechanical Equipment in accordance with AT/FP requirements.

(a) Dumpsters Enclosures. Dumpster enclosures shall be compatible with the building's architectural theme.

(b) Equipment Enclosures. Provide mechanical equipment horizontal enclosures to allow clearance for maintenance and as required by the equipment manufacturer. Screen wall shall be a minimum of 1-foot above the height of the tallest section of the equipment.

(c) Utility Pads. Install all concrete utility pads located outside the building exterior for any mechanical or utility device needed for the building operation and function. Include all necessary piping, wiring, or utility extensions for the device to function as designed. Locate mechanical equipment next to existing or proposed sidewalks, pathways, or parking areas to eliminate the need to construct additional hard surface access.

6.3.3. Site Functional Requirements:

6.3.3.1. Stormwater Management (SWM) Systems.

The Contractor shall provided all stormwater management for this Project as shown on drawings in Appendix J and specifications in Appendix AA.

Hardin County Water District No. 1 (HCWD1) owns the stormwater management system which is maintained by Veolia Water North America. The Contractor shall provide stormwater management in accordance to federal, state and local regulations. Minimize the impact of construction activities on drainage and prevent loss of soils by water and wind erosion. In accordance with the requirements of the Energy Independence and Security Act of 2007, this project shall utilize site planning, design, and construction strategies to maintain or restore the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of storm water runoff flow. Integrate Low Impact Development (LID) and sustainable design strategies into project site planning, design and construction in order to maintain existing water quality at the site.

The stormwater drainage and stormwater management system drawings included in Appendix J have been coordinated with and approved by the Fort Knox Environmental Management Division and HCWD1/Veolia Water. Coordinate the stormwater drainage system plan with the Fort Knox Environmental Management Division and HCWD1 / Veolia Water for review and approval prior to finalizing building design. Construct the permanent stormwater drainage system concurrently with the construction of the facility and coordinate with the Installation. The contact for HCWD1 is Preston Pendley (270) 352-4280 ext. 224 or ppendley@hcwd1.com. The contact for Veolia Water is Kenny Morley (270) 304-5410 or kenneth.morley@veoliawaterna.com.

6.3.3.2. Erosion and Sediment Control

The Contractor shall implement and comply with the Erosion and Sediment Control measures outlined on drawings in Appendix J and specifications in Appendix AA.

The Erosion and Sediment Control measures shown on drawings in Appendix J and specifications in Appendix AA comply with KPDES for the limits of the overall construction site. Coordinate the lay down spaces, haul roads, and fabrication areas with the sites Storm Water Pollution Prevention Plan (SWPPP) and in accordance with the Fort Knox DPW.

6.3.3.3. Vehicular Circulation.

Elements pertaining to vehicle circulation are part of this project. The Contractor shall construct all elements pertaining to vehicular circulation as shown on the drawings in Appendix J and specifications in Appendix AA and as described.

Vehicular Circulation shall promote safe, efficient movement of vehicles and pedestrians within the site area.

(a) Emergency Vehicle Access. The ground access surface shall accommodate all Fort Knox Fire Department Trucks and Emergency Vehicles in accordance with all applicable criteria.

(b) Provide fire vehicle access as a minimum to two sides of each facility.

(c) 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.

Provide access for the following Fort Knox Fire Department equipment:

Vehicle ID	GVW	Height	Length	Width	Turning Radius

ENG #1	39,800 lbs	9’-10”	30’-2”	8’-4”	41’-0”
ENG #2	39,800 lbs	9’-10”	30’-2”	8’-4”	41’-0”
RESCUE	35,000 lbs	10’-2”	29’-11”	8’-5”	27’-0”
LADDER	62,000 lbs	11’-2”	38’-0”	8’-0”	43’-6”
MASEY	29,000 lbs	8’-6”	25’-2”	8’-0”	75’-0”
TITAN	52,000 lbs	12’-4”	32’-4”	9’-8”	87’-0”

(Note: TITAN is ONLY for airfield operations)

(d) Fire Lane Dimensions: Fire Lanes shall be a minimum of 20 feet.

(e) Fire Lane Markings: Delineate Emergency access drives and Fire Lanes with 6-inch wide red striping and the words “FIRE LANE NO PARKING” in 4-inch letters within the stripes.

6.4. SITE ENGINEERING

6.4.1. Existing Topographical Conditions

6.4.1. Existing Topographic Conditions: The government has provided three dimensional digital topographic and utility survey information of the existing site. The survey provides control points based on state plane coordinates and identifies horizontal and vertical datums. All existing surface features and underground utilities on the site are identified by this topographic survey. Refer to drawings in Appendix J for existing site conditions. Any discrepancies which are found in the Government furnished survey shall be brought to the immediate attention of the Government for clarification.

In addition to the topographic survey, the government has performed a geophysical survey of the existing site, to aid the contractor in identifying any underground anomalies. The results of the geophysical investigation are presented in Appendix CC.

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.

6.4.2.2. Soil Compaction and Foundation Excavations. Each layer of fill placement shall be no greater than 8 inches thick. Compact each layer to not less than the percent of maximum density.

6.4.3. Fire Flow Tests See Appendix D for results of fire flow tests to use for basis of design for fire flow and domestic water supply requirements.

The Contractor shall construct new fire and domestic lines as shown on drawings in Appendix J and specifications in Appendix AA. The results of the fire flow tests based on existing site conditions is included in Appendix D and shall be used for basis of design for fire flow and domestic water supply requirements.

6.4.4. Pavement Engineering and Traffic Estimates:

6.4.4.1. General

The drawings included in Appendix J and specifications included in Appendix AA of this RFP are fully developed for construction and shall be considered prescriptive in nature. The design build contractor shall complete the design and construct all site elements as shown on these construction drawings. Deviations from these drawings are discouraged unless absolutely necessary. In general, the designs are complete for the following systems described herein and comply with the referenced requirements.

The Contractor shall construct all new pavements as shown on drawings in Appendix J and specifications in Appendix AA.

Pavements, sidewalks and crosswalks shall be constructed as shown in Appendix J Drawings and Appendix AA Technical Specifications. The designs included in this RFP take into account traffic loads, existing soil conditions and Fort Knox specific requirements.

6.4.4.2. Sidewalks and Crosswalks. Provide pedestrian circulation improvements within the project boundary. Provide walkway connections to existing sidewalks where appropriate and orient pedestrian traffic to safe, convenient roadway crossings. Provide walkways for the project site to provide access to the building entrance, service area, and outdoor site activity areas for convenience and maintenance access. Refer to Appendix J for proposed location of sidewalks, curbs and gutters.

(a) Sidewalks. Sidewalks shall provide an ample functional system of walks connecting structures, parking areas, streets, and other walks as pedestrian traffic demands. Sidewalks shall be a minimum of 6'-wide. In addition, carefully review paths of travel between buildings within this and adjacent complexes to determine a layout of sidewalks that is sufficient to meet the likely paths of travel as well as.

(1) Sidewalks designed to support emergency vehicle traffic shall be a minimum of 20' wide. Coordinate with the Fire Chief for location requirement.

(2) Sidewalks designed to support service vehicle traffic shall be a minimum of 10' wide.

(3) Construct non-vehicular sidewalks with a minimum thickness of 4" and design joint patterns uniformly that do not exceed the length to width ratio of 1:1.25.

(4) Slope sidewalks to meet all requirements for ABA.

(b) Crosswalks. Provide improved crosswalks in street areas adjacent to the site where appropriate. If patron parking cannot be designed to avoid pedestrians crossing travel lanes due to site constraints, provide crosswalks to connect all sidewalks to the main building entrance. Paint crosswalks ith striping, or other improvements, to identify the pedestrian area in the street travel lanes. Divert drainage ways at roadway swales or provide culverts to prevent area drainage from crossing walkways. Slope sidewalks at all crosswalks, parking lots, and other grade changes to meet ABA requirements.

6.4.5. Traffic Signage and Pavement Markings

Traffic signals are not required for this project. Traffic signage as shown in Appendix J Drawings, meets MUTCD requirements for traffic signs and pavement markings.

6.4.6. Base Utility Information

6.4.6.1. General: The Fort Knox Installation's DPW supervises infrastructure and utilities and in some cases they are owned and operated by private entities. Provide fire and domestic water, natural gas, storm sewers, storm sewer detention, sanitary sewers, electric, and communications (Cable Television Service, Telephone and Communications lines) to the facility for utility rerouting or new service. Reference existing and proposed base utility information in Appendix J. Field verify all existing and proposed locations of utilities and coordinate with the Installation's DPW.

(a) Maintain water and gas service to existing buildings during construction. When this is not possible, provide a 2-week notice of the required outage.

(b) Existing utility services such as potable water, sanitary sewer, electric, natural gas, and COMM are all located: As shown in Appendix J Drawings.

(c) Metering Utilities. In addition to paragraph 5.2.5 requirements, provide metering in accordance with Public Service Commission (PSC) and Fort Knox standards. For privatized utilities, coordinate with the privatization utility(ies) for the proper meter base and meter installation (Nolin RECC Electric, HCWD1). Connect the pulse initiators to the building Direct Digital Control system so that the data is transmitted to the building controls and to the Post BAS.

(d) Building Near Existing Utilities: 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 utility provider to determine final routing of lines, and locations of connections points.

(e) Utility Permits. Include adequate time in the project schedule for the acquisition and approval of permits. The Contractor is responsible for all required permits listed in Paragraph 6.16.

(f) Existing utility service lines and mains serving other buildings adjacent to the site which remain occupied during construction shall remain in service, uninterrupted, until those buildings are abandoned or until the Government accepts new water distribution line(s).

The Contractor shall construct fire and domestic water, natural gas, storm sewers, sanitary sewers, electric, and communications (Cable Television Service, Telephone and Communications lines) as shown on drawings in Appendix J and specifications in Appendix AA

- Any changes or modifications to the routing or utility points of connections shown in drawings in Appendix J will need to be coordinated with the Contracting Officer and respective utility provider. Modifications to the utility designs as shown on the drawings in Appendix J are discouraged.

The drawings included in Appendix J and specifications included in Appendix AA of this RFP are fully developed for construction and shall be considered prescriptive in nature. The design build contractor shall complete the design and construct all site elements as shown on these construction drawings and specifications. Deviations from these drawings and specifications are discouraged unless absolutely necessary. In general, the designs are complete for the following systems described herein and comply with the referenced requirements:

- Water Distribution System (see paragraph 6.4.6.4). The Contractor shall construct fire and domestic water systems and obtain all permits as indicated in paragraph 6.16.4.

- Drawings included in Appendix J show both domestic and fire water distribution and service sizes and routing, including valves, fire hydrants, post indicator valves and points of connection. Should the Contractor choose to change the points of connection, it will do so at no additional cost to the Government. Any revisions to the water line points of connection shall be coordinated with the utility owners.

- Coordinate the sequence and timing of all water line construction activities with Fort Knox. Do not begin any work associated with water system before obtaining all required permits and approvals for the water system in coordination with Fort Knox.

- Sanitary Sewerage System (see paragraph 6.4.6.5). The Contractor shall construct the sanitary sewer system and obtain all permits as indicated in paragraph 6.16.5. Should the

Contractor choose to change the points of connection, it shall be at no additional cost to the Government. Any revisions to the sanitary sewer line points of connection shall be coordinated with the utility owner.

- Gas Distribution System (see paragraph 6.4.6.6). The Contractor shall construct the natural gas distribution system. Any changes to the natural distribution lines from what is shown on the drawings in Appendix J and specifications in Appendix AA shall be in accordance with Fort Knox standards and Department of Transportation standards. Coordinate with Fort Knox to determine the re-routing of any new or relocated distribution system, the locations of service lines, the locations of connection points to the gas distribution lines and the location of natural gas lines from what is shown in drawings in Appendix J. Should the Contractor choose change the points of connection or modify the natural gas lines from what is shown on drawings in Appendix J, it shall be at no additional cost to the Government.

- Electrical System (see paragraph 6.4.6.3)

- Telecommunications System (see paragraph 6.4.6.2)

- Cable Television System (see paragraph 6.4.6.7)

6.4.6.2. Telecommunications: The Network Enterprise Center (NEC) formally known as the Department of Information Management (DOIM), oversees the telephone and communication service at Fort Knox. Design, 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. Coordinate with NEC during the design process. Point of Contact is Cindy Durham, Plans Officer, Network Enterprise Center (NEC), Comm: (502) 624-4169, Fax: (502) 624-7788, E-mail: cindy.durham@us.army.mil

6.4.6.3. Electrical: Nolin RECC owns the electrical distribution system at Fort Knox. Coordinate exterior electrical work Nolin RECC and Fort Knox DPW, Electrical Utility Section. Existing Drawings are available from both Nolin RECC and Fort Knox.

 (a) Points of Contact are Vince Heuser, Vice President – System Operations Office: Nolin RECC, 411 Ring Road,Elizabethtown, KY 42701, Comm (270) 735-105, Fax: (270) 735-1068 E-mail: vheuser@nolinrecc.com and Mark Richarson, Engineering Plans Review Office, DPW, Comm: (270) 268-0733, Fax: (502) 624-3679, E-mail: mark.richarson2@us.army.mil

 (b) Meter: Nolin RECC will furnish and install the secondary service meter and meter cabinet at service activation under separate contract with the Government.

6.4.6.4. Water Distribution System: Coordinate with Fort Knox, DPW to complete the water system design. Install the water distribution piping, including the connection to the existing main piping, and including the relocation or demolition of existing water distribution lines. Install warning tape above all underground piping. Install plastic lines with a tracer wire and warning tape. Valves shall have resilient seats. Perform hydrostatic testing separately from the piping disinfecting. Disinfect all new water lines and get a clean test report before making connection to the existing water main. Loop new lines and provide a valve with box at all new or existing lines intersections. Provide Fort Knox DPW with a copy of the test report providing results from a bacteriological test on water quality. Fort Knox shall inspect all construction of water distribution piping. Points of contact for Fort Knox are Wesley Prather (502)624-5954 and Bob Ender (502)624-5252.

 (a) Design and construct the water distribution system in accordance with the Kentucky KRS, which requires the use of the latest edition of the Ten State Standards, with AWWA standards, and with all policies, procedures, standards, specifications and details required by Fort Knox.

 (b) Install, test and document fire service mains, hydrants, and appurtenances in accordance with all

applicable criteria. Use of existing hydrants is preferred. If existing hydrants must be relocated, install new hydrants.. Protect hydrants located in areas subject to vehicular damage with barriers. Fire hydrants shall be compatible with hydrants presently in use at Fort Knox and shall have national standard thread fire department connections, be faced toward the hard surfaced area immediately adjacent to the hydrant, and open with counter clockwise turn. Hydrants shall be dry barrel type.

 (c) Determine the following for each building: the required capacity of domestic water required for the building; the domestic water service line size; the required capacity of the fire water service line for the building; the fire water service line size; and the location of the entrances to the building of the domestic water and fire water service lines. Coordinate with Fort Knox to determine the routing of any new or relocated water distribution lines, the routing and locations of service lines, the locations of connection points to the existing water distribution system, the locations of existing water distribution lines to be removed, and the locations of fire hydrants and post indicator valves. Include the following on the contract drawings of site utilities: the routing of water distribution and water service lines outside the buildings' five foot lines and noted as "existing" or "new"; the locations of all fire hydrants on the site noted as "existing fire hydrant", or "new fire hydrant"; the location of post indicator valves; existing water distribution and service lines to be removed or replaced; and include water flow test information, including the available static water pressure, the residual pressure and the associated flow, and the location and identification of the test hydrant and flow hydrants.

 (d) Coordinate the sequence and timing of all water line construction activities with Fort Knox. Do not begin , any work associated with the water system before obtaining all required permits and approvals for the water system in coordination with Fort Knox.

6.4.6.5. Sanitary Sewerage System: Hardin County Water District No. 1 (HCWD1) owns the sanitary sewer system Veolia Water North America maintains it. Design and install the sanitary sewer for the facility in accordance with Hardin County Water District No. 1 (HCWD1) Standard Wastewater System Design Guidelines. Obtain the HCWD1 Standard Wastewater System Design Guidelines from Mr. Kenny Morley (270) 304-5410 or kenneth.morley@veoliawaterna.com. Alternate contact for HCWD1 is Preston Pendley (270) 352-4280 ext. 224 or ppendley@hcwd1.com. Submit an application for connection to HCWD1 as soon as possible after contract notice to proceed. The application shall include proposed demand data and a rough draft of the proposed utility layout for the site. Design the sewer system with approval by HCWD1, Provide information to HCWD1 about the building sewer systems and coordinate with them during the sewer design. Determine the following for the building(s)/project: the projected wastewater flow from the building, the required sewer line size, and the location of the entrances to the building of the sewer lines. See paragraph 6.16 for sanitary sewer permit requirements.

 (a) Coordinate with HCWD1 / Veolia Water to determine the routing of any new or relocated trunk lines, the routing and locations of sewer lines, the locations of connection points to the existing sewer system, the locations of existing sewer lines to be removed, and the locations of manholes. Comply with the Hardin County Water District No. 1 (HCWD1) and State of Kentucky design and installation guidelines, and all HCWD1 policies, procedures, standards, specifications and details. After acceptance by the government, Fort Knox turns the system over to HCWD1. Point of Contact for HCWD1 is Mr. Brett Pyles, (270) 352-4280 ext. 215 and for Veolia Water at Fort Knox is Jeffrey T. Greer, (502) 942-6020 ext. 21 or (270) 268-5173.

 (b) Connections to Sewage Collection Mains and Building Service Lines: Establish the location for the connection based upon economics and site design parameters. Connect the new system to the existing gravity mains at a new manhole.

 (c) Field Quality Control for Sanitary Sewer Distribution System: HCWD1 / Veolia Water reserves the right to inspect all construction of the sanitary sewer system. The contracting officer and HCWD1 / Veolia Water representatives will conduct field inspections and witness field tests specified. Perform field tests, and provide labor, equipment, and incidentals required for testing. The Government won't provide water needed for field tests. For force mains, 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.

6.4.6.6. Gas Distribution System: Fort Knox owns and operates the gas distribution system. The design and construction of the required building service lines and modifications to any distribution lines shall be in accordance with Fort Knox standards and Department of Transportation standards. Coordinate with Fort Knox to determine the routing of any new or relocated gas distribution lines, the routing and locations of service lines, the locations of connection points to the existing gas distribution system, the locations of existing gas distribution lines to be removed, as well as the sequence and timing of construction activities . The Fort Knox standards are available for review at Building 80. Points of contact for Fort Knox are Wesley Prather (502) 624-5944, and Bob Ender (502) 624-5252.

 (a) The main pressure in the system is approximately 50 psig. Regulator stations are installed throughout the system to regulate the gas pressure to 15 psig. If a new regulator station is required in the gas distribution system, construct the regulator station in a duplex arrangement so that either regulator can be isolated for maintenance without interrupting gas service. Gas is regulated to low pressure at buildings. Remove existing lines not used back to where the main line is and cap.

 (b) Determine the size and location of pressure regulating stations; the required capacity of gas required for each building; the low pressure gas service line sizes for each building; and the location of the entrances to the buildings of the gas service lines and locations of the building gas regulators and meters.

 (c) Gas piping shall be polyethylene (PE) pipe, SDR 11 or SDR 11.5. Underground valves shall be polyethylene. Install a tracer wire and warning tape above the piping. Install anodeless risers where piping rises above grade.

 (d) Drawings shall depict the routing of gas distribution and gas service lines outside the buildings; the location of gas meters and regulators; and existing gas distribution and service lines to be removed or replaced.

6.4.6.7. Cable Television (CATV): Insight Cable provides and maintains cable television service. Provide cable television outlets in areas as described in Paragraph 3. Provide an empty 4 inch conduit from the closest outside Insight source cable into the building communications closet. Design, furnish, and install all interior conduit, wiring, outlet boxes, jacks and wall plates from the communications room(s) within the facilities. Coordinate cable television work with Insight Cable and Fort Knox NEC (reference 6.4.6.5. for NEC point of contact). Insight Cable Points of Contact are: Nathen Howerton, Construction Supervisor, 4701 Commerce Crossing Dr, Louisville, Ky 40229, Office: (502) 357-4318, Cell: (502) 639-6838, Email: howerton.n@insightcom.com or Wes Vasey, Engineering. Supervisor, Office: (502) 357-4608. Cell: (502) 379-3648, Fax: (502) 357-4327, Email: vasey.w@insightcom.com and the field representative is C.W. Hesler, Field Engineer, Office: (502) 357-4381, cell: (502) 817-5009, Email: hesler.c@insightcom.com

6.4.7. Cut and Fill

6.4.7.1. General

The site grading and storm water systems, including storm water management, for the new Engineering Battalion Complex is part of this project. Refer to drawings in Appendix J and specifications in Appendix AA.

6.4.7.2. Grading

All Fort Knox 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 to prevent loss of soils by water and wind erosion. Site designs should minimize the disturbance of land, utilize natural drainage paths where possible, and take into account future construction in the area. The

difference in grade between the Finished Floor Elevation (FFE) and the ground surface immediately adjacent to the buildings shall be a minimum of 6 inches, except at personnel and overhead doors. The ground outside the buildings shall have a minimum of 5% slope away from all exterior walls for the first 10-feet and positive drainage thereafter.

(a) Confirm off-site drainage areas that will contribute to the site drainage system.

(b) Divert this drainage around or through the site and outlet downstream of the on-site drainage discharge outlet point.

(c) Site contours and drainage features shall ensure reasonable runoff volumes and travel times into individual catch basins and ditches, etc.

(d) 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.

(e) Designs that improve on existing water quality by incorporating sustainable design principles are encouraged, and consistent with budget constraints and activity requirements.

6.4.7.3. Soil Compaction: Contractor's project Geotechnical Engineer shall approve soil compaction equipment. Moistened or aerate material as necessary to provide the moisture content necessary to obtain the compaction specified with the equipment used. Each loose layer of fill placement shall be no greater than 8-inches thick.

6.4.7.4. Sink Holes: Historically, the potential for sinkholes does exist at Fort Knox. The preliminary site characteristics for this particular site are located in Appendix A. Geotechnical Information.

6.4.8. Borrow Material

6.4.8. Borrow Material: Coordinate borrow material required for construction with the Contracting Officer and obtain from sources on Government property, if available, and as close to the construction site as possible. Strive to achieve a balanced cut and fill for earthwork. See drawings in Appendix J for proposed location of borrow pit and haul route.

If fill material is required the Contractor shall provide appropriate material from an off-site location. All fill brought onto the installation is required to be lab tested or certified to be clean and free of harmful compounds and materials. All material shall be certified 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 to the site.

6.4.9. Haul Routes and Staging Areas

Use the Brandenburg Station Road gate for inspected access for commercial vehicles. Use Baker Road gate as a secondary commercial vehicle access point from 0600 – 0900 hrs, Monday thru Friday. For specific routing to the site refer to Appendix J, Borrow/Disposal Area Plan for Haul Route. Brave Rifles Regiment Ave. will be closed from Knox St. to Spearhead Division Loop to all traffic from 0630 to 0730 each day for use as a PT route.

Maintenance of Haul Routes on Fort Knox property is NOT the responsibility of the Contractor except where damages occur due to not following a standard of due diligence, non-safe driving, excessive speeds, excessive weights, etc. In these cases, the haul route will be repaired to Fort Knox Standards at the Contractor's expense.

6.4.10. Clearing and Grubbing:

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.

6.4.11. Landscaping:

Design and install landscaping as shown on drawings in Appendix J and specifications in Appendix AA.

The following paragraphs are provided for guidance only.

Landscaping must meet the AT/FP requirements and in accordance with Appendix I, Acceptable Plants List. Design landscaping using the services of a qualified Landscape Architect, experienced in site planning and planting design. Provide a complete, integrated landscape-planting plan for the overall project. The design shall reflect appropriate groupings, foundation plantings, and street tree plantings to define the open spaces to ensure a complete landscaped project. Choose plant materials on the basis of plant hardiness, climate, soil conditions, low maintenance, and quality. Selected 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. Plant varieties shall be nursery grown or plantation grown stock. They shall be grown under climatic conditions similar to those in the locality of the project.

(a) Confirm off-site drainage areas that will contribute to the site drainage system. Divert this drainage around or through the site and outlet downstream of the on-site drainage discharge outlet point.

(b) Quality. Provide well-shaped, well-grown, vigorous, healthy plants having healthy and well-branched root systems. Plants shall be free from disease, harmful insects and insect eggs, sunscald injury, disfigurement, and abrasion. Provide plants that are typical of the species or variety.

(c) Shade and Flowering Trees. Provide a height relationship to caliper. Height of branching should bear a relationship to the size and variety of tree specified, and with the crown in good balance with the trunk. Do not "pole" or remove the leader from trees.

(d) Single Stem. Trunk shall be reasonably straight and symmetrical with crown and have a persistent main leader.

(e) Multi-Stem. All countable stems, in aggregate, shall average the size specified. To be considered a stem, there should be no division of the trunk, which branches more than 6 inches from the ground level.

(f) Specimen. Provide a plant that is well branched and pruned naturally according to the species. The form of growth desired, which may not be in accordance with natural growth habit, shall be as indicated.

(g) Deciduous Shrub. Provide plants having the height and number of primary stems as recommended by the agency having jurisdiction. An acceptable plant shall be well shaped with sufficient well-spaced side branches recognized by the trade as typical for the variety grown in the region.

(h) Coniferous Evergreen. Provide the height-to-spread ratio as recommended by the agency having jurisdiction. Do not "pole" or remove the leader from trees. An acceptable plant shall be exceptionally heavy, well shaped and trimmed to form a symmetrical and tightly knit plant. The form of growth desired shall be as indicated.

(i) Broadleaf Evergreen. Provide the ratio of height-to-spread as recommended by the agency having jurisdiction. An acceptable plant shall be well shaped and recognized by the trade as typical for the variety grown in the region.

(j) Ground Cover. Provide pants with the minimum number of runners and length of runner as recommended by the agency having jurisdiction. Furnish plants that have heavy, well-developed, and balanced top with vigorous well developed root system, furnished in containers.

(k) Measurement. Plant measurements shall be in accordance with the agency having jurisdiction.

(l) Percolation Test. Perform percolation test to determine positive drainage of plant pits and beds. Identify soil and drainage conditions detrimental to the growth of plant material submit plan to correcting the conditions.

(m) Soil Test. Perform a soil test for pH, chemical analysis, and mechanical analysis to establish the quantities and type of soil amendments required to meet local growing conditions for the type and variety of plant material specified.

(n) Installation. Verify the location of underground utilities. When obstructions below ground or poor drainage affect the planting operation, submit proposed adjustments to plant location, type of plant, and planting method or drainage correction. Install plant material during appropriate planting times and conditions recommended by the trade for the type and variety of plant material specified. Excavate and backfill plant pits as recommended by the agency having jurisdiction. Perform the planting operation only during periods when beneficial results can be obtained. When special conditions warrant a variance to the planting operations, submit proposed planting times.

(o) Pruning. Prune the total amount of foliage by one-fourth to one-third on installed trees and shrubs to compensate for loss of roots and transplanting shock. Retain the typical growth habit of individual plants. Do not "pole" or remove the leader from trees. Do not leader prune or "top-off" the leader.

(p) Passive Barriers. 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.

(q) 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.

(r) 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.

(s) 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.

(t) 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. Remove unhealthy or dead plants immediately and replace as soon as seasonal conditions permit in accordance with the following warranty paragraph.

(u) Warranty. Guaranty furnished plant material to be in a vigorous growing condition for a period of 12 months regardless of the contract time period. A plant shall be replaced one time under this guarantee. Transplanting existing plants requires no guarantee.

6.4.12. Turf:

(a) Seed. Provide state approved seed of the latest season's crop 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. Fort Knox Environmental must approve the submitted selection.

(b) Sod. Provide State approved sod 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 two (2) 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 will 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. Measurement for thickness shall exclude top growth and thatch. The limitation of time between harvesting and placing sod shall be 36 hours.

(c) Sprig Quality. Provide the cultivar as healthy living stems, stolons, or rhizomes with attached roots, including two (2) or three (3) nodes, from four (4) to (6) inches long, without adhering soil. Provide sprigs which have been grown under climatic conditions similar to those in the locality of the project. Obtain sprigs 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 will 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, seed the areas designated for turf with a temporary seed. When no other turfing materials have been applied, apply the quantity of one-half of the required soil amendments and till the area.

(e) Final Turf. Install turf during appropriate planting times and conditions recommended by the trade for the type and variety of turf specified. Perform turf operations only during periods when beneficial results can be obtained. Maintain drainage patterns. Install turf by using the methods as recommended by the trade for the type and variety of turf specified. Immediately after turfing, protect the area 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. Repair an unsatisfactory stand of turf 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. Place sod 5 feet +/- of the

center line in all ditch flow lines and slopes, around each building, and in a 2-foot strip adjacent to all structures such as curbs, sidewalks, roads, catch basins (yard inlets), 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.

(d) Maintenance During Establishment Period.: Maintenance of turfed areas includes 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 Knox**’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 Knox’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 identified 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:

to be consistent with adjacent buildings in the area. The primary theme shall be consistent the IBCT Dining Hall (Bldg 2835) for general image, materials and color. The IBCT Barracks Complex (Bldgs 2838, 2839, 2840, 2841) shall be a secondary consideration for building theme. See Appendix F Conceptual Aesthetic Considerations.

All buildings and structures shall present a general image compatible with the primary theme requirement identified above and integrate with the existing image, material and color presented by the adjacent St John, Hurley and Burke motor pool buildings. The buildings' use of exterior materials is permitted to be more consistent with that of office/warehouse facilities in the private sector. Suggested materials for the buildings are precast concrete panel or masonry wainscot with metal siding above.

The following exerpt was taken from the Fort Knox Installation Design Guide and shall be implemented in this project to the extent practical and applicable:

"8.2. BUILDING CHARACTERISTICS

Building design characteristics were developed for each theme's visual zones. These characteristics were based on the existing conditions identified by the design team during the survey of each visual zone.

8.2.3 Troop Support Theme

Industrial Visual Zone. The buildings within this visual zone are primarily for the storage and maintenance of vehicles and equipment.

Current Conditions:

Large clear span building construction is typical.

The buildings are located on the perimeter of the installation near the training areas. The buildings have been positioned to be accessible from main roads and the training areas.

The buildings are horizontal and tall with large access doors (Figure 8.17).

The buildings are structural steel with flat or low slope roofing systems.

Building Characteristics:

Large clear span steel and masonry construction with durable damage resistant finish materials should be used.

Clearly identify the main entrances for vehicles and personnel and keep them separate.

Construct at a minimum low slope roof systems with sky lights for interior natural lighting (2:12 and greater).

8.3. STRUCTURAL CHARACTER

Structural character varies depending upon the use of the structure and when it was built. Difference in character may also result when the character and scale of adjacent buildings or uses are ignored. Coordinating structural characteristics, such as form, compatible scales, massing, color, texture, materials, and fenestration, helps provide a consistent and coherent sense of order and place. Building entrances should be in a prominent location. Service areas should be screened from view. All structures shall meet the requirements of ADAAG and UFAS for accessibility. Seismic evaluations for performance shall be conducted per TI 809-05. Historical buildings, landmarks and districts should be preserved and protected according to NHPA and army regulations. Renovations and additions should be compatible with architectural character of any building being added to. Plazas and courtyards should be located as part of the primary entrance to a building. Building life cycle, energy and maintenance costs should be minimized through sustainable design principles. Building materials and color should be durable, low maintenance while encouraging a variety of expression while

reflecting the building's function. Consult the following appendices for detailed information regarding colors, materials and sustainable building design requirements for LEED qualification.

8.3.3 Troop Support Theme

Industrial Visual Zone. The buildings within this zone have a structural character which consists of large repair facilities (Figure 8.38). During the visual analysis, the following observations were noted by the design team:

Form, Scale, Height and Massing

The scale of the buildings is monumental.

The height varies two and three stories.

The buildings are linear and large.

The buildings are symmetrical.

Roof Shapes and Materials

The roofs are low slope type (1/2:12 to 3:12).

The roof material is pre-finished metal or built up type roofing systems.

Fenestration

Clerestory windows in the roof system are used for natural lighting.

Large access doors for vehicles and machinery.

8.4. BUILDING ENTRANCES

An entrance is a primary design feature of any building. The entrance should be well defined and recognizable as a point of entry. The entrance to a building should be in a prominent location and should be oriented toward the primary adjacent public space, such as a courtyard, lawn, parking lot, or street (Figure 8.43). An entrance should be designed to provide continuity with other entrances to the building and the entrances of adjacent buildings. The design of a building's entrance designs should address accessibility as needed. Entrances to buildings within the Installation and Troop Support Themes should be easily identifiable and constructed of durable materials and finishes.

8.4.3 Troop Support Theme

Entrances should be constructed of durable materials."

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 Knox. 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) The total square footage of the barracks shall not exceed the maximum square footage indicated in paragraph 2.1 of Section 01 10 00. The total building square footage is based on 366 gross square feet per occupant, as specified, plus an additional 1,845 gross square feet that may be used only as needed to increase energy and sustainability performance, as specified in Section 01 10 00 - paragraph 5.9.2 and as specified in ECB 2011-1 and ECB 2010-14. See Appendix EE Building Layouts for a first floor plan layout that represents a workable solution reviewed by the Government and has been coordinated with the site design.

(c) Exterior Skin. If the Offerors proposal consists of brick or masonry unit wall systems 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 repellant 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.

(d) Daylighting is acceptable in most cases for roofs and walls if applicable to replace artificial lighting. Prismatic Day Lighting is desired for roof skylight systems. Optimize lighting performance with occupancy and photocell control through prismatic lenses to maximize light transmittance to eliminate undesirable hot spots, glare and UV damage to the daylit space.

(e) Provide a removable Interchangeable Core (IC) integrated keying system for all doors. IC's shall be compatible with the existing key system used at Fort Knox. Combination locks used in secured areas shall be Mass Hamilton X09 type. Electric locks shall be stand alone Best BASIS "G" system with encoders and Kiosh. Coordinate installation with the DPW Locksmith Shop. Point of contact is Henry Bailey, Office (502) 624-8136, Mobile (270) 268-1513.

(f) Building Number Identification Signage. Provide Building Number Identification Signage per the following criteria. Contact COR for example if needed. Size – 8" x 20" x ¼" thick with ¼" raised characters. Material/Finish – ¼" thick cast aluminum, plain border, black leatherette background with 6" raised characters centered on plaque. Typestyle – Helvetica Medium. Placement/Installation – Minimum of two signs per building located on the front and rear of the structure at the two most prevalent corners for viewing from the street. Verify locations with the COR. Mount not less than 7'-0" from finish grade and secure with four theft-proof anchors.

(g) Multiple Building Number Identification Signage. Provide Building Number Identification Signage per the following criteria. Contact COR for example if needed. Complex identification sign - For projects that include multiple buildings in a complex, such as this complex, provide masonry (match building exterior) complex identification signage, in addition to the individual building signs referenced above. Contact COR for example if needed.

6.5.3. Not Used

6.5.4. INTERIOR DESIGN

6.5.4.1. Communication Room Closets: COMM Closet locks shall be a SIMPLEX PUSHBUTTON LOCK with key over ride. Provide PART # SIL L1021B626, for left hand doors and SILR1021B626 for right hand doors.

(a) Interior Partitions and Walls. Where moisture or moisture infiltration from the wall cavity cannot be eliminated or sufficiently reduced, consider wall coverings with higher permeability ratings. The use of wall coverings that do not breathe such as vinyl wall coverings is not permitted due to the tendency for mold to develop.

(b) Interior Glass and Glazing. Coordinate the arrangement of fenestrations with the proposed furniture layout.

Interior building signage requirements:

Coordinate review of signage with Fort Knox Fire Chief at the 100% design phase review (Marvin Gunderson, (502) 624-6016). The Fire Chief shall review the correct placement, quantity of signage and the proposed path of egress that will be graphically illustrated on the sign.

6.6. STRUCTURAL DESIGN

6.6.1. Site Specific

6.6.1.1. Roof Live Load – 20 psf

6.6.1.2. Snow Load – 15 psf (pg, ground snow load)

6.6.1.3. Wind Load – 120 mph, 3-second gust

6.6.1.4. Seismic Criteria - As determined from a site specific geotechnical investigation, but not less than the following values: Ss = 0.26g ; S1 = 0.11g

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.

6.6.3. Extend bearing portions of substructure to levels below the frost line. Frost penetration is 32 inches below grade.

6.6.4. 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.

6.6.5. Radon Mitigation: Ensure that the building prevents/mitigates the accumulation of radon gas. Fort Knox requires the installation of radon mitigation features be included in all new construction. The design and construction of foundation walls, slabs, and crawl spaces shall include provisions for the reduction of radon entry and facilitate its removal. The Contractor shall evaluate available on-site data against Table 1 in UFC 3-490-04A Design; Indoor Radon Prevention and Mitigation - 15 May 2003 and include the appropriate mitigation identified in the design. If no data is available utilize the EPA radon maps located on the US EPA radon web site. Note that UFC 3-490-04A is inactive and is only applicable to the extent specifically stated in this paragraph. The Contactor shall incorporate the most stringent mitigation requirements of UFC 3-490-04A as identified above and EPA's "Radon Prevention in the Design and Construction of Schools and Other Large Buildings" Third Printing with Addendum, June 1994 or most current version. Route radon piping out through the roof of the building and contain a gooseneck. Provide a 120 volt receptacle in the attic space to provide power for any necessary radon exhaust fan in the future. Point of contact for these items is Bobby Barker, Fort Knox Environmental Division (502) 624-3629. Design-build contractor shall coordinate with Fort Knox POC and include Fort Knox in all prepatory meetings.

6.6.6. Water Barrier: A capillary water barrier is required under all interior slabs-on-grade. The capillary water barrier shall, as a minimum, prevent the migration of termites, radon, and moisture.

6.6.7. 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.

6.6.8. Termite Prevention: Fort Knox has an approved Installation Pest Management Plan (IPMP). Use the current IPMP's approved list of pesticides . All insecticide and pesticide work on Fort Knox must comply with the IPMP. Report the quantity, location and products used to Environmental Management Division, Mike Brandenburg, (502) 624-7368.

6.7. THERMAL PERFORMANCE

Not Used.

6.8. PLUMBING

6.8.1. Piping: Do not use copper pipe for domestic water supply. Do not use PVC, CPVC or ABS pipe for condensate drains on equipment utilizing R-410A refrigerant.

6.8.2. Water Heaters: Storage type domestic water heaters greater than 75,000 BTU/hr input shall be direct-vent type and shall have a minimum thermal efficiency of 90% when rated in accordance with ANSI Z21.10.3 and shall have standby losses not exceeding the maximum allowed by ASHRAE 90.1.

6.8.3. Boilers: If a boiler is required to prevent low water temperature in water-source heat pump systems or in ground-coupled heat pump systems or used in other type systems or applications, the boiler shall be condensing type and shall have a minimum efficiency of 92% at all conditions at which the boiler will operate.

6.8.4. Heat Recovery: Provide drain heat recovery from showers and kitchen dishwashing equipment. Exception: Shower drain fixtures located on slab-on-grade floors. 6.8.5. Low Flow Fixtures: Lavatory faucets shall flow 0.50 GPM maximum at 80 psi supply pressure. Shower heads shall flow 1.50 GPM maximum at 80 psi supply pressure. Shower heads shall be equipped with manual shutoff valve. Water closets shall flow 1.28 GPM maximum at 80 psi supply pressure.

6.8.6. Water Coolers: Provide one water cooler per floor in the Administration Building. Provide one water cooler in each readiness module adjacent to mud wash utility sinks.

6.8.7 Exterior freeze proof wall hydrants shall be provided around the perimeter of each facility. Perimeter separation distances between wall hydrants shall not exceed 100 feet. A minimum of one wall hydrant shall be provided on each façade (i.e. north, south east, and west exposure) of each facility.

6.8.8 The requirement for a domestic water booster bump shall be determined by the Contractor based on the fire flow test data from the project site, which is located in Appendix D. If required, a complete domestic water booster pump installation shall be provided for the facility.

6.9. SITE ELECTRICAL AND TELECOMMUNICATIONS SYSTEMS

6.9.1. Electrical Distribution: Perform trenching and backfilling and provide and install ducts on the primary side. Primary ducts shall be PVC with steel 90-degree elbows. Primary ducts under roadways shall be concrete encased. Nolin RECC shall provide and install primary cabling.

6.9.2. New Distribution System: The point of connection for the primary feed to the site shall be:

- For the COF buildings, the point of connection shall be Nolin RECC pole #60862.
- For the Barracks building, the point of connection shall be Nolin RECC pole #60772.
- For the Battalion HQ, the point of connection shall be Nolin RECC pole #60791.

Primary ductbank shall be routed underground from each of these connection points to the transformer locations as shown on drawing ES-101 in Appendix J.

Coordinate points of connection with Nolin RECC prior to installation.

Coordinate connections with Nolin RECC and DPW, Electrical Utility Section. Reference 6.4.6.3. for Nolin points of contact.

(a) Primary distribution. Provide and install Schedule 40 PVC ducts on the primary side. Primary ducts under roadways shall be concrete encased. Nolin RECC shall provide and install primary cabling.

(b) Secondary distribution. System shall consist of direct buried Schedule 40 PVC conduit and conductors.

For the COF, UEPH and Battalion Headquarters buildings, provide secondary distribution system consisting of direct buried conduit and conductors from the transformer to each of the three buildings as shown in drawing ES-101 of Appendix J.

6.9.3. Transformers: Nolin RECC will provide and install transformers under separate contract with the Government (NIC). Contractor shall provide concrete pad per Nolin specifications. Contractor shall provide transformer grounding as shown in Appendix J drawings. Coordinate with Nolin RECC.

6.9.4. Service Entrance: Service entrance equipment shall consist of low voltage switchboard utilizing molded case circuit breakers or switchgear using air circuit breakers. Fused main or distribution sections are not allowed. Equipment shall be sized for the projected use of the building plus 25% (min) for future expansion. Provide secondary surge arrestors at each facility.

6.9.5. Street and Area Lighting: Provide lighting design 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; common area walks, and at all steps in area walkways. Exterior lighting (parking lot, street, building, etc.) shall be LED. Provide parking lot and security lighting at a maintained level of 0.5 to 1.0 foot-candles and shall have a uniformity ratio, maximum to minimum, of 20:1 or less. Parking lot lights away from entrances should have occupancy sensors on parking lot lights. Provide photocell and timeclock control for exterior lighting. Illuminate building entrances to 10 footcandles. Nolin RECC will provide and install street and parking lot lighting (NIC). Contractor to provide and install conduits and concrete bases within the contract price. Nolin RECC will provide and install wiring, poles, and fixtures. Reference 6.4.6.3. for Nolin points of contact.

6.9.5.1. Provide and install photocell control with external disconnect on the exterior of all buildings and street lighting to meet Fort Knox or Nolin RECC street light standards.

6.9.6. Telecommunications

See Appendix J for utility drawings with approximate locations for manholes and services. Coordinate all telecommunications work Fort Knox NEC, reference 6.4.6.2. for point of contact.

6.9.6.1. Commercial telephone, Fort Knox telephone, and cable television wiring may occupy the same trench, but not the same duct/manhole system.

(a) Rotary trenchers or plowing are not allowed during trenching or excavation, except in rear 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. Minimum of 36" cover must be provided for all direct buried and top of duct systems unless directed by NEC.

6.9.6.2. Provide and install cabling and duct for the Fort Knox telephone system from the existing exterior system to the building for administrative telephone support. Terminate service entrance cables on protected terminal blocks and all Fiber Optic cables on service entrance termination hardware located in the main communications room. Label Fiber Optic Cables terminated in the facility LIU using the NEC label scheme. The one line label shall consist of the following: cable number, fiber count, local building number and remote building number. Cable number and fiber count will be provided by the NEC. Refer to drawing ES-101 in Appendix J for copper and fiber optic communications routing. Contact NEC POC for availability and location to obtain fiber/copper required. Extend outside plant copper to the racks by a feeder cable. Extend exact pair count to the racks/cabinets and terminated on CAT 6 RJ45 patch panels utilizing 110 connection style terminations. Terminate all riser cables on 110 blocks on backboard in main Telecommunication Room. Terminate Remote Telecommunication Closet's copper riser on RJ45 CAT 6 110 block panels in the racks. Mark outside plant cable with cable number, terminal # and buildings it supports. the Fort Knox NEC or their approved Contractor with compensation by the General Contractor will perform final connections in manhole system, unless prior approval is granted by the NEC. Contractor shall perform all building terminations.

6.9.6.3. The premises distribution shall consist of inside-plant horizontal, riser, and backbone cables and connecting hardware to transport telephone and data (including LAN) signals among equipment items in a building.

6.9.6.4. Entrance conduits in all buildings shall be a minimum of 2-4” ducts, with a separate 1-4” duct for CATV.

6.9.6.5. Do not implement Free Space Optic (FSO) systems unless approved by the NEC.

6.9.6.6. Coordinate with the NEC for a list of areas where 48” of cover is required above the top of the duct or duct encasement.

6.9.6.7. Splice cable either in manholes or pedestals. Do not make buried splices unless NEC approves in writing. No splicing of either fiber or copper in manholes shall occur unless approved by the NEC.

6.9.6.8. Do not use aerial cable, without express Ft Knox NEC agreement and approval for isolated circumstances.

6.9.6.9. 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. Submit 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.

6.9.6.10. Install warning signs in accordance with the following:

(a) Sign mounted to steel PSP stake; orange in color

(b) 4’ below ground in concrete; rising 5’ above ground

(c) No closer than 2 feet from the center of the ditch

(d) If there is a change in direction, position a sign immediately at the turn showing the line

(e) Although I3A states for warning signs to be placed at every 250', for those lengths that end up being less than 250', provide sign(s) accordingly, even if an additional sign is necessary.

Commercial telephone service will be provided by AT&T for the Barracks in addition to the base communications. Provide a 4 inch conduit from the project boundary to the communications room. AT&T will provide cabling. Coordinate with AT&T during the design process. Point of Contact is Robert Sanders, 502-348-4550, rs1556@att.com.

6.10. FACILITY ELECTRICAL AND TELECOMMUNICATIONS SYSTEMS

[Not Supplied - PS_Facility_Electrical : FACILITY_ELECTRICAL]

6.10.1. Telecommunications

6.10.1.1. Coordinate all telecommunications work Fort Knox NEC. Reference paragraph 6.4.6 for point of contact..

6.10.1.2. Provide dual jacks in lieu of single jacks. Voice/NIPRNET dual jacks shall be two CAT 6 RJ45 type with blue inserts. Provide a common wiring structure. Utilize all jacks as voice or data. Labeling scheme shall consist of patch panel-port # (Ex P1-1/patch panel 1, port 1). Provide and locate Room # of the Communications Room that supports the jack at the bottom of each faceplate. Label patch Panels in the Communication Closet P1, P2, P3, etc, regardless of panel density. Labeling of the ports internal to the patch panels is not required.

6.10.1.3. Building Cabling Systems Planning/Design. 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, firestopping, grounding, and labeling. Items under Outside Plant (OSP) Cabling infrastructure encompass, but are not limited to, manhole and duct infrastructure, copper cable, FO cable, cross-connects, terminations, cable vaults and copper and FO entrance cable.

6.10.1.4. Terminate copper distribution on 110 type rack mounted patch panels only. Do not install 110 type patch panels on backboards. Racks/cabinets shall contain an L6-30R and L5-30R electrical outlet mounted at the bottom of the rack. Place a Quad 20 Amp NEMA 5-20R circuit directly behind the cabinet/racks on the wall. Provide at least 1 quad 20A per every 2 racks. Racks/cabinets shall contain 6" vertical and 3" horizontal cable management. The NEC POC must approve layout of the wiring within the racks/cabinets . If cable management and patch panels utilize in excess of 50% of rack space, then provide additional rack(s) for installation of house data/voice network equipment (GFE).

6.10.1.5. All voice/data wiring is a common wiring scheme. All wiring is blue in color and all jacks are blue in color. Terminations will be to "B" standards. Layout of communications room and labeling scheme are provided in Appendix FF Building Telecommunications.

6.10.1.6. Install Fiber Optic patch panels in cabinets or racks that house the LAN equipment. Do not install fiber optic patch panels on backboards. All new fiber optic terminations shall use LC connectors.

6.10.1.7. Key telecommunication Room doors separate from other locks in the building IAW DPW standards. Provide two copies of the key to the NEC POC. Reference section 6.5.2.6 for additional lock requirements.

6.10.1.8. In case of exterior access to Telecommunication rooms, install equipment cabinet(s) instead of racks. Cabinet(s) shall be dust rated with glass front door and accessible rear panel.

6.10.1.9. Switches. Provide and install switching for partial area lighting for small area use within large areas (i.e. Cafeteria's, Conference Areas, Maintenance Areas). Provide occupancy and light level sensor, on every high bay fixture; time set shall be 0-30 minutes, factory installed is preferred.

6.10.2. Intrusion Detection Systems (IDS): Where applicable to the facility type) the Government will install IDS Point of contact for Fort Knox Physical Security coordination is Mike Kiely at (502) 624-3085 or email Michael.S.Kiely@us.army.mil.

6.10.3. Electronic Security Surveillance (ESS): Where applicable to the facility type, the Government will install ESS Systems.Point of contact for Fort Knox Physical Security coordination is Mike Kiely at (502) 624-3085 or email Michael.S.Kiely@us.army.mil.

6.11. HEATING, VENTILATING, AND AIR CONDITIONING

6.11.1. Provide a control system for each building in accordance with Appendix GG and integrate each control system to the installation’s existing UMCS. Building controls, HVAC controls, and meters shall be compatible with the existing base wide wireless, building automation, Trane Tracer System. All building automation systems installed on post must seamlessly integrate back to the base wide Tracer Summit System. This should include complete interface software capable of programming, configuring, and monitoring the digital controllers. Interface of the new DDC system with the site's existing server and operator workstation and software including graphic creation, scheduling, alarming, and trending. Graphics should be similar to the existing base standard graphics illustrating: map location, building exterior picture, floor plans including drill down buttons, equipment graphics, comparable points list to existing graphics, and diagnostics. Coordinate with Installation Energy Manager during the design process.

6.11.2. Point of contact for Fort Knox UMCS’s is R.J. Dyrdek, Project Manager/Energy Manager Office: ENG & SVCS DIV (IMSE-KNX-PW), BLDG 1110B RM 315, 125 6th Ave Ste 320, Fort Knox, KY 40121-5719; Comm: (502) 624-2604 ; Fax: (502) 624-3679; E-mail: robert.dyrdek@us.army.mil

6.11.3. Ground Coupled Heat Pump Systems: Give ground-coupled heat pump systems primary consideration. If this system is not used, submit an energy simulation and life cycle cost analysis demonstrating that the proposed system is more life cycle cost effective with the contract proposal. Ground source heat pump units shall have a cooling mode Energy Efficiency Ratio (EER) of 14.0 minimum when rated in accordance with ISO 13256-1 with 77°F entering water.

(a) For ground coupled heath pump systems, assume a geothermal well field thermal conductivity of 1.85 Btu/hr-ft-F and a thermal diffusivity of 1.25 ft^2/day.

(b) Installation shall be performed under the supervision of a Certified Installer, certified by the International Ground Source Heat Pump Association (IGHSPA).

(c) The site utilities shall be coordinated so that there is no interference between the utility routing and individual ground heat exchangers and associated piping serving other buildings in the complex. See Appendix J Drawings for allowable locations of well fields (Separate Field option shown on drawing C-103 or Combined Field option shown on drawing C-104).

(d) Below-ground pipe and fitting shall be high-density polyethylene with heat-fused joints. The water source heat pump system shall connect to a site geothermal system provided in this project. The geothermal system shall be connected to the ground heat exchanger(s) provided by the contractor.

(e) Borings shall be no closer than 20-feet on center. Borings shall be cased as required by subsurface conditions. Boreholes shall be backfilled with thermally enhanced grouts or #9 limestone rock. Spoil material from the drilling shall not be used to backfill the boreholes.

6.11.4. Regardless of the type of HVAC system selected at a minimum the HVAC system provided for each Facility shall be designed, installed and constructed such that it can be centrally connected to a future ground coupled heat pump system (GCHPS) and site geothermal well system. The connection point shall be provided at the HVAC system central plant in order to minimize the requirements to the system, and not require renovations or upgrades to the HVAC distribution systems location throughout the facility. Provide additional HVAC building temperature controls to accommodate a future GCHPS system. Provide a minimum of twelve extra control points in the control system for the future GCHPS.

6.11.5. Not Used

6.11.6. Fire Protection: Refer to Paragraph 6.13 for additional HVAC Fire Protection requirements.

6.11.7. Mechanical Drawings. In addition to the requirements of Section 01 33 16, drawings shall be provided showing the site design of any geothermal well field systems and related ground coupled heat pump systems, if those systems are provided.

6.11.8. Do not use PVC, CPVC or ABS pipe for condensate drains on equipment utilizing R-410A refrigerant.

6.11.9 Utility Management Control System.

Integrate the control system to the installation's existing UMCS. The existing UMCS is described in paragraphs 6.11.1 -2 and Appendix GG.

6.12. ENERGY CONSERVATION

6.12.1. General

Design Review. Coordinate with Installation Energy Manager during the design process. Point of contact for Fort Knox FMCS's is R.J. Dyrdek at (502) 624-2604 or email robert.dyrdek@us.army.mil.

(a) 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.

6.12.1.1 Energy Conservation Features:

Parking lot, roadway and walkway lighting shall utilize LED lamps and be controlled by a system of photocells and motion sensors. The fixtures shall turn on for a user specified amount of time when motion is detected by the motion sensors. The lights shall only be allowed to turn on when the natural light is below the threshold set by the photocells. Lighting near entrances shall be controlled by photocell only, not motion detector, so that they remain on at all times from dusk until dawn.

A daylighting control system shall be provided for the TA-50 Gear Storage spaces in the COF Readiness Modules. The system shall turn off all lights in these spaces when enough natural light is present. The system shall have a control panel in an easily accessible location that will allow the user to override the system and to adjust the light level on/off threshold.

In addition to the energy conservation features indicated in paragraph 5.9, all building lighting systems, including night-lighting and egress lighting systems shall be provided with control methods to

automatically shut-off the building/area lighting when the building/area is unoccupied. The goal is to have lights off when the building/area is unoccupied.

(b) The DB Contractor shall comply with the requirements of the Ft. Knox Basewide Energy Management and Control System in Appendix GG.

6.12.2. 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:

Ground Loop Geothermal Systems.

6.12.2.1. Requirements for the following renewable energy features are discussed in other sections of the RFP:

Solar Hot Water Heating – Refer to Paragraph 5.9.4 for specific requirements.

Ground Coupled Heat Pump – Refer to Paragraph 6.11.3 for specific requirements.

LED Street and Area Lighting – Refer to Paragraph 6.9.5 for specific requirements.

6.13. FIRE PROTECTION

6.13.1 Combined Automatic Sprinkler System / Wet Manual Standpipe System:

6.13.1.1 Install a combined Automatic Sprinkler / Wet Manual Standpipe throughout each COF Readiness Facility and the UEPH. Install an automatic sprinkler system throughout the COF Administrative Facility and Battalion Headquarters.

6.13.1.2 Provide a separate fire sprinkler service connection for each facility.

6.13.1.3 Provide vane type water flow switch on the system riser. Install a floor control assembly as illustrated in UFC 3-600-01, figure 4-1 for each floor. Ensure that main riser flow switches alarm at least 10 seconds after the floor control assembly flow switch.

6.13.1.4 Install tamper switches on all control valves. This includes (but is not limited to) floor control assemblies, riser control valves, post indicator valves and backflow test connection control valve (normally closed).

6.13.1.5 Monitor all flow switches and tamper switches with the building fire alarm system. Install a test & drain at each floor control assembly. Locate inspector test valve in an accessible location, not over 7-feet off the floor that is not exposed to freezing. Terminate the test drain outdoors with appropriate splash guard protection as required.

6.13.1.6 Locate Fire Department Connection (FDC) at readily accessible location on the front of each building.

6.13.1.7 A backflow preventer is not required at each building since the sprinkler system is fed from a dedicated fire line. A double check backflow preventer is required at the fire pump installation to avoid cross contamination of the domestic water lines and fire lines.

6.13.1.8 See Appendix D for water flow test. Provide a central fire pump installation to serve the building fire sprinkler systems. .

6.13.2 Fire Pump System / Prepackaged Fire Pump House

6.13.2.1 Provide a complete diesel fire pump system with a prepackaged fire pump house to serve the site. Provide in accordance with UFC 3-600-01 and NFPA 20.

6.13.2.2 Provide primary and standby diesel fire pumps each rated to provide 100 psi at 750 gpm. Configure the standby pump to only run upon failure of the primary pump. The pumps shall not run at the same time.

6.13.2.3 Provide a “Pre-Assembled Pump Building” complete with all materials and accessories as needed for a complete installation.

6.13.2.4 The work shall include the furnishing, delivery, and installation of a pre-assembled, pre-engineered, steel building and fire pump system.

6.13.2.5 The structure design and manufacture shall, as a minimum, conform to ASCE (American Society of Civil Engineers) current edition of "Minimum Design Loads for Buildings and Other Structures" and to the MBMA (Metal Building Manufacturers Association) "Recommended Design Practices Manual."

6.13.2.6 Building shall be manufactured and built to satisfy current editions of UFC 3-600-01, The Life Safety Code (NFPA 101), the International Building Code (IBC), and the National Electrical Code (NEC).

6.13.2.7 Building Manufacturer shall supply plans and calculations stamped by a Registered Professional Engineer.

6.13.2.8 The Fire Pump building shall present a general image compatible with the primary theme of the buildings as identified in the RFP Section 01 10 00, Paragraph 6.5.2. The Fire Pump buildings' use of exterior materials is permitted to be more consistent with that of office/warehouse facilities in the private sector. Suggested materials for the Fire Pump building is precast concrete panel or masonry wainscot with metal siding above. .A color chart shall be provided to the Owner for exterior color selection prior to manufacturing.

6.13.2.9 Building Manufacturer to have a Quality Control program that follows building through to completion and is passed onto Owner with all instruction manuals and final drawings.

6.13.2.10 Additionally, the building manufacturer to have been in the fire pump building business for a minimum of 5 years, and able to supply proof of supplying at least 25 Buildings of a similar type in that time.

6.13.2.11 Manufacturer shall guarantee that the complete building will have no defects in materials and workmanship for a period of TWO YEARS, except as limited or extended by the original equipment or component manufacturer.

6.13.2.12 Metal Exteriors and Roofing shall have a 70% PVDF resin based paint coating, over a Galvalume substrate, with a Twenty Year Warranty against rust perforation, a Thirty Year Warranty against fading and chalking and a Forty Year Warranty against flaking peeling and checking. Coatings to meet minimum performance requirements as set forth in ASCA specification 96 and AAMA specification 2605. (KYNAR 500 is an approved coating).

6.13.2.13 The materials shall be new, unused, and fabricated in a workmanlike manner in a factory environment. Hot rolled steel to meet as a minimum standard ASTM –A36, and all galvanized steel to meet as a minimum standard ASTMA -653.

6.13.2.14 Framework: The fire pump building shall have a complete, internal, self-supporting, structural steel frame which does not rely on the exterior panels or roof cover panels for its structural strength or framing. The building framework shall include 8 to 16 gauge, cold-formed, galvanized steel

structural members. Building framework to have a flush wall, post and beam format with girts and purlins, and full trusses on both endwalls which easily allows for future expansion and/or modifications. Wall and ceiling structural support system are to be designed to provide load carrying capability for anticipated equipment loads using 16 gauge galvanized steel hat channels behind liner panel for reinforcement as needed, with locations shown on approval drawings. Roof to have 8 to 14 gauge solid web hot rolled steel trusses.

6.13.2.15 Insulation: Exterior walls shall have a minimum of 3.5", fiberglass batt insulation and a vapor barrier. The ceiling shall have a minimum of 6" insulation and a vapor barrier. In addition to the insulation in the walls and ceiling, an additional 1" fiber-glass insulation blanket shall be installed over the entire building framework and under the exterior wall and roof panels, as a thermal break. The insulation system shall provide a minimum of R-14 in the walls, R-21 above the ceiling.

6.13.2.16 Roof: A roof pitched 1 inch in 12 or greater shall have a covering of overlapping, 26 gauge, "Multi-Rib" ribbed steel panels with a baked-on Kynar 500, PVDF resin-based finish over a galvalume substrate, in manufacturer's standard colors. Overlapping roof panels shall be installed with appropriate self-tapping fasteners with integral gaskets. A roof with a pitch of less than 1 inch in 12 shall have a roof covering of mechanically-seamed, 24 gauge, Standing-Seam Roofing, with a minimum seam height of 2". Standing seam roof panels shall be of Galvalume steel, with a baked-on Kynar 500, PVDF resin-based coating and shall have no visible fasteners on main run. Roof to include a matching, die-formed ridge cap, and a fully supported 3" overhang. Properly sized attic space ventilation shall be provided. Roof to be either a gable or one way slope. Heavy duty steel lift eyes to be supplied and mounted to the roof trusses as needed for lifting the building.

6.13.2.17 Exterior Walls: The exterior walls shall be precast concrete, masonry or metal siding of 26 gauge "Multi-Rib" ribbed steel panels with a PVDF resin-based finish over a galvalume substrate in manufacturer's standard colors. Exterior siding panels to be overlapped and installed with appropriate self-tapping fasteners with integral gaskets, and shall be removable without any disturbance to interior panels. Butted seams are not allowed. All openings in walls are to be structurally framed, sleeved, trimmed, and provided with external drip caps. Repair or replacement of exterior panels must be able to be done entirely from outside.

6.13.2.18 Exterior Trim: The exterior trim package shall include stepped or boxed eave, rake, fascia, base, corner, jamb, and header trim in, 26 gauge Galvalume material with owner's choice of standard KYNAR colors.

6.13.2.19 Interior Finish: The building's interior walls and ceiling shall be lined with flush-fit 22 gauge, roll-formed liner panels, with concealed fasteners and a baked-on White polyester finish over G-90 galvanized substrate. The building interior shall feature a complete matching trim system including base, jamb, header, and ceiling trim. Liner to be reinforced with 14 gauge hat channels mounted vertically as needed for heavy wall mounted items.

6.13.2.20 Fasteners, Adhesives, and Sealants: The fasteners, adhesives, and sealants utilized shall be of types approved for use on this type of structure as required by the appropriate agency or governing body.

6.13.2.21 Closures: Matching, pre-molded, closed cell elastomer closures provided by the siding and roof panel manufacturer shall be installed according to the manufacturer's recommendations at the eave line, beneath the roof panels, and where the trim meets the wall panels.

6.13.2.22 Minimum Standards. Doors shall at a minimum comply with Steel Door Institute directive SDI-100.

6.13.2.23 Doors and Frames. Doors to be constructed of no less than 18-gauge steel faced leafs with stiffeners and 16 gauge door frames. Doors and frames to be hot-dipped galvanized to ASTM

designations A924 and A653, then factory primed and painted with epoxy enamel to match the building or the trim. Door to have insulated core.

6.13.2.24 Door Sizes and Quantity. Shall be 72” X 84” Double type at a minimum or as indicated on the drawings.

6.13.2.25 Door Hardware shall include: NRP stainless steel ball bearing hinges, minimum of Three (3) per door, LCN4111 closer with hold open arm, weatherstripping and sweep, Reese #797B, Threshold, Reese #V301, watershed, at top of door, Reese #202C; 203C, drip cap, extending 3” past door edge.

6.13.2.26 The building shall be equipped with a heater with thermostat.

6.13.2.27 The building shall be equipped with an exhaust fan and thermostat.

6.13.2.28 The building shall be equipped with 4' interior florescent lights

6.13.2.29 The building shall be equipped with a wall mounted convenience outlet.

6.13.2.30 The building shall be equipped with a lighting panel box with 7 1/2 KVA Transformer.

6.13.2.31 The building shall be equipped with 15 Amp single pole circuit breakers.

6.13.2.32 The building shall be equipped with an Exterior weatherproof sodium vapor light.

6.13.2.33 The building shall be equipped with a motorized damper.

6.13.2.34 The building shall be equipped with an Emergency light

6.13.2.35 The building shall be equipped with an exterior red rotating beacon

6.13.2.36 The building shall be equipped with a fire sprinkler system.

6.13.2.37 The building shall be equipped with a fire alarm system and Monaco radio transceiver. Provide a dedicated fire alarm control unit inside the fire pump house.

6.13.2.38 Provide the following Monaco transmitting zones (minimum) at the fire pump building: 1. Pull Station (Alarm), 2. Smoke/Heat Detector (Alarm), 3. Water Flow (Alarm), 4. Fire Pump #1 Running (Alarm), 5. Fire Pump #2 Running (Alarm), 6. Low Pump Room Temperature (Supervisory), 7. Selector Switch Not in Automatic (Supervisory), 8. Low Fuel (Supervisory), 9. Low Battery (Supervisory), 10. Engine Failed to Start (Trouble), 11. Engine Over Speed (Trouble), 12. Low Oil Pressure (Trouble), 13. High Water Temperature (Trouble), 14. Battery Charger/AC Power Failure (Trouble), 15. FACP Trouble (Trouble).

6.13.2 Combined Fire Alarm / Mass Notification System:

6.13.2.1 Provide SimplexGrinnell, Gamewell FCI, Notifier 3030 or approved equal Fire Alarm and Mass Notification System. Equals, submitted for approval, will be reviewed by the Fire Chief.

6.13.2.2 Provide a combination fire alarm and mass notification system with Monaco (BTX-M) receiver for each facility. Provide transmitter and associated components to accommodate 52 zones. The transceiver must be compatible with the existing Monaco D-21 Central Station. Coordinate programming with the Fort Knox Fire Department.

6.13.2.3 Provide all programming codes, passwords, and associated components required to access, update, modify, and maintain the system.

6.13.2.4 Key all panel boxes alike.

6.13.2.5 Provide red panel boxes.

6.13.2.6 Provide fire alarm / mass notification system training no later than the date of final system acceptance.

6.13.2.7 Locate the fire alarm/mass notification panel and transmitter in Electric or Communication Room with an exterior door. Provide a remote annunciator and local operator console (LOC) near the building main entrance.

6.13.2.8 Provide manual pull stations at all exterior entrances / exits including mechanical, electrical, and communications rooms.

6.13.2.9 Provide smoke detection at each fire alarm control unit, control panel, audio amplifier panel, and booster power supply.

6.13.2.10 Provide addressable smoke detectors with sounder bases in sleeping and residential areas in accordance with NFPA 101. Upon alarm, activate the sounder base and provide a supervisory signal at the main fire alarm control unit. Smoke detectors with sounder bases shall be provided in all bedrooms and immediately outside the bedrooms. Alarms shall only sound within individual sleeping areas and annunciate at the fire alarm panel only and shall not actuate the building fire alarm system notification appliances for 180 seconds. After 180 seconds, the alarm activation shall annunciate at the fire alarm panel and be transmitted to the Fire Department via the Monaco transmitter. Smoke detectors shall be part of the building fire alarm system and smoke alarms that receive their power from building electrical systems are prohibited.

6.13.2.11 Provide speakers in accordance with UFC 4-021-01, NFPA 101, and NFPA 72. Ensure that audibility is in accordance with NFPA 72. Ensure that intelligibility is in accordance with UFC 4-021-01.Provide speakers at all locations in the building. Measure audibility and intelligibility with doors closed. Provide weatherproof speakers on the exterior of the building in accordance with UFC 4-021-01. Provide exterior speakers around building entrances/exits and other outdoor areas commonly used by building occupants such as smoke shelters and picnic areas.

6.13.2.12 Provide fire alarm strobes in accordance with the Architectural Barriers Act (ABA) adopted by Department of Defense.

6.13.2.13 Provide an amber mass notification strobe next to each fire alarm strobe.

6.13.2.14 Provide Class A, SLC circuits.

6.13.2.15 Provide Class A, Notification Appliance Circuits.

6.13.2.16 Provide Class A or Class B, Initiating Device Circuits.

6.13.2.17 Conductors shall go from device to device and appliance to appliance without splices. Use terminal boards when wire spices are unavoidable. Electrical wire nuts are prohibited.

6.13.2.18 All panels and associated equipment shall operate on the secondary power source for 72-hours in the non-alarm (supervisory) state and 15- minutes in alarm status. In addition, the system must support 60 minutes of mass notification with no standby requirement.

6.13.2.19 Each audio amplifier shall be constantly supervised for any condition that could render the amplifier inoperable at its maximum output. Failure of any component shall cause automatic transfer

to a designated backup amplifier, illumination of a visual trouble indicator and audible alarm on the control panel.

6.13.2.20 Paint junction box covers red. Provide red conduit for fire alarm circuits.

6.13.2.21 Pre-program seven messages for the MNS as follows: (MALE VOICE) Repeat all messages twice. Activation names in bold.

(1) **Hazardous Material Emergency** – Shelter in place: C3Tone 2 rounds (Fire Alarm Sound Clips on Wheelock Website): “Attention, Attention. A HAZARDOUS material or other emergency has been reported. Immediately take shelter inside a facility. Accomplish required shelter in-place actions and await further instructions.”
(2) **Hazardous Material Emergency** – Evacuate: C3Tone 2 rounds (Fire Alarm Sound Clips on Wheelock Website): “Attention, Attention. A HAZARDOUS material or other emergency has been reported. Stand by for evacuation instructions.
(3) **All Clear:** Verbal: “May I have your attention please. May I have your attention please, all clear, the emergency has ended.”
(4) **Routine Test:** Stutter (File 13): 5 seconds “May I have your attention please. This is a test of the Fort Knox Mass Notification System, this is only a test.” POC for Message Steve Robertson, 305 CES/CEX
(5) **Force Protection Threat Condition Alert:** ; Label as: “FPCON ALERT”: Siren 5 seconds (Fire Alarm Sound Clips from Wheelock Website): “Attention, Attention. The Force Protection Condition for Fort Knox has changed. Tune your television to the commander’s access channel or access the base intranet for further information.”
(6) **Tornado Warning:** (tornado wail) Label as: “Tornado Warning”, 5 seconds: “Your attention please. A tornado warning has been issued for Fort Knox and the local area. Implement your tornado plan and take shelter immediately.”
(7) **Fire Evacuation:** Two cycles of the temporal 3 pattern, then the evacuation message (twice), then two more cycles of the temporal 3 pattern. The message: “May I have your attention please. A fire emergency has been reported in the building. Proceed clammily calmly to the nearest exit and leave the building immediately. All handicap occupants shall use the building evacuation plan”.

NOTE: The temporal 3 pattern shall only be used for FIRE EVACUATION messages.

NOTE: The pre-recorded message alert tone level shall be equal to or not more than 3 DBA above the audio DBA level.

6.13.2.22 Label the LOC and ACU message buttons as follows:
(a) HAZMAT SIP (Amber strobes)
(b) HAZMAT EVAC (Amber strobes)
(c) ALL CLEAR (Amber strobes)
(d) ROUTINE TEST (Amber strobes)
(e) TORNADO (Amber strobes)
(f) FPCON (Amber strobes)
(g) FIRE (Clear strobes)
(h) SPARE
(i) AMBER VISUAL SWITCH (Amber strobes)

6.13.2.23 Message Rules:
(a) When the first button is pushed it shall have priority over any sequential buttons pushed, regardless of message.
(b) Buttons 1-6 will play the respective MNS message and activate the amber strobes.
(c) Button 7 will play the fire message and activate the clear strobes, but will not perform any other fire alarm control features as a normal fire would.
(d) The microphone at the LOC will have priority over any prerecorded message button.
(e) When activating or keying the microphone at the LOC or ACU, the amber strobes shall activate.

(f) FACP (ACU) microphone shall take priority over the live voice message from fire dispatch.
(g) The LOC microphone shall take priority over the live voice message from fire dispatch.
(h) The LOC microphone located by remote annunciator shall take priority over any other LOC microphone or the live voice message from fire dispatch or prerecorded messages.
(i) Activation of the “Amber Visuals” switch will turn on or turn off the amber strobes, provided no other button or the microphone has been activated.

6.13.3 Knox Box: Provide and install a 3200 series hinged door recess mounted “Knox Box” part number 3275, manufactured by “The Knox Company” or approved equal. Install the vault in accordance with the manufacturer directions. The vault shall be dark bronze and recess mounted on the exterior wall near the main entrance or near the closest door that leads to the fire alarm/mass notification panels of each building. Equip the vault with a supervisory switch connected to the fire alarm system. Coordinate with the Fire Department for ordering information and compliance.

6.13.4 Install the “KNOX” company stainless steel 2.5-inch male NST locking FDC caps or approved equal on each fire department connection. Submit “KNOX” FDC locking caps keys the day the FDC caps are installed.

6.13.5 Portable Fire Extinguishers:

6.13.5.1 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.

6.13.5.2 Government will provide ten-pound portable dry chemical (Class ABC) Fire Extinguishers manufactured by Amerex. Government will also provide 6-liter wet chemical portable fire extinguishers in all kitchenettes and commercial kitchens equipped with fixed wet chemical suppression system.

6.13.6 Heating, Ventilation, Air Conditioning (HVAC) Fire Protection Requirements:

6.13.6.1 Provide fire alarm system and duct smoke detectors by same manufacturer. Install duct detectors where required by NFPA 90A.

6.13.6.2 Detection activation shall not activate the building general evacuation notification appliances; however, it shall generate a special supervisory alarm that is transmitted to the Fire department via the fire alarm/mass notification control panel.

6.13.6.3 Where duct smoke detectors are installed in concealed locations or more than 10’ above the finish floor, or in arrangement where the detector’s alarm or supervisory indicator is not visible, provide remote indicator and test switch in location that is visible, accessible, and indicates the location of the device.

6.13.7 Elevator Hoistways and Machine Rooms: Protect elevator hoistways and machine rooms in accordance with UFC 3-600-01 with additional provisions herein. Provide heat detectors within 2-feet of all sprinklers installed in machine room and hoist way when sprinklers are required. Heat detectors shall have both a lower temperature rating and a higher sensitivity as compared to sprinklers. Heat detectors shall activate prior to sprinkler activation and shut down elevator power via a shunt trip breaker thru the FACP. Program a time delay equal to the amount of time for the elevator to travel from the top of the hoist way to the lowest recall level before activation of the power shunt trip in conjunction with heat detector activation. Water flow or pressure switch shall shut down elevator power immediately upon activation. The use of devices with time delay switches or time delay capability is not permitted.

6.13.8 Elevator Inspection: Fire Inspector from Post Fire Department shall also witness the acceptance test and inspection with the Certified Elevator Inspector.

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 Contractor. Validation of credits will be accomplished by the Government. LEED certification of the project by the Contractor is required. The Contractor will obtain LEED certification prior to project closeout. Application, payment of certification of fees and all coordination with USGBC during the certification process will be by the Contractor. GBCI interim review of design phase data is not required by the Government but is recommended. Government validation during project execution does not relieve or modify in any way the Contractor's responsibility to satisfy all requirements for certification as defined by LEED and GBCI. Contractor is not responsible for design phase LEED documentation of any unaltered portion of the design that is accomplished by others. If the project includes unaltered complete design by others, during the certification process Contractor will coordinate all GBCI comments on LEED credits that fall outside Contractor's scope of responsibility with the Government for coordination with the Designer of Record, and Contractor will not be penalized if project fails to achieve certification at the minimum required level due to loss of credits that are the responsibility of others.

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 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 does not have an on-post recycling facility available for Contractor's use.

Regional Priority Credits (Version 3 only)

The project zip code is 40121.

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) 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.

(b) LEED Application Guide for Multiple Buildings and On-Campus Projects (AGMBC)

This RFP has been developed according to the 2010 AGMBC. Four LEED projects have been registered by the Government for this project under a project block (ID # 1000015527) as of 4 May 2011. Appendix O indicates credits which will be required for the project.

Master Site Project ID: 1000015543

COF Project ID: 1000015544

Barracks Project ID: 1000015545

Battalion HQ Project ID: 1000015546

The COF complex has been registered as a single building project. If the Contractor chooses to pursue LEED certification for each building as a separate LEED project, they will be responsible for all fees associated with registration and certification.

(c) LEED Rating Levels

The Contractor shall not propose LEED ratings above Silver if any additional cost will be incurred by the Government.

(d) 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.

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 including 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

(e) 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:

- All HVAC equipment efficiency ratings shall meet or exceed ASHRAE 189.1 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): 0.15 cfm/ft2

6.15. ENVIRONMENTAL

6.15.1. Safety and Health Requirements for Construction Activities:

6.15.1.1. Provide a site specific Accident Prevention Plan for all work performed in accordance with IAW EM 385-1-1 Appendix A.

6.15.1.2. Provide the Installation Safety Office with employee training certification documents if equipment containing a radioactive source is needed. Information provided should consist of equipment use and the duration.

6.15.1.3. Contractors conducting subsurface work shall evaluate the construction area for possible Unexploded Ordinance (UXO). If a possible UXO is discovered notify 911 immediately.

(a) Munitions Response Sites (MRS) - when work is being performed at sites with a potential MEC issues all work will need to be performed in accordance with EP 75-1-2, August 2004, Munitions and Explosives of Concern (MEC) Support during Hazardous, Toxic and Radioactive Waste (HTRW) and Construction Activities. EP75-1-2 requires site specific planning documents to be generated and reviewed by USACE MM CX for review. These documents are discussed in section 3 Planning Consideration for MEC support. Chapter 5 Anomaly Avoidance Procedures During HTRW Investigations/Design Activities shall be adhered to.

6.15.1.4. Contact both the Fire Department and Installation Safety Office prior to entering a confined space.

6.15.2. Spill Response Procedure and Plan:

6.15.2.1. Notify the Fire Department immediately in the event of a hazardous spill. The first person on-scene that identifies the hazard must notify the Fire Department – this may or may not be the designated POC.

6.15.2.2. After notifying the Fire Department, call the DPW Environmental Branch, the Army Corps of Engineers' Administrative Contracting Officer, and the Installation Safety Office.

6.15.2.3. The Fort Knox Fire Department and DPW Environmental Branch are responsible for any off-installation notification.

6.15.2.4. For the spill control (Spill Response) plan, as part of the Environmental Protection Plan required by Section 01 57 20.00 10, also include a listing of the hazardous materials stored on site, and a site diagram outlining where the storage sites are located. Train all supervisors on site in the execution of the Spill Plan. Document all training

6.15.3. Solid Waste Disposal/Diversion Practices: Solid Waste Disposal/Diversion Practices shall be in accordance with Appendix E, Environmental information. All construction activities at Fort Knox 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.

6.15.4. Contaminated Soils: In the event that abnormalities, discolorations, odors, oil or other signs of potential contamination by hazardous materials are encountered during excavation, soil borings or other construction activities, stop work, and notify the Government immediately. Follow with written notice within 24 hours, indicating date, time and location of potential contaminants encountered. In the event contaminated soil is encountered, all field and laboratory technicians must be trained and certified for handling hazardous materials.

6.15.5. Installation Forester: The Installation Forester must complete a survey before any trees with diameters greater than 6 inches are removed between April 1 and October 15. Trees 6-inches and above diameter at breast height provide habitat for endangered species. This is in addition to Section 3.1 Land Resources under Section 01 57 20.00 10.

6.15.6. Wetlands: No jurisdictional wetlands have been identified on the project site.

6.15.7. Solid Waste: There is no record of landfill or solid waste management areas present at the project site.

6.16. PERMITS

Obtain all permits (local, state and federal) required for design and construction of all site features and utilities. Provide information to obtain all necessary permits, as described below.

6.16.1. Excavation Permit. Obtain approved excavation permits prior to digging. Request for excavation permits shall be in accordance with installation policies. Coordinate all excavation activities with the Project Engineer. Coordinate with the appropriate utility service to mark underground utilities (gas/water/sewer/electric/steam/chill water/storm/fuel lines/drain, and telephone and cable) in the vicinity of the excavation no earlier than three days prior to work being started.

6.16.2. Air Permits (Fuel Burning Equipment). Provide air permit information through the COR to Fort Knox Environmental Division. Obtain a construction/operation permit prior to construction. Provide information for the permits using the Checklist for Non-Process Source and the Vent Stack Checklist. Checklists are included at the end of this specification in Appendix C of this specification. Complete each checklist for each piece of fuel-burning equipment. Fort Knox has requested that they be informed of the size and type of units to be installed as soon as it is known. Fort Knox will forward generic permit applications to the State to expedite the process. When the specific equipment information is known, forward it to Fort Knox for completion of the applications. No construction may begin until these permits are obtained. Point of contact for these items is Eric Brown, Fort Knox Environmental Division (502) 624-8239, or via e-mail at eric.james.brown@knox.army.mil.

6.16.3. Air Permits (Cooling Equipment). Provide air permit information through the COR to Fort Knox Environmental Division. Obtain a construction/operation permit prior to construction. Provide cooling equipment information (chillers, heat pumps, cooling towers, condensing units, etc.), including equipment type, equipment capacity, refrigerant type in each piece of equipment, and amount of refrigerant in each piece of equipment. Submit information as soon as possible. No construction may begin until these permits are obtained. Point of contact for these items is Eric Brown, Fort Knox Environmental Division.

6.16.4 Water Permits. The water distribution system design and construction, including the permits, is part of this project. Submit four (4) copies of the application through Fort Knox (the water distribution system owner). Fort Knox will assist in the preparation of the permit application. Point of Contact for Fort Knox is Warren Clifford, (502) 624-7917.

6.16.5 Sanitary Sewer Permits. The sanitary sewer system design and construction, including the permits, is part of this project. The utility owner, Hardin County Water District No. 1 (HCWD1), and Fort Knox will review the permits. Submit four (4) copies of the application to Fort Knox. HCWD1 does the permitting for the sewer connections. Veolia does not do permits. Point of contact for HCWD1 is Preston Pendley, (270) 352-4280 ext. 224 or ppendley@hcwd1.com. Point of contact for Veolia Water at Fort Knox is Kenny Morley, (270) 304-5410 or kenneth.morley@veoliawaterna.com. Point of Contact for fort Knox is Warren Clifford, (502) 624-7917. Connections will be prohibited by HCWD1 until downstream construction is accepted and transferred to HCWD1.

6.16.6 Erosion and Sediment Control Permit. An NOI permit is not required for this project. The SWPPP included in Appendix J Drawings has been approved by Fort Knox Environmental Division.

6.17. DEMOLITION

6.17.1. Demolition that is NOT included in this contract:

6.17.1.1. Existing buildings on the project site that are intended to be removed for construction of this contract will be removed by the Government under separate contract prior to the start of construction of this project. The following buildings are intended to be demolished under that contract: Buildings 2754, 2755, 2756, 2757, 2760, 2761, 2786, 2787, 2788, 2789, and 2799. Building demolition will include complete building structure removal (everything inside the building exterior envelope including slabs and foundations to a depth of four feet). Demolition will also include the concrete building aprons (adjacent to the buildings), wash out areas, oil/water separators, building-associated mechanical equipment, and transformers.

Backfill associated with this demolition contract shall be assumed to be of inadequate bearing capacity for vehicular paving and buildings. In areas of vehicular paving and building, the Contractor shall remove the inadequate bearing capacity soil and recompact as necessary.

6.17.1.2. Underground Storage Tanks (UST) on the project site that are intended to be removed for construction of this contract will be removed by the Government under separate contract prior to the start of construction of this project. The following USTs are intended to be removed under that contract: UST south of Bldg 2799 and UST west of Bldg 2786. UST demolition will include complete tank and bollard removal, remedial action (if necessary) and compacted backfill.

6.17.1.3. Overhead electric service on the project site that is intended to be removed for construction of this contract will be removed by the Government under separate contract prior to the start of construction of this project. All existing overhead electric is intended to be removed under that contract. Overhead electric demolition will include removal of the electric and communication wires and poles. Any overhead electric that remains shall be constructed around.

6.17.2. Demolition included in this contract: Refer to paragraph 5.12 for Construction and Demolition Waste Management.

6.17.2.1. Existing pavement on the project site that are intended to be removed for construction of this contract, except as specifically identified in paragraph 6.17.1 and on the drawings in Appendix J, shall be demolished.

6.17.2.2. All other demolition that may be required to complete the construction of this project.

6.18. ADDITIONAL FACILITIES

There are no additional facilities.

6.19 SUPPLEMENTAL REQUIREMENTS TO THE RFP

6.19.1 The following requirements shall be added to Section 01 45 04.00 10, 3.4 QUALITY CONTROL ORGANIZATION, paragraphs 3.4.1. through 3.4.4. as follows. The most stringent requirements of the following requirements and Section 01 45 04.00 10 shall apply.

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 6 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 Manger 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 indentified 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 indentified 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 indentified 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. 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.

3.4.4.1.9. 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, 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 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.

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 idenify 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 six (6) 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 two (2) 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 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. Uuse 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. All submitted BIM Models and associated Facility Data shall be fully compatible with Bentley BIM V8i and the USACE Bentley BIM Workspace 09Q4b_V8i

(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) **22" x 34"** 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	2	1	2	2
Commander, U.S.Army Engineer District, Center of Standardization **Savannah Dist & Fort Worth Dist**	0/0	9/9	9/9	3	0	3	3
Installation	2/0	2/0	2/0	2	2	2	2
U.S.Army Corps of Engineers Construction Area Office	3/0	3/0	3/0	3	1	3	1
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) **22" x 34"** 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)
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

Except for full or half-sized drawings for Installation personnel, as designated in the Table above, 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 eight (8) 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 STRUCURAL 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 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. NOT USED

1.2. NOT USED

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 fort 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 specificy 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 (thermallyfused 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 manufactures 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 commerical 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.

raining tables shall be reconfigurable, moveable and storable; lighter weight folding with dollies or castered 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 Accessibllity 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 Section712, 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		Date Submitted (to be filled in by Contractor)	Government Reviewer's Use
PAR		**FEATURE**	**DUE AT**		**REQUIRED DOCUMENTATION**	**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 of GBCI for purposes of compliance with project requirement to obtain LEED certifiaction.						
	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 buiding, statement indicating distance from building entrance.		ARC

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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 interiorfixtures 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 façade/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 convyance 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
			**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 lising, 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 lising, 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 anufacturer 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	X	Manufacturer published product data or certification confirming material VOCs in spreadsheet		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	X	Manufacturer published product data or certification confirming material VOCs in spreadsheet		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	X	Manufacturer published product data or certification confirming material compliance label in spreadsheet		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	X	Manufacturer published product data or certification confirming material urea formaldehyde in spreadsheet		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

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			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 withcompliant daylight zone. Percentage calculation of areas withcompliant 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							

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IDc1.1		Innovation in Design	Final Design		Narrative decribing 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.		
IDc1.2		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 responsiblilities 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 22" x 34" 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 Bentley BIM V8i. 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 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. The USACE Bentley BIM Workspace 09Q4b_V8i must be used and can be downloaded from the CAD/BIM Technology Center website, currently https://cadbim.usace.army.mil.

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 District 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 Date 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.

7.5. "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 devise
- 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 various USACE District offices. 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 1,000 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 10 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 20 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 IMPC 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 warrantied 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 Contractors 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 Warrantied 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 (MDSD) 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
19th Engineering Battalion Complex

Fort Knox, Kentucky
TTL Project No. 100811079

Prepared by:

TTL

geotechnical • analytical • materials • environmental

Report
of
Geotechnical Exploration

TTL Project No. 100811079

July 15, 2011

19th Engineering Battalion Complex
Fort Knox, Kentucky

5010 Linbar Drive, Suite 153
Nashville, TN 37211
615.331.7770
www.ttlusa.com

July 15, 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
19th Engineering Battalion Complex
Fort Knox, Kentucky
TTL Project Number 100811079

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 a new complex for the 19th Engineering Battalion within the limits of the Fort Knox Military Installation in Fort Knox, Kentucky. We understand that the proposed construction will consist of the following:

- Two company operations facilities with covered hardstands and a company operations facility administrative building
- A battalion headquarters building
- A barracks facility
- Subsurface utilities
- Low Impact Development (LID) Stormwater management structures
- Hardstands to accommodate engineering equipment
- Approximately 400 new POV parking areas and access drives for automobiles

We understand that the proposed battalion headquarters facility and barracks facility located in the southwestern portion of the site will feature finished floor elevations of approximately 760 MS. Therefore, based on the existing grades, cuts of 1 foot or less and fills of up to 3 feet will be required across the building footprint of these proposed structures. The proposed company operations facilities and administrative building located in the northwestern portion of the site will feature finished floor elevations of approximately 774 MSL. Therefore, up to 14 feet of fill will be required within the footprint of these proposed structures.

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 800 vehicles per day can be expected within the new POV parking areas. We understand that the hardstands will feature

traffic varying from M88 recovery vehicles, dozers, tandem axle, rubber tired trucks, HMMWV's, tanks, and scrapers. For the purposes of providing pavement design recommendations, we have assumed the following traffic frequencies.

- 5 tanks per day
- 5 M88 vehicles per day
- 150 rubber tired, tandem axle trucks per day
- 250 HMMWV's per day
- 5 scrapers 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.

EXPLORATION AND TESTING

The subsurface exploration was conducted by advancing a total of 22 soil borings at the locations shown on the appended Plan. The borings were located in the field by measuring distances from known points, and surface elevations at the boring locations were estimated using available topographic data. Therefore, boring locations and elevations should be considered approximate.

Specifically, 11 soil borings were advanced within the limits of proposed structures to depths of 15 to 20 feet below the existing ground surface. Nine soil borings were advanced within the limits of proposed hardstands and parking and drive areas to depths of 5 to 7.5 feet below the existing ground surface, and two soil borings were advanced to depths of 4 feet within the limits of proposed low impact stormwater detention areas. 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.*" In addition, relatively undisturbed (Shelby) samples were obtained at borings B-2, B-5, B-12, and B-16.

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

Test 1		Test 2	
Depth (ft)	Resistivity (ohm-cm)	Depth (ft)	Resistivity (ohm-cm)
5	5,126	5	6,390
10	5,927	10	6,899

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: Resistivity Test Results

Boring S-1		Boring S-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	0.08	2-depth	0.20

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 remain stored at our Nashville office for 30 days and may then be discarded, unless we are directed otherwise.

SITE AND SUBSURFACE CONDITIONS

Existing Site Conditions

The area proposed for construction is located within the northern half of the Fort Knox Military Installation in Fort Knox, Kentucky approximately 1,000 feet north of the intersection of Old Ironsides Avenue and Brave Rifles Regiment Avenue. The area proposed for construction currently features existing structures, concrete pavement areas, hardstands and motor-pools, grassy lawn areas, and landscaping. The existing structures appeared to be single story with concrete slab-on-grade floors and either exterior CMU foundation walls or a metal skin veneer. Within the motor-pool areas, various vehicles were observed including HMMWV's, dozers, tanks, and tandem-axle trucks.

Topographically, the site demonstrates as much as 14 feet of relief as the ground surface generally slopes downward toward a low point in the central portion of the site and then south away from the site. Based on existing grades and ground cover, drainage is judged to be good across the area proposed for construction. We have included photograph of the proposed construction areas in the following sections.

Condition of Existing Site Infrastructure

As discussed, the existing site infrastructure includes structures and concrete pavements. Based on our research, we understand that the structures are 30 years or more of age. We were not able to obtain access to the interior of the structures, however; based, on our reconnaissance of the exterior, the structures appear to have performed satisfactorily. Isolated "hairline" width cracks (1/16 of an inch wide) were typically observed within mortar joints in a stair-step pattern along portions of the exterior of the structures. In isolated areas, chipping of the foundation walls of the structure was observed. Specifically, we observed the exterior of buildings 2954 through 2958 and 2786 through 2789.

The existing concrete pavement areas also generally appeared to be performing satisfactorily. However, in isolated areas, extreme spalling and chipping of the concrete was observed within individual panels and across several panels. In isolated locations within the Hurley Motor Pool, concrete chipping exposed the steel reinforcement within the paved areas, as can be observed in the photograph below.

Photo 1-View of pavement in Hurley Motor-Pool

Photo 2-View of damaged concrete pavement

Photo 3-View of typical concrete pavement

Photo 4-View of existing site conditions

Subsurface Condtions

At the locations explored, 15 of the 22 borings initially encountered a surficial interval of concrete pavement (measuring 6 to 10 inches in thickness). At six of these locations, the concrete was underlain by an interval of gravel measuring 3 to 12 inches in thickness. Of the remaining 7 borings, 5 initially encountered topsoil and vegetation extending to depths of 5 to 12 inches below the existing ground surface, while the remaining 2 borings encountered gravel at the ground surface measuring 5 to 12 inches in thickness.

Below the surficial intervals and extending to depths of 2 to 6 feet below the existing ground surface, 8 of the borings (B-1, B-2, B-3, B-8, B-9, B-10, B-11, and B-16) encountered existing fill consisting of very stiff to medium consistency, silty, yellowish brown to grayish brown clay with occasional gravel sized chert fragments varying to gravel sized rock fragments with some clay sized particles. Beneath the fill and extending to the depths explored, the borings generally encountered stiff to very stiff consistency, yellowish brown to reddish brown residual clay (CL or CH based on USCS) with occasional gravel sized chert fragments in the soil matrix. Isolated intervals of medium consistency soil were encountered at borings B-4 (18.5-20 feet), B-5 (13.5-15 feet), B-16 (13.5-15 feet), B-19 (1-2.5 feet), and B-20 (1-2.5 feet.)

Borings B-1 through B-4 were terminated at a deths of 5 feet below the existing ground surface, while borings B-5 and B-6 were terminated at a depth of 25 feet below the existing ground surface, and boring B-7 was terminated at a depth of 50 feet below the existing ground surface.

Laboratory Testing

Natural moisture content testing indicated moisture contents varying from approximately 15% to 33% and generally increasing with depth. Unconfined compressive strength testing conducted on Shelby tube samples obtained at borings B-3, B-5, and B-16 resulted in unconfined compressive strengths of 5.6 ksf, 3.8 ksf, and 8.0 ksf, respectively. Dry unit weights corresponding to these tests were 100.1 pcf, 101.9 pcf, and 111.8 pcf, respectively. A bulk sample was obtained from auger cuttings and split spoon samples obtained from borings B-14, B-3, and B-2 and was subjected to standard Proctor testing (ASTM D 698) which indicated a maximum dry density (MDD) of 109.7 pcf and optimum moisture content of 16.5%. 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 B-3 (6-7.5 feet), B-4 (1-2.5 feet), and B-17(1-2.5 feet) with values of 6.7, 6.3, and 4.9 obtained, respectively. In addition to the above described Wenner 4-pin resistivity testing, soil resistivity was tested at borings B-4 and B-17 at a depth of 1-2.5 feet below the existing ground surface with resistivity values of 6,423 ohm-cm and 6,078 ohm-cm obtained, respectively. Grain size distribution testing conducted on samples from borings B-8, B-17, S-1, and S-2 indicated that 66 to 85 percent of the soil particles were finer (smaller) than a United States Sieve Number 200. A one dimensional consolidation test was performed on a Shelby tube sample obtained from boring B-12 (4-6 feet), from a portion of the site where 8 to 12 feet of fill is proposed. 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 24 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. In addition, based on our research, spings have occurred within the eastern half of the Fort Knox military installation in the past but not in the vicinity of the project site.

COMMENTS AND RECOMMENDATIONS

Sinkhole Risks

No evidence of sinkholes or karst activity was observed in the vicinity of the project site during our exploration. However, 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 we understand that several karst features are present within the limits of Fort Knox. Further, 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 5 inches to 12 inches in order to remove the topsoil, vegetation, and surficial gravel pavement from the areas proposed for construction, while stripping depths are expected to increase to 9 to 22 inches to remove the existing concrete and underlying gravel. Thicker stripping intervals may be encountered at isolated locations between our borings. In any case, the underlying soil subgrade should be exposed across the contruction 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 8 of the borings (B-1, B-2, B-3, B-8, B-9, B-10, B-11, and B-16) extending to depths of 2 to 6 feet below the existing ground surface. Additional intervals of fill are likely to be present between our borings in the southeastern quarter of the site, particularly within the limits of the proposed headquarters building. 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 excessively 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 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, we do not expect large quantities of subgrade repair to be necessary. However, a surficial interval of medium consistency material was encountered at borings B-9, B-14, B-19, and B-20 at depths of 1-2.5 feet. Medium consistency soils ('N'-values of 4 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 poor to fair drainage, This condition tends to lead to surficial soils becoming wet, soft, and unstable during periods of wet weather. Therefore, 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 698 (standard 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.

Depending on the time of year that construction takes place, the contractor may consider using shot rock fill in lieu of soil fill. Shot rock fill should consist of a well-graded mixture of particles ranging in size from a maximum of 18 inches in diameter downward to 1 inch, and the material should contain less than 10% soil-sized particles. The shot rock fill must be placed in lifts not exceeding 18 inches in thickness. Each lift must be placed with heavy equipment, such as a large vibratory compactor or a large bulldozer (Caterpillar D-8 or larger), making a minimum of 5 passes in each of two orthogonal directions. Densification of shot rock must be monitored by experienced technical personnel.

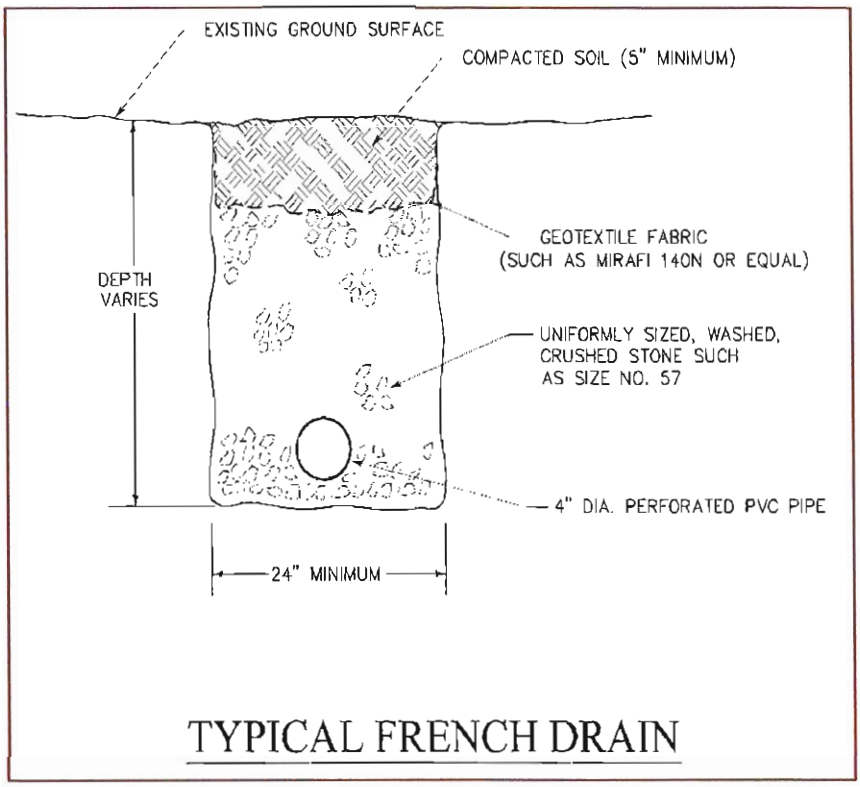
If shot rock fill is used, we recommend that it be placed to the foundation bearing elevation and the pad be "capped" with dense graded aggregate (DGA) fill to the subgrade elevation. This will provide a more uniform and consistent subgrade for slab-on-grade preparation and will allow for more efficient and less labor intensive excavations to be conducted within the upper portions of the building pad. Dense graded aggregate (DGA) should consist of a crushed mineral aggregate placed in lifts not exceeding 6 inches and should be compacted to at least 95% of its maximum modified Proctor dry density.

We expect that a critical part of this project will be the filling operations to achieve the finished grades within the proposed company operation facility buildings in the northwest quarter of the site. As stated, fills of up to 14 feet will be required within these areas. When deciding whether to use soil or shot rock fill, several factors should be considered. Typically, soil fill is 2 to 2.5 times less costly than shot rock fill. However, soil fill placement is significantly affected by prevailing weather conditions, with soil fill being difficult to adequately compact during the wetter, colder times of the year, while shot rock can be successfully placed and compacted year-round. Shot rock fill can also be compacted using only a single piece of heavy equipment, while soil fill placement and compaction requires at least two. Shot rock fill, due to its constituents, is also less susceptible to settlement due its own weight or from equal foundation loading. However, excavations for utilities or foundations within soil are invariably "cleaner" than in shot rock, with shot rock excavations tending to become wider and larger than necessary in order to fully remove larger rock pieces, resulting in the need for additional concrete or smaller diameter granular fill to backfill in enlarged areas.

Based on the discussion above, advantages and disadvantages exist for utilizing either clean soil fill or shot rock fill on site. Accordingly, we have provided usage recommendations for each material depending on the decision of the owner.

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).



TYPICAL FRENCH DRAIN

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.

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:

POV Flexible Pavement
(Automobile and light truck traffic)

Material	Thickness
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	11 ½ inches

*All materials and procedures used in pavement construction should conform to the Standard Specification for Road and Bridge Construction 2004 Edition sections 400 and 806.

**The mineral aggregate base should conform to specifications stated in the 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 development. 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 trucks or tracked equipment (such as PLS trucks and M88 recovery vehicles) should utilize a Portland cement concrete (PCC) pavement. The concrete pavement design is based on U.S. Army manual TM 5-822-13 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 4: PCC Pavement Design Thicknesses

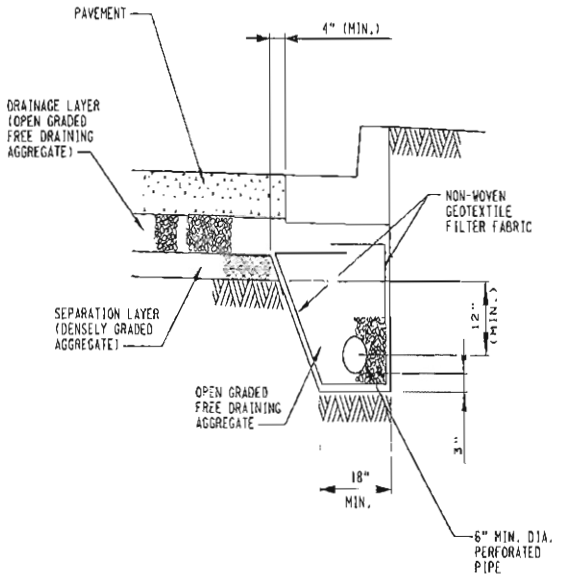
Pavement Area	Concrete Thickness
POV light duty areas	6 inches
POV heavy duty areas	6 inches
Hardstands and engineering equipment areas	10 inches

Rigid pavements should be underlain by a minimum of 8 inches of free draining aggregate base (such as ASTMD 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 and should be reinforced using deformed bars or welded wire

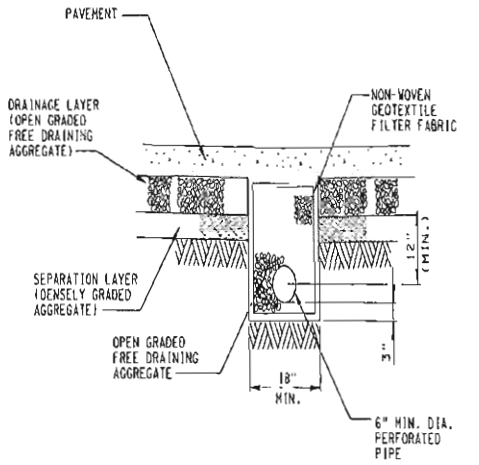
fabric. We recommend steel reinforcement of 0.10% based on U.S. Army manual TM 5-822-13 Figure 7-1. Pavements which do not have a tied concrete shoulder should be thickened by 25 percent to account for the edge loading conditions. Construction joints should be doweled to provide load transfer across 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). The under-drains should be extended to day-light.

Figure 1-Under-drain configuration (courtesy of USACOE)



TYPICAL SHOULDER UNDERDRAIN DETAIL



TYPICAL INTERIOR UNDERDRAIN DETAIL

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. We do not recommend installation of landscape beds or islands in the pavement areas. Such features provide an avenue for water to enter into the pavement section and underlying soil subgrade. Water penetration usually results in degradation of the pavement section with time as vehicular traffic traverses the affected area. Above grade planter boxes, with drainage discharge onto the top of the pavement or directed into sewers, should be considered if landscape features are desired.

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 inches
Dowels:	⅝ inch diameter
Dowel Spacing:	12 inches on center
Dowel Length:	12 inches long
Dowel Embedment:	6 inches
Pavement Thickness:	10 inches
Dowels:	1¼ inch diameter
Dowel Spacing:	12 inches on center
Dowel Length:	24 inches long
Dowel Embedment:	10 inches

Consideration for concrete pavement with tracked vehicles

As discussed, severe spalling and surficial abrasion of existing concrete pavements was observed within portions of the Hurley Motorpool where tracked vehicles were present. If the steel tracks associated with vehicles such as an M88 or M1 traverse rigid concrete pavements without rubber covers, significant abrasion and damage to the concrete surface can occur regardless of the concrete design thickness. We expect that the distress observed is likely due to this scenario. In consideration

of this effect, we offer the following comments and recommendations in an attempt to preserve areas where heavy tracked, equipment traffic in particular is expected.

Generally, a higher compressive strength concrete design (28-day compressive strength of 5,000 to 6,000 psi) should be considered for added durability. In addition, using 1 to 1-1/2 inch size aggregate and a water-cement ratio of 0.50 or less will reduce the potential for shrinkage. Finally, construction and contraction joints may be "armored" by using steel angle with welded studs on both sides of the joints. This practice will reduce the potential for tracks to erode and spall the joints.

Reinforced Turf for Fire and Emergency Lanes

We understand that a reinforced turf or natural paved area is requested for the proposed fire lanes, and that the civil engineer desires to use concrete pavers with perforations that will allow vegetation growth as a surface coarse. Based on the loading expected with fire trucks and emergency equipment, we recommend that the subgrade support for the concrete pavers consist of a minimum of 8 inches of free draining aggregate underlain by a minimum of 12 inches of dense graded aggregate placed and compacted as described above.

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. In addition, we recommend that the base stone be "daylighted" at the edge of 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 L. Wall, P.E.
Geotechnical Engineer

Daniel D. Tetramova, P.E.
Vice President

Cc: Mr. Nick Yeretzian, 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.

ASFE
THE BEST PEOPLE ON EARTH

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Geotechnical Exploration
19th Engineering Battalion Complex
Fort Knox, Kentucky
TTL Project No. 100811079

APPENDIX 1

PLAN, PROFILES, AND LOGS

LEGEND

B-6 — BORING LOCATION

S-1 — BORING LOCATION

SOURCE: DRAWING PROVIDED BY BARGE, WAGGONER, SUMNER AND CANNON, INC.

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ALABAMA ● GEORGIA ● TENNESSEE

BARGE WAGGONER SUMNER AND CANNON, INC.

19th ENGINEERING BATTALION COMPLEX

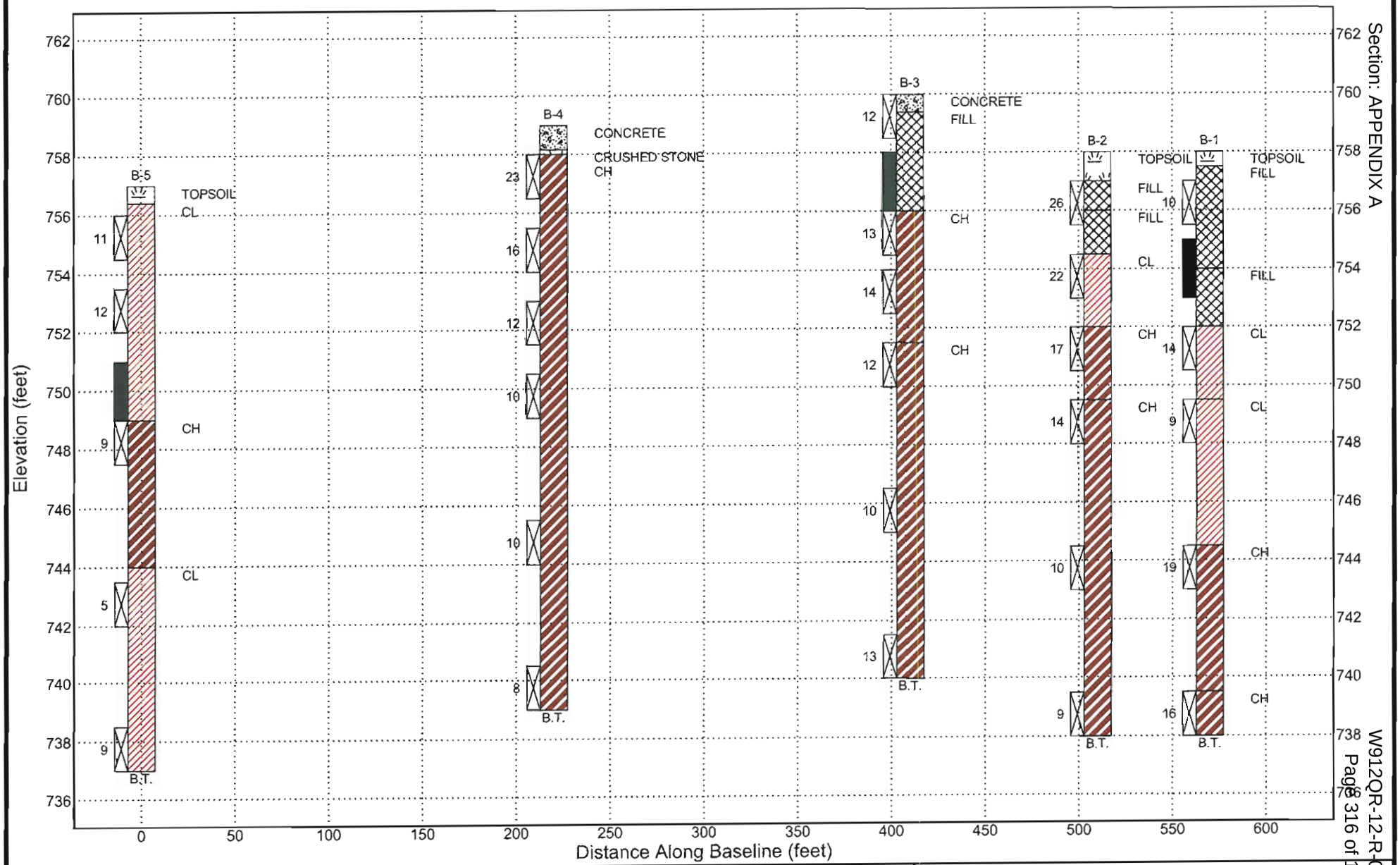
FORT KNOX MILITARY BASE

FORT KNOX, KENTUCKY

Date: JULY 2011

Project Number: 100811079

BORING LOCATION PLAN



SUBSURFACE CROSS-SECTION B-1 TO B-5

Client: Barge Waggoner Sumner & Cannon, Inc.
Project: 19th Engineering Batallion Complex
Location: Fort Knox, Kentucky
Project Number:100811079

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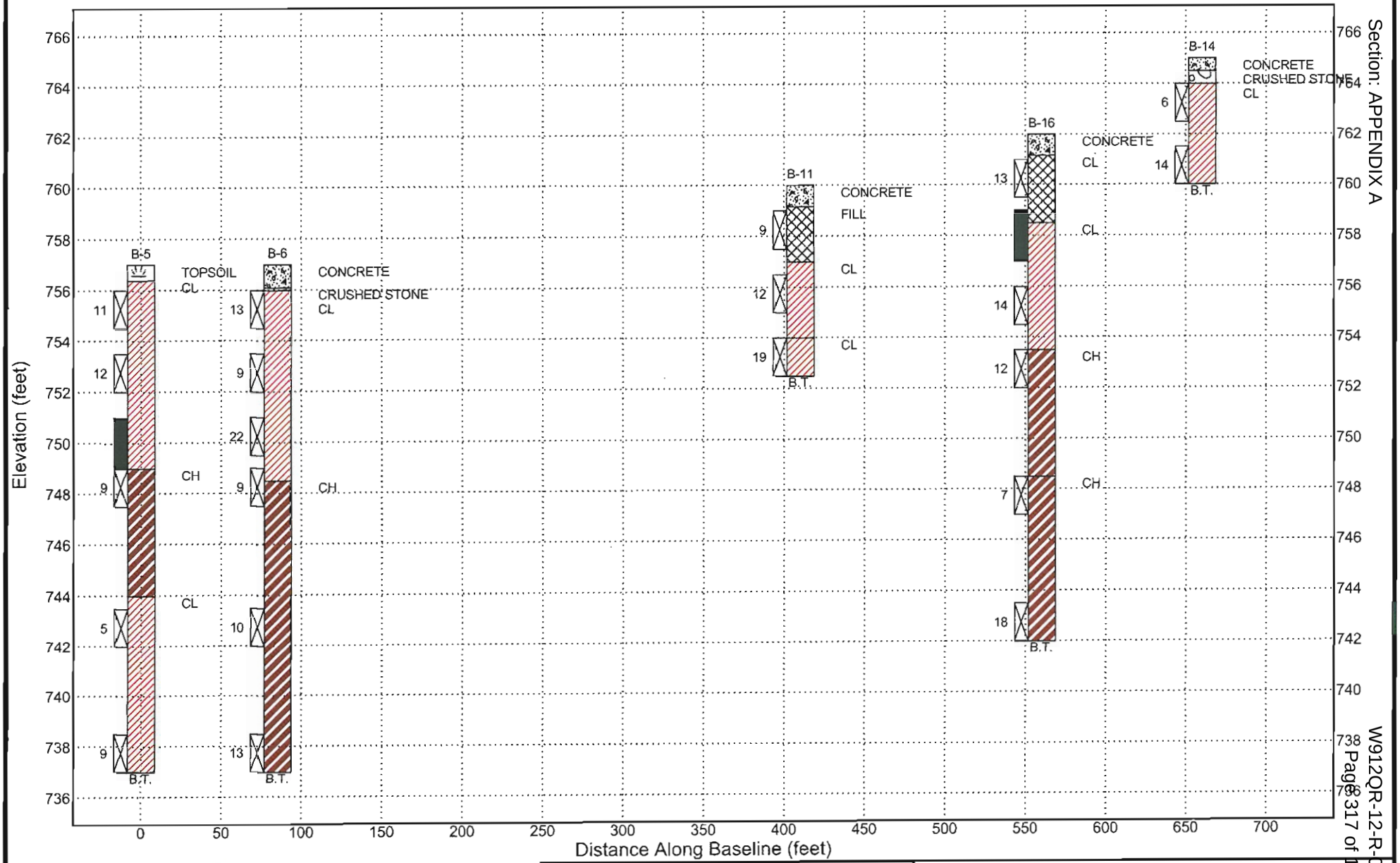
LEGEND: See Legend Key Sheet for explanation of symbols

N (bpf) / Recovery% Core Size RQD% / Material Symbol / % Moisture Classification

Water level at time of boring
Delayed water level
Cave-in depth
Perched water level.

B.T. = Boring Terminated A.R. = Auger Refusal



SUBSURFACE CROSS-SECTION B-5 TO B-14

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Project: 19th Engineering Batallion Complex
Location: Fort Knox, Kentucky
Project Number:100811079

LEGEND: See Legend Key Sheet for explanation of symbols

N (bpf)
% Moisture
Classification
Material Symbol
Recovery%
Core Size
RQD%
B.T. = Boring Terminated A.R. = Auger Refusal

Water level at time of boring
Delayed water level
Cave-in depth
Perched water level.

Section: APPENDIX A
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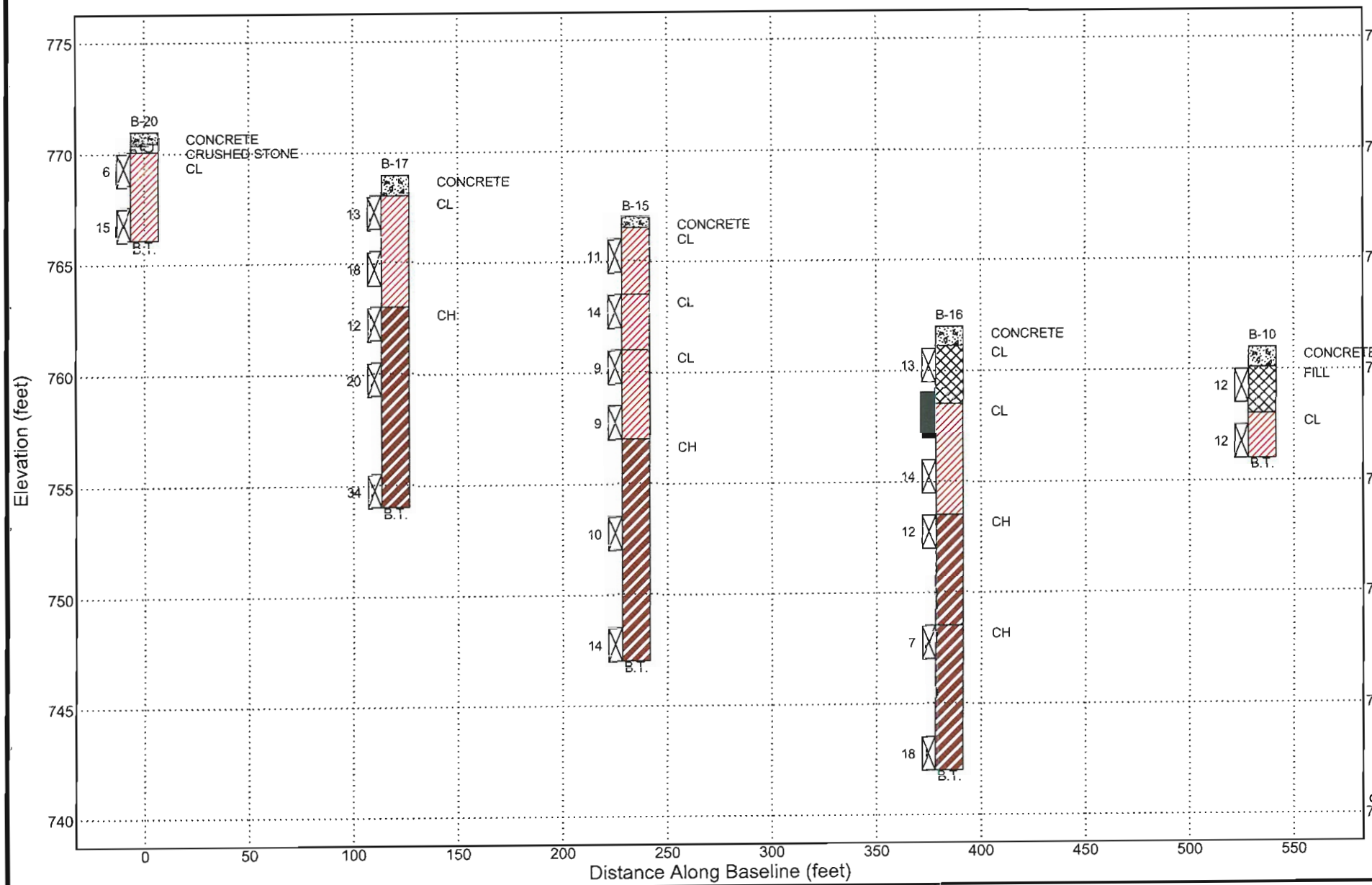

SUBSURFACE CROSS-SECTION B-10 TO B-20

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Client: Barge Waggoner Sumner & Cannon, Inc.
Project: 19th Engineering Batallion Complex
Location: Fort Knox, Kentucky
Project Number:100811079

LEGEND: See Legend Key Sheet for explanation of symbols

N (bpf) | % Moisture Classrfication | Material Symbol | Recovery% Core Size RQD%

B.T. = Boring Terminated A.R. = Auger Refusal

Water level at time of boring
Delayed water level
Cave-in depth
Perched water level.

DESCRIPTIVE TERMINOLOGY INCLUDED ON BORING LOGS

MOISTURE CONDITIONS

	Fine-Grained Soils	Coarse-Grained Soils
Dry	Seems dry, but contains some moisture	Contains no noticeable moisture
Moist	Moisture below the plastic limit	Contains a noticeable amount of moisture, but no appreciable free water
Very Moist	Moisture above the plastic limit, but below the liquid limit	
Wet	Moisture may approach the liquid limit	Contains free water, but voids are not water-filled
Saturated	Moisture is frequently at or above the liquid limit	Soil voids are water-filled or nearly so

STANDARD PENETRATION RESISTANCE (N)[1]

Sands (Cohesionless Soils)		Silts and Clays (Cohesive Soils)	
# of Blows, N	Relative Density	# of Blows, N	Relative Consistency
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

Term	Range
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)

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

Rock

- CHALK
- COAL
- DOLOMITE
- GNEISS
- GRANITE
- LIMESTONE
- QUARTZITE
- SANDSTONE
- SAPROLITE
- SCHIST
- SHALE
- SILTSTONE

Other Materials

- BITUMINOUS CONCRETE
- BOULDERS & COBBLES
- CONCRETE
- CRUSHED STONE
- DEBRIS
- FILL
- TOPSOIL

Samplers

- AUGER CUTTINGS
- BULK SAMPLE
- CONTINUOUS SAMPLER
- DYNAMIC CONE PENETROMETER
- PITCHER SAMPLER or PRESSUREMETER
- ROCK CORE
- SHELBY TUBE
- SPLIT SPOON
- NO RECOVERY

Water Level Symbols

- WATER LEVEL AT TIME OF DRILLING
- DELAYED WATER LEVEL
- CAVE-IN DEPTH

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Fort Knox, Kentucky

LOG OF BORING B-1

Page 1 of 1

Drilling Co.:	*Tri-State Drilling*	TTL Project No.:	*100811079*
Driller:	*Fred Reynolds*	Date Drilled:	*6/20/2011*
Logged by:	*M. Wall*	Boring Depth:	*20 feet*
Equipment:	*CME 55*	Boring Elevation:	*758 feet*
Hammer Type:	*Automatic*	Coordinates:	*Not Available*
Drilling Method:	*Hollow Stem Auger w/SPT Sampling*		

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)	SAMPLE DATA TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6") RQD / % REC	STANDARD PENETRATION TEST DATA (blows per foot)
				Topsoil and vegetation (6 inches)					
				FILL: clay, (CL), stiff, silty, brown, trace of weathered chert				5 - 5 - 5 N = 10	
	755								
5				FILL: gravel sized rock fragments					
			CL	RESIDUUM: clay, (CL), stiff, silty, yellowish brown to grayish brown, mottled red				11 - 7 - 7 N = 14	
	750								
			CL	Clay (CL), stiff, silty, reddish brown, with some chert				3 - 3 - 6 N = 9	
10									
	745								
			CH	Clay (CL), very stiff, slightly silty, reddish-brown, trace of sand				5 - 8 - 11 N = 19	
15									
	740								
			CH	Clay (CL), very stiff, slightly silty, reddish-brown, traces of weathered chert				8 - 8 - 8 N = 16	
20				Boring terminated at 20 feet.					
	735								

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LOG OF BORING B-2
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Drilling Co.:	*Tri-State Drilling*	TTL Project No.:	*100811079*
Driller:	*Fred Reynolds*	Date Drilled:	*6/20/2011*
Logged by:	*M. Wall*	Boring Depth:	*20 feet*
Equipment:	*CME 55*	Boring Elevation:	*758 feet*
Hammer Type:	*Automatic*	Coordinates:	*Not Available*
Drilling Method:	*Hollow Stem Auger w/SPT Sampling*		

Remarks:
Borehole dry upon completion of drilling activities and 24 hours after completion of drilling activities.

DEPTH (ft)	ELEVATION (ft)	USCS CLASSIFICATION	MATERIALS DESCRIPTION	MOISTURE (%)	PPV (tsf)	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6") RQD / % REC	STANDARD PENETRATION TEST DATA (blows per foot)
			Topsoil and vegetation (12 inches)					
			FILL: gravel sized rock fragments					
	755		FILL: clay (CL), very stiff, silty, brown				9 - 13 - 13 N = 26	
5		CL	RESIDUUM: clay, (CL), very stiff, silty, yellowish brown				3 - 10 - 12 N = 22	
	750	CH	Clay (CH), very stiff, slightly silty, reddish brown to yellowish brown, trace chert				3 - 8 - 9 N = 17	
10		CH	Clay (CH), stiff, slightly silty, reddish brown, with trace chert				2 - 6 - 8 N = 14	
	745						2 - 4 - 6 N = 10	
15								
	740						2 - 4 - 5 N = 9	
20			Boring terminated at 20 feet.					
	735							

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LOG OF BORING B-3
Page 1 of 1

Drilling Co.:	*Tri-State Drilling*	**TTL** Project No.:	*100811079*
Driller:	*Fred Reynolds*	Date Drilled:	*6/20/2011*
Logged by:	*M. Wall*	Boring Depth:	*20 feet*
Equipment:	*CME 55*	Boring Elevation:	*760 feet*
Hammer Type:	*Automatic*	Coordinates:	*Not Available*
Drilling Method:	*Hollow Stem Auger w/SPT Sampling*		

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 (1st 6" / 2nd 6" / 3rd 6") RQD / % REC	STANDARD PENETRATION TEST DATA (blows per foot)
	760			Concrete pavement with rebar (7 inches)					
				FILL: clay, (CL), stiff, silty, brown				3 - 6 - 6 N = 12	
5	755		CH	RESIDUUM: clay (CH), stiff, slightly silty, reddish brown to yellowish brown, trace of chert				6 - 6 - 7 N = 13	
								4 - 6 - 8 N = 14	
			CH	Clay (CH), stiff, slightly silty, reddish brown, moist, with some chert				2 - 6 - 6 N = 12	
10	750								
								2 - 4 - 6 N = 10	
15	745								
								2 - 6 - 7 N = 13	
20	740			Boring terminated at 20 feet.					

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Fort Knox, Kentucky

LOG OF BORING B-4

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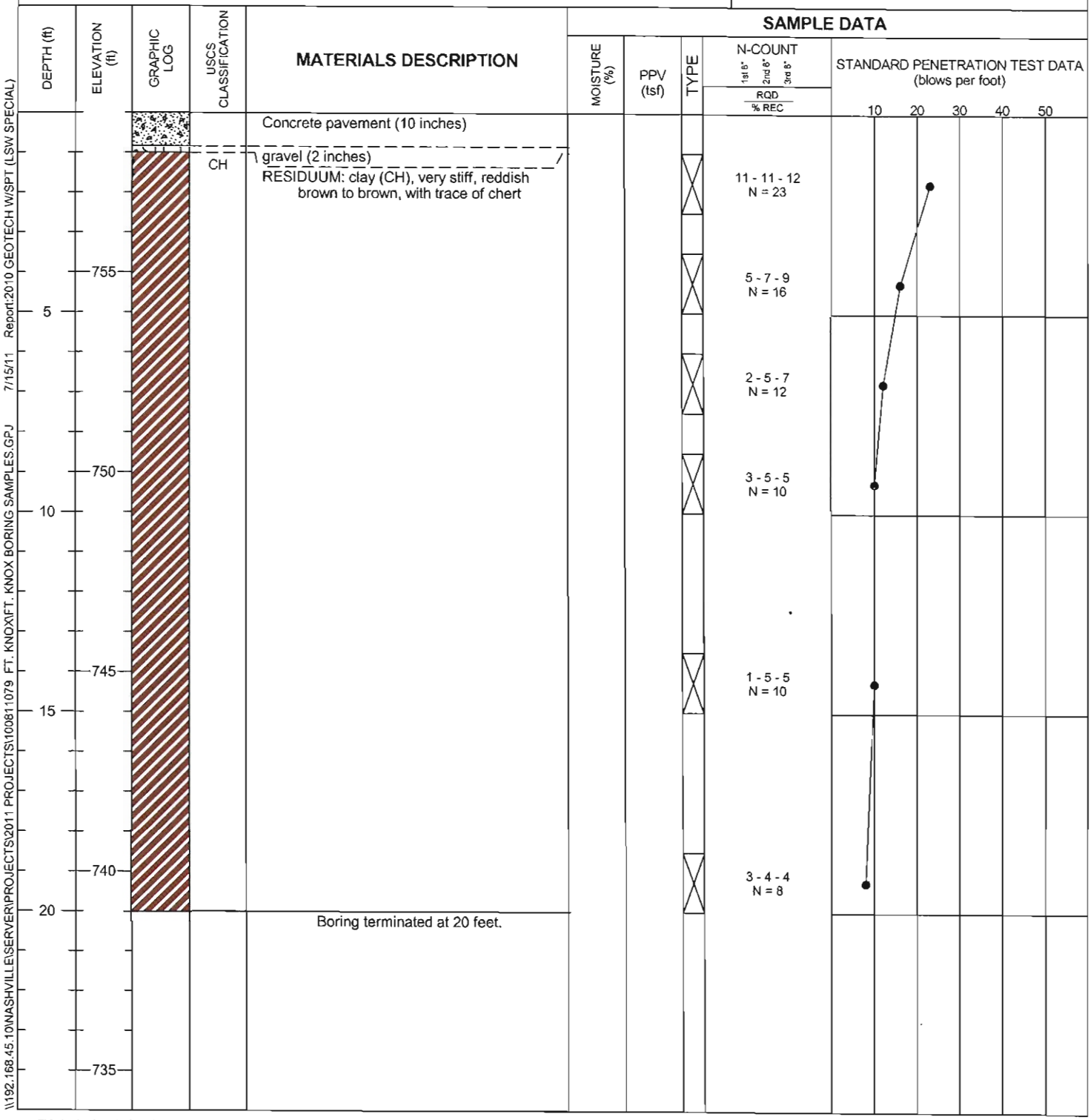
Drilling Co.:	*Tri-State Drilling*	**TTL** Project No.:	*100811079*
Driller:	*Fred Reynolds*	Date Drilled:	*6/20/2011*
Logged by:	*M. Wall*	Boring Depth:	*20 feet*
Equipment:	*CME 55*	Boring Elevation:	*759 feet*
Hammer Type:	*Automatic*	Coordinates:	*Not Available*
Drilling Method:	*Hollow Stem Auger w/SPT Sampling*		

Remarks:
Borehole dry upon completion of drilling activities and 24 hours after completion of drilling activities.



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LOG OF BORING B-5

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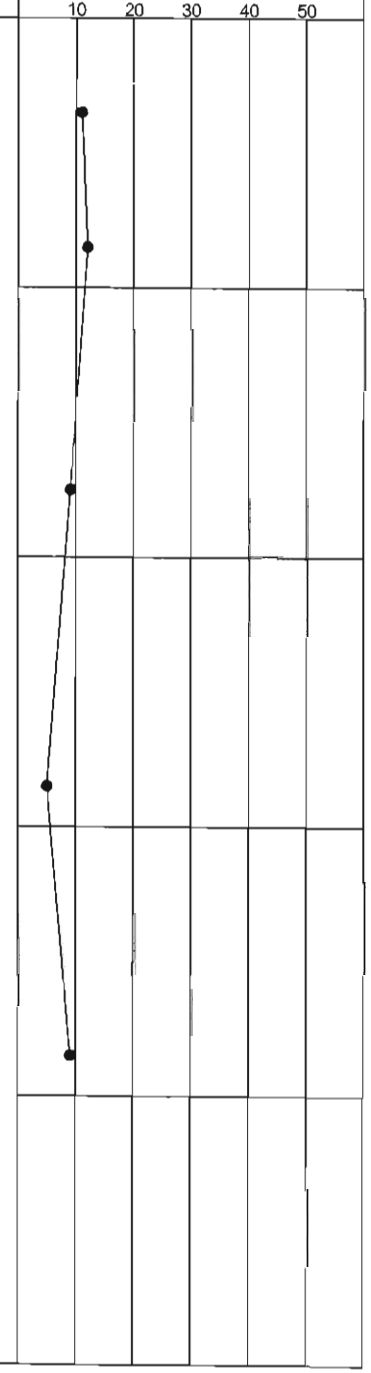
Drilling Co.:	*Tri-State Drilling*	TTL Project No.:	*100811079*
Driller:	*Fred Reynolds*	Date Drilled:	*6/20/2011*
Logged by:	*M. Wall*	Boring Depth:	*20 feet*
Equipment:	*CME 55*	Boring Elevation:	*757 feet*
Hammer Type:	*Automatic*	Coordinates:	*Not Available*
Drilling Method:	*Hollow Stem Auger w/SPT Sampling*		

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	N-COUNT (1st 6" 2nd 6" 3rd 6") / RQD % REC
				Topsoil (7 inches)				
			CL	RESIDUUM: clay, (CL), stiff, silty, light brown				
	755							5 - 5 - 6 N = 11
								4 - 4 - 8 N = 12
5								
	750							
			CH	Clay, (CH), stiff, slightly silty, reddish brown, mottled yellow, with trace of weathered chert				4 - 4 - 5 N = 9
10								
	745							
			CL	Clay, (CL), medium to stiff, silty, reddish brown, mottled gray, moist, with trace weathered chert				2 - 2 - 3 N = 5
15								
	740							
								4 - 4 - 5 N = 9
20				Boring terminated at 20 feet.				
	735							

STANDARD PENETRATION TEST DATA (blows per foot)



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LOG OF BORING B-6

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Drilling Co.:	*Tri-State Drilling*	**TTL** Project No.:	*100811079*
Driller:	*Fred Reynolds*	Date Drilled:	*6/20/2011*
Logged by:	*M. Wall*	Boring Depth:	*20 feet*
Equipment:	*CME 55*	Boring Elevation:	*757 feet*
Hammer Type:	*Automatic*	Coordinates:	*Not Available*
Drilling Method:	*Hollow Stem Auger w/SPT Sampling*		

Remarks:
Borehole dry upon completion of drilling activities and 24 hours after completion of drilling activities.

DEPTH (ft)	ELEVATION (ft)	USCS CLASSIFICATION	MATERIALS DESCRIPTION	MOISTURE (%)	PPV (tsf)	TYPE	SAMPLE DATA: N-COUNT (1st 6" / 2nd 6" / 3rd 6") RQD / % REC	SAMPLE DATA: STANDARD PENETRATION TEST DATA (blows per foot)
0	757		Concrete slab (10 inches)					
		CL	gravel (2 inches)					
			RESIDUUM: clay, (CL), stiff to very stiff, silty, yellowish brown to brown, mottled gray				6 - 7 - 6 N = 13	
5	750						2 - 3 - 6 N = 9	
							4 - 11 - 11 N = 22	
		CH	Clay (CH), stiff, yellowish-brown, mottled red, trace of chert				4 - 4 - 5 N = 9	
10	745							
							4 - 4 - 6 N = 10	
15	740							
							6 - 6 - 7 N = 13	
20	735		Boring terminated at 20 feet.					

STANDARD PENETRATION TEST DATA (blows per foot): 10 20 30 40 50

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LOG OF BORING B-7

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Drilling Co.:	*Tri-State Drilling*	**TTL** Project No.:	*100811079*
Driller:	*Fred Reynolds*	Date Drilled:	*6/20/2011*
Logged by:	*M. Wall*	Boring Depth:	*7.5 feet*
Equipment:	*CME 55*	Boring Elevation:	*759 feet*
Hammer Type:	*Automatic*	Coordinates:	*Not Available*
Drilling Method:	*Hollow Stem Auger w/SPT Sampling*		

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)	SAMPLE DATA: TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6") RQD / % REC	STANDARD PENETRATION TEST DATA (blows per foot)
0			GP	Gravel (5 inches)					
			CL	RESIDUUM: clay (CL), stiff, silty, reddish-brown				3 - 5 - 7 N = 12	
			CL	Clay (CL), stiff, silty, brown, mottled gray				3 - 4 - 6 N = 10	
5	755		CL	Clay (CL), very stiff, reddish- brown, with trace of chert				6 - 9 - 10 N = 19	
				Boring terminated at 7.5 feet.					
10	750								
15	745								
20	740								
	735								

STANDARD PENETRATION TEST DATA (blows per foot): 10 20 30 40 50

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Drilling Co.:	*Tri-State Drilling*	**TTL** Project No.:	*100811079*
Driller:	*Fred Reynolds*	Date Drilled:	*6/20/2011*
Logged by:	*M. Wall*	Boring Depth:	*5 feet*
Equipment:	*CME 55*	Boring Elevation:	*762 feet*
Hammer Type:	*Automatic*	Coordinates:	*Not Available*
Drilling Method:	*Hollow Stem Auger w/SPT Sampling*		

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	SAMPLE DATA: MOISTURE (%)	PPV (tsf)	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6") RQD / % REC	STANDARD PENETRATION TEST DATA (blows per foot)
				Gravel (12 inches)					
	760			FILL: gravel with some silty, brown clay				11 - 9 - 5 N = 14	
			CL	RESIDUUM: clay, (CL), stiff, silty, brown to yellowish brown					
5								5 - 5 - 7 N = 12	
	755			Boring terminated at 5 feet.					
10	750								
15	745								
20	740								

10 20 30 40 50

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LOG OF BORING B-9
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Drilling Co.:	*Tri-State Drilling*	**TTL** Project No.:	*100811079*
Driller:	*Fred Reynolds*	Date Drilled:	*6/20/2011*
Logged by:	*M. Wall*	Boring Depth:	*7.5 feet*
Equipment:	*CME 55*	Boring Elevation:	*760 feet*
Hammer Type:	*Automatic*	Coordinates:	*Not Available*
Drilling Method:	*Hollow Stem Auger w/SPT Sampling*		

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)	SAMPLE DATA: TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6") RQD % REC	STANDARD PENETRATION TEST DATA (blows per foot)
0	760			Concrete pavement with rebar (8 inches)					
				gravel (4 inches)					
				FILL: clay (CL), medium, silty, gray, moist, with some gravel				8 - 4 - 4 N = 8	
5	755							1 - 2 - 4 N = 6	
			CL	RESIDUUM: clay (CL), stiff, grayish brown to yellow brown, moist				2 - 7 - 9 N = 16	
				Boring terminated at 7.5 feet.					
10	750								
15	745								
20	740								

STANDARD PENETRATION TEST DATA (blows per foot): 10 20 30 40 50

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BORING B-10
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Drilling Co.:	*Tri-State Drilling*	**TTL** Project No.:	*100811079*
Driller:	*Fred Reynolds*	Date Drilled:	*6/23/2011*
Logged by:	*M. Wall*	Boring Depth:	*5 feet*
Equipment:	*CME 55*	Boring Elevation:	*761 feet*
Hammer Type:	*Automatic*	Coordinates:	*Not Available*
Drilling Method:	*Hollow Stem Auger w/SPT Sampling*		

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	SAMPLE DATA: MOISTURE (%)	PPV (tsf)	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6") RQD / % REC	STANDARD PENETRATION TEST DATA (blows per foot)
	760			Concrete with rebar (10 inches)					
				FILL: clay (CL), stiff, silty, brown and gray, moist				3 - 5 - 7 N = 12	
			CL	RESIDUUM: clay (CL), stiff, silty, reddish-brown,				4 - 5 - 7 N = 12	
5	755			Boring terminated at 5 feet.					
10	750								
15	745								
20	740								

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BORING B-11
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Drilling Co.:	*Tri-State Drilling*	**TTL** Project No.:	*100811079*
Driller:	*Fred Reynolds*	Date Drilled:	*6/23/2011*
Logged by:	*M. Wall*	Boring Depth:	*7.5 feet*
Equipment:	*CME 55*	Boring Elevation:	*760 feet*
Hammer Type:	*Automatic*	Coordinates:	*Not Available*
Drilling Method:	*Hollow Stem Auger w/SPT Sampling*		

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)	SAMPLE DATA: TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6") RQD / % REC	STANDARD PENETRATION TEST DATA (blows per foot)
	760			Concrete pavement with rebar (10 inches)					
				FILL: clay (CL), stiff, silty, brown, trace of organics				8 - 5 - 4 N = 9	
			CL	RESIDUUM: clay, (CL), stiff, silty, light brown to grayish brown				4 - 6 - 6 N = 12	
5	755		CL	Clay (CL), very stiff, slightly silty, reddish brown				6 - 8 - 11 N = 19	
				Boring terminated at 7.5 feet.					
10	750								
15	745								
20	740								

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LOG OF BORING B-12

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Drilling Co.:	*Tri-State Drilling*	TTL Project No.:	*100811079*
Driller:	*Fred Reynolds*	Date Drilled:	*6/23/2011*
Logged by:	*M. Wall*	Boring Depth:	*20 feet*
Equipment:	*CME 55*	Boring Elevation:	*764 feet*
Hammer Type:	*Automatic*	Coordinates:	*Not Available*
Drilling Method:	*Hollow Stem Auger w/SPT Sampling*		

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	N-COUNT (1st 6" / 2nd 6" / 3rd 6") RQD / % REC	STANDARD PENETRATION TEST DATA (blows per foot)
0				Concrete pavement with rebar (10 inches)					
			CL	RESIDUUM: clay (CL), stiff, silty, brown to grayish brown				2 - 4 - 6 N = 10	
5	760								
			CL	Clay (CL), stiff, silty, sandy, reddish brown, mottled gray				3 - 4 - 6 N = 10	
								3 - 4 - 7 N = 11	
10	755								
								10 - 13 - 7 N = 20	
15	750								
			SC	Clayey Sand (SC), firm, fine to medium, reddish brown, moist				9 - 9 - 14 N = 23	
20	745			Boring terminated at 20 feet.					
	740								

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LOG OF BORING B-13
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Drilling Co.:	*Tri-State Drilling*	TTL Project No.:	*100811079*
Driller:	*Fred Reynolds*	Date Drilled:	*6/21/2011*
Logged by:	*M. Wall*	Boring Depth:	*7.5 feet*
Equipment:	*CME 55*	Boring Elevation:	*775 feet*
Hammer Type:	*Automatic*	Coordinates:	*Not Available*
Drilling Method:	*Hollow Stem Auger w/SPT Sampling*		

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	SAMPLE DATA: MOISTURE (%)	PPV (tsf)	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6") RQD / % REC	STANDARD PENETRATION TEST DATA (blows per foot)
0	775			Concrete slab (9 inches)					
				gravel (3 inches)					
			CL	RESIDUUM: clay (CL), stiff, silty, yellowish brown to brown				9 - 7 - 4 N = 11	
								7 - 7 - 9 N = 16	
5	770							4 - 7 - 11 N = 18	
				Boring terminated at 7.5 feet.					
10	765								
15	760								
20	755								

10 20 30 40 50

\\192.168.45.10\NASHVILLESERVER\PROJECTS\2011 PROJECTS\100811079 FT. KNOX\FT. KNOX BORING SAMPLES.GPJ 7/15/11 Report:2010 GEOTECH W/SPT (LSW SPECIAL)

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19TH ENGINEERING BATALLION COMPLEX
Fort Knox, Kentucky

LOG OF BORING B-14

Page 1 of 1

Drilling Co.:	*Tri-State Drilling*	**TTL** Project No.:	*100811079*
Driller:	*Fred Reynolds*	Date Drilled:	*6/21/2011*
Logged by:	*M. Way*	Boring Depth:	*5 feet*
Equipment:	*CME 55*	Boring Elevation:	*765 feet*
Hammer Type:	*Automatic*	Coordinates:	*Not Available*
Drilling Method:	*Hollow Stem Auger w/SPT Sampling*		

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 (1st 6" / 2nd 6" / 3rd 6") ROD / % REC	SAMPLE DATA: STANDARD PENETRATION TEST DATA (blows per foot)
	765			Concrete pavement (6 inches)					
				gravel (6 inches)					
			CL	RESIDUUM: clay (CL), medium to stiff, silty, brown to yellowish brown				1 - 2 - 4 N = 6	
								5 - 6 - 8 N = 14	
5	760			Boring terminated at 5 feet.					
10	755								
15	750								
20	745								

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Fort Knox, Kentucky

BORING B-15
Page 1 of 1

Drilling Co.:	*Tri-State Drilling*	TTL Project No.:	*100811079*
Driller:	*Fred Reynolds*	Date Drilled:	*6/23/2011*
Logged by:	*M. Wall*	Boring Depth:	*20 feet*
Equipment:	*CME 55*	Boring Elevation:	*767 feet*
Hammer Type:	*Automatic*	Coordinates:	*Not Available*
Drilling Method:	*Hollow Stem Auger w/SPT Sampling*		

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	N-COUNT (1st 6" / 2nd 6" / 3rd 6") RQD / % REC	STANDARD PENETRATION TEST DATA (blows per foot)
0				Concrete pavement with rebar (6 inches)					
				FILL: clay, (CL), stiff, silty, yellowish brown					
	765							3 - 5 - 6 N = 11	
			CL	Clay (CL), stiff, silty, slightly sandy, brown, (possible fill)				4 - 6 - 8 N = 14	
5									
			CL	RESIDUUM: clay, (CL), stiff, silty, yellowish brown, with trace of weathered chert				3 - 4 - 5 N = 9	
	760								
								2 - 4 - 5 N = 9	
10			CH	Clay (CH), stiff, slightly silty, reddish brown and gray					
	755								
								3 - 4 - 6 N = 10	
15									
	750								
								6 - 7 - 7 N = 14	
20				Boring terminated at 20 feet.					
	745								

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19TH ENGINEERING BATALLION COMPLEX
Fort Knox, Kentucky

Page 1 of 1

Drilling Co.:	*Tri-State Drilling*	**TTL** Project No.:	*100811079*
Driller:	*Fred Reynolds*	Date Drilled:	*6/23/2011*
Logged by:	*M. Wall*	Boring Depth:	*20 feet*
Equipment:	*CME 55*	Boring Elevation:	*762 feet*
Hammer Type:	*Automatic*	Coordinates:	*Not Available*
Drilling Method:	*Hollow Stem Auger w/SPT Sampling*		

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	SAMPLE DATA: MOISTURE (%)	PPV (tsf)	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6") RQD / % REC	STANDARD PENETRATION TEST DATA (blows per foot)
				Concrete pavement with rebar (10 inches)					
	760		CL	FILL: clay (CL), stiff, silty, slightly sandy, brown and gray				3 - 5 - 8 N = 13	
5	755		CL	RESIDUUM: clay, (CL), stiff, silty, yellowish brown				5 - 7 - 7 N = 14	
10	750		CH	Clay (CH), stiff, reddish brown and gray				3 - 5 - 7 N = 12	
15	745		CH	Clay (CH), stiff, reddish brown, with trace of weathered chert				3 - 3 - 4 N = 7	
20	740			Boring terminated at 20 feet.				6 - 8 - 10 N = 18	

10 20 30 40 50

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19TH ENGINEERING BATALLION COMPLEX
Fort Knox, Kentucky

LOG OF BORING B-17

Page 1 of 1

Drilling Co.:	*Tri-State Drilling*	**TTL** Project No.:	*100811079*
Driller:	*Fred Reynolds*	Date Drilled:	*6/21/2011*
Logged by:	*M. Wall*	Boring Depth:	*15 feet*
Equipment:	*CME 55*	Boring Elevation:	*769 feet*
Hammer Type:	*Automatic*	Coordinates:	*Not Available*
Drilling Method:	*Hollow Stem Auger w/SPT Sampling*		

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 (1st 6" / 2nd 6" / 3rd 6") RQD / % REC	SAMPLE DATA: STANDARD PENETRATION TEST DATA (blows per foot)
				Concrete pavement (12 inches)					
			CL	RESIDUUM: clay (CL), stiff, silty, light brown and gray				4 - 5 - 8 N = 13	
	765							5 - 8 - 10 N = 18	
5			CH	Clay (CH), stiff, slightly silty, reddish brown, with trace chert				5 - 5 - 7 N = 12	
	760							5 - 7 - 13 N = 20	
10									
	755							10 - 15 - 19 N = 34	
15				Boring terminated at 15 feet.					
	750								
20									
	745								

STANDARD PENETRATION TEST DATA (blows per foot): 10 20 30 40 50

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19TH ENGINEERING BATALLION COMPLEX
Fort Knox, Kentucky

BORING B-18
Page 1 of 1

Drilling Co.:	*Tri-State Drilling*	TTL Project No.:	*100811079*
Driller:	*Fred Reynolds*	Date Drilled:	*6/21/2011*
Logged by:	*M. Wall*	Boring Depth:	*15 feet*
Equipment:	*CME 55*	Boring Elevation:	*766 feet*
Hammer Type:	*Automatic*	Coordinates:	*Not Available*
Drilling Method:	*Hollow Stem Auger w/SPT Sampling*		

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 (1st 6" / 2nd 6" / 3rd 6") RQD / % REC	SAMPLE DATA: STANDARD PENETRATION TEST DATA (blows per foot)
0	765			Concrete pavement (8 inches)					
				Gravel (4 inches)					
			CL	RESIDUUM: clay (CL), stiff, silty, brown and gray				3 - 4 - 7 N = 11	
5								6 - 7 - 9 N = 16	
	760		CH	Clay (CH), stiff, slightly silty, reddish brown, trace of chert				4 - 4 - 6 N = 10	
10								4 - 6 - 8 N = 14	
	755								
15				Boring terminated at 15 feet.				9 - 10 - 11 N = 21	
	750								
20									
	745								

10 20 30 40 50

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19TH ENGINEERING BATALLION COMPLEX
Fort Knox, Kentucky

LOG OF BORING B-19

Page 1 of 1

Drilling Co.:	*Tri-State Drilling*	**TTL** Project No.:	*100811079*
Driller:	*Fred Reynolds*	Date Drilled:	*6/21/2011*
Logged by:	*M. Wall*	Boring Depth:	*7.5 feet*
Equipment:	*CME 55*	Boring Elevation:	*768 feet*
Hammer Type:	*Automatic*	Coordinates:	*Not Available*
Drilling Method:	*Hollow Stem Auger w/SPT Sampling*		

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 (1st 6" / 2nd 6" / 3rd 6") RQD / % REC	STANDARD PENETRATION TEST DATA (blows per foot)
				Concrete pavement (10 inches)					
	765		CL	RESIDUUM: clay, (CL), medium, silty, brown				2 - 3 - 4 N = 7	
5			CH	Clay (CH), hard, reddish brown, with some chert				6 - 26 - 21 N = 47	
								9 - 25 - 26 N = 51	
	760			Boring terminated at 7.5 feet.					
10									
	755								
15									
	750								
20									
	745								

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19TH ENGINEERING BATALLION COMPLEX
Fort Knox, Kentucky

BORING B-20

Page 1 of 1

Drilling Co.:	*Tri-State Drilling*	TTL Project No.:	*100811079*
Driller:	*Fred Reynolds*	Date Drilled:	*6/21/2011*
Logged by:	*M. Wall*	Boring Depth:	*5 feet*
Equipment:	*CME 55*	Boring Elevation:	*771 feet*
Hammer Type:	*Automatic*	Coordinates:	*Not Available*
Drilling Method:	*Hollow Stem Auger w/SPT Sampling*		

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	SAMPLE DATA: MOISTURE (%)	PPV (tsf)	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6") / RQD / % REC	STANDARD PENETRATION TEST DATA (blows per foot)
				Concrete pavement (7 inches)					
				Gravel (5 inches)					
	770		CL	RESIDUUM: clay (CL), medium to stiff, silty, brown and gray				2 - 2 - 4 N = 6	
								4 - 6 - 9 N = 15	
5	765			Boring terminated at 5 feet.					
10	760								
15	755								
20	750								

STANDARD PENETRATION TEST DATA (blows per foot): 10 20 30 40 50

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19TH ENGINEERING BATALLION COMPLEX
Fort Knox, Kentucky

LOG OF BORING S-1
Page 1 of 1

Drilling Co.:	*Tri-State Drilling*	TTL Project No.:	*100811079*
Driller:	*Fred Reynolds*	Date Drilled:	*6/21/2011*
Logged by:	*M. Wall*	Boring Depth:	*4 feet*
Equipment:	*CME 55*	Boring Elevation:	*757 feet*
Hammer Type:	*Automatic*	Coordinates:	*Not Available*
Drilling Method:	*Hollow Stem Auger w/SPT Sampling*		

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	N-COUNT (1st 6" / 2nd 6" / 3rd 6") RQD / % REC	STANDARD PENETRATION TEST DATA (blows per foot)
				Topsoil (5 inches)					
			CL	RESIDUUM: clay, (CL), very stiff, silty, brown, with trace roots		12		7 - 8 - 13 N = 21	
	755		CL	clay (CL), very stiff, silty, yellowish brown		16		7 - 8 - 14 N = 22	
				Boring terminated at 4 feet.					
5	750								
10	745								
15	740								
20	735								

SAMPLE DATA

STANDARD PENETRATION TEST DATA (blows per foot): 10 20 30 40 50

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19TH ENGINEERING BATALLION COMPLEX
Fort Knox, Kentucky

BORING S-2
Page 1 of 1

Drilling Co.:	*Tri-State Drilling*	TTL Project No.:	*100811079*
Driller:	*Fred Reynolds*	Date Drilled:	*6/21/2011*
Logged by:	*M. Wall*	Boring Depth:	*4 feet*
Equipment:	*CME 55*	Boring Elevation:	*760 feet*
Hammer Type:	*Automatic*	Coordinates:	*Not Available*
Drilling Method:	*Hollow Stem Auger w/SPT Sampling*		

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	SAMPLE DATA: MOISTURE (%)	PPV (tsf)	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6") RQD / % REC	STANDARD PENETRATION TEST DATA (blows per foot)
0	760			Topsoil (5 inches)					
			CL	RESIDUUM: clay (CL), stiff, silty, brown, trace of organics				2 - 4 - 6 N = 10	
								11 - 16 - 16 N = 32	
				Boring terminated at 4 feet.					
5	755								
10	750								
15	745								
20	740								

STANDARD PENETRATION TEST DATA (blows per foot): 10 20 30 40 50

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Geotechnical Exploration
19th Engineering Battalion Complex
Fort Knox, Kentucky
TTL Project No. 100811079

APPENDIX 2

LABORATORY TEST DATA

Boring	Depth	Date Sampled	Class-ification	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B-12	1 - 2.5	6/20/2011		21								
B-12	-											
B-12	6 - 7.5	6/20/2011		20								
B-12	8.5 - 10	6/20/2011		23								
B-12	13.5 - 15	6/20/2011		14								
B-12	18.5 - 20	6/20/2011		15								
B-14	0 - 4	6/20/2011	CL									
B-16	3 - 5	6/20/2011	CL							111.8		
B-17	1 - 2.5	6/20/2011	CL	20	38	19	19	0.075	93			
B-17	3.5 - 5	6/20/2011		19								
B-17	6 - 7.5	6/20/2011		25								
B-17	8.5 - 10	6/20/2011		29								
B-17	13.5 - 15	6/20/2011		29								
B-2	3.5 - 5	6/20/2011	CL	19	32	19	13					
B-3	2 - 4	6/20/2011	CL							100.1		
B-3	6 - 7.5	6/20/2011	CH	27	64	25	39					
B-4	1 - 2.5	6/20/2011		15								
B-4	3.5 - 5	6/20/2011		26								
B-4	6 - 7.5	6/20/2011		29								
B-4	8.5 - 10	6/20/2011		26								
B-4	13.5 - 15	6/20/2011		28								
B-4	18.5 - 20	6/20/2011		33								
B-5	1 - 2.5	6/20/2011	CL	21	38	20	18					
B-5	6 - 8	6/20/2011	CL							101.9		
B-8	3.5 - 5	6/20/2011	CL	20	41	16	25	0.075	84			
S-1	0 - 2	6/21/2011	CL					9.5	85			
S-2	2 - 4	6/21/2011	CL					37.5	66			

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Summary of Laboratory Results

Client: Barge Waggoner Sumner & Cannon, Inc.
Project: Fort Knox 19th Engineering Battalion
Location: Fort Knox, Kentucky
Project Number: 100811079

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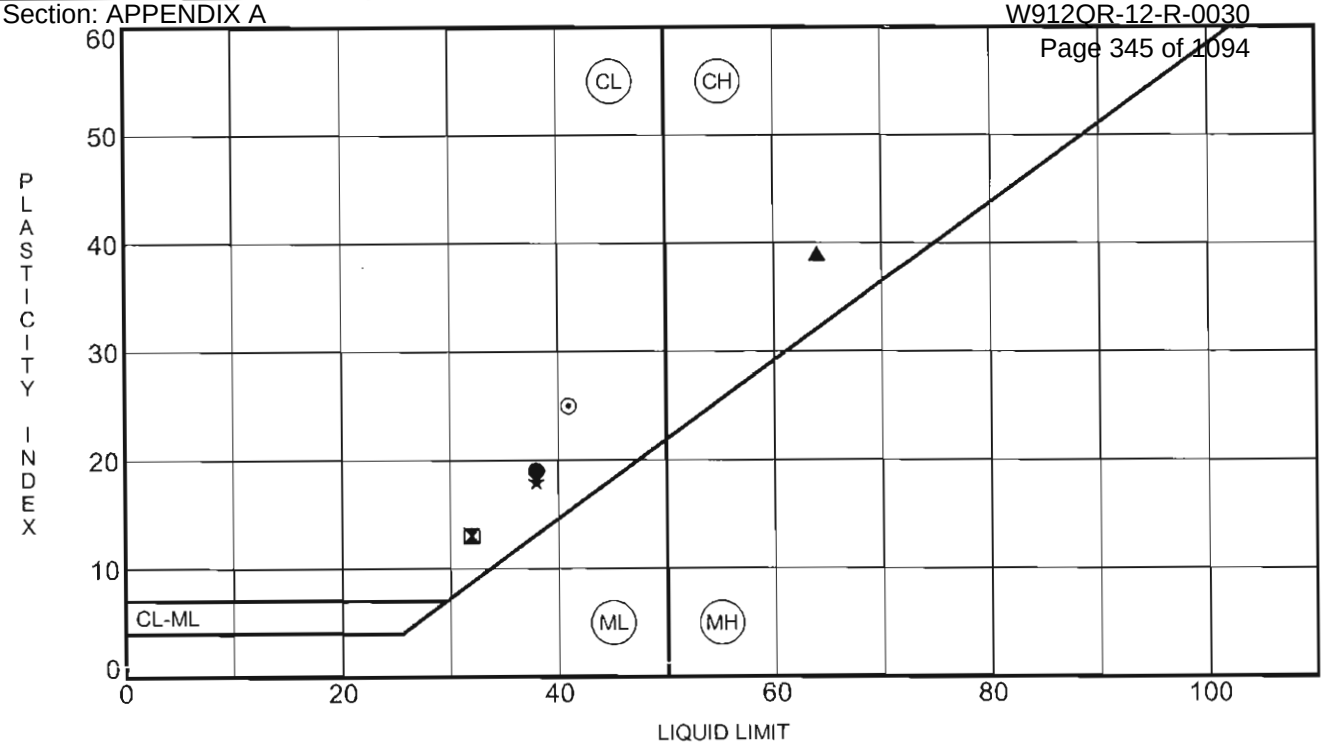

	Sample ID	Depth (ft)	Date Sampled	WC	LL	PL	PI	Fines	Classification
●	B-17	1 - 2.5	6/20/2011	20	38	19	19	93	Clay, lean, yellowish-brown (CL)
⊠	B-2	3.5 - 5	6/20/2011	19	32	19	13		Clay, silty, light brown (CL)
▲	B-3	6 - 7.5	6/20/2011	27	64	25	39		Clay, yellowish-red (CH)
★	B-5	1 - 2.5	6/20/2011	21	38	20	18		Clay, silty, brown (CL)
⊙	B-8	3.5 - 5	6/20/2011	20	41	16	25	84	Clay, lean, yellowish-brown (CL)

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ATTERBERG LIMITS RESULTS

Client: Barge Waggoner Sumner & Cannon, Inc.
Project: Fort Knox 19th Engineering Battalion
Location: Fort Knox, Kentucky
Project Number: 100811079

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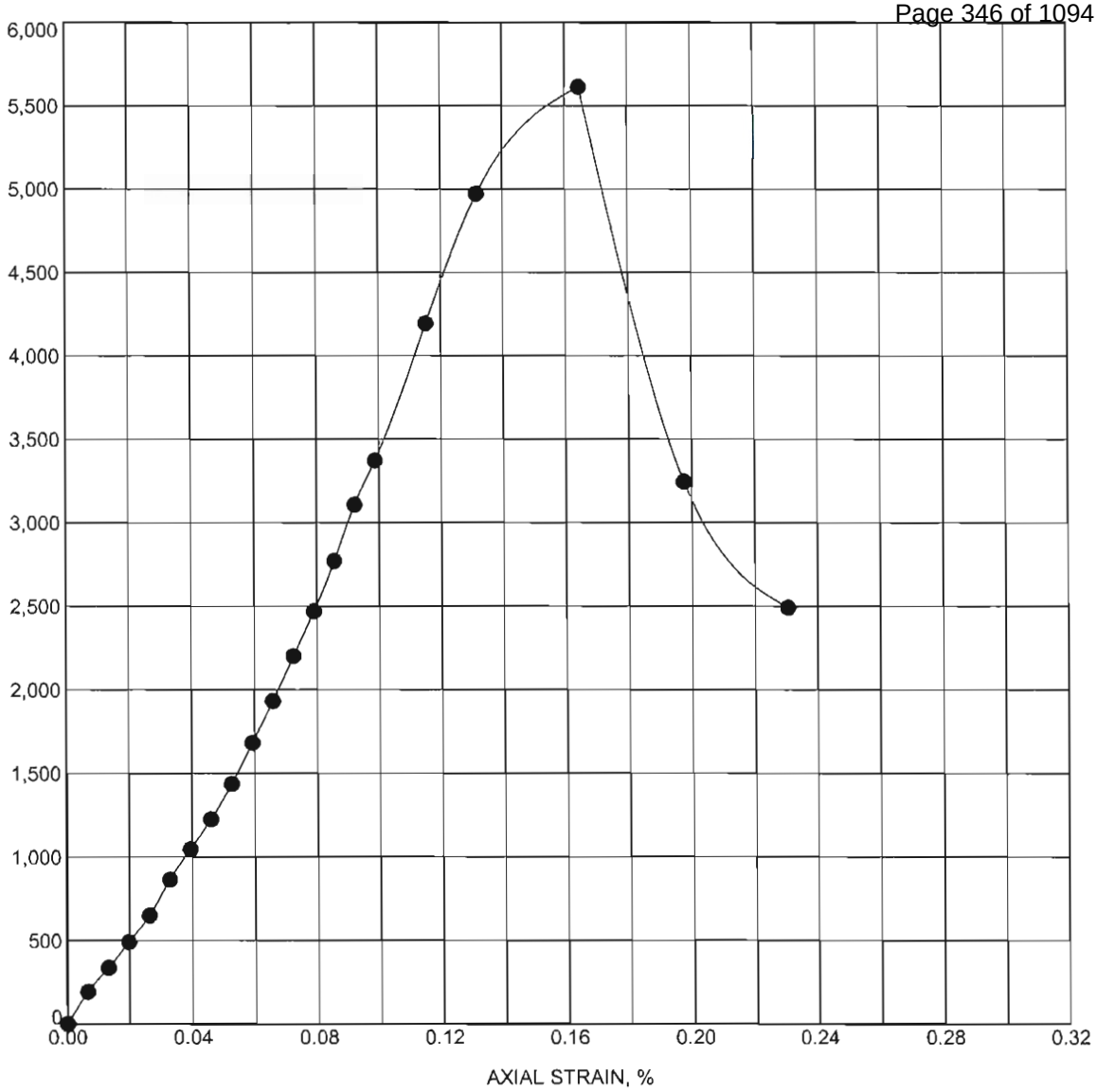

Boring ID	Sample Depth		Date Sampled	Date Tested
B-16	**3 - 5 ft of 20 ft boring**		**6/20/2011**	**6/30/2011**
Unconfined Strength (psf)	Undrained Shear Strength (psf)	Failure Strain (%)	Strain Rate (in./min.)	Test Method
5614.6	**2807.3**	**0.2**	**0.080**	**ASTM D 2166**

USCS Classification	Liquid Limit	Plastic Limit	Plastic Index	Specific Gravity	Type
Clay, silty, yellowish-brown (CL)	**---**	**---**	**---**		**Undisturbed**

Water Content %	Wet Density (pcf)	Dry Density (pcf)	Saturation %	Void Ratio	Specimen Diameter (in.)	Specimen Height (in.)	Height/Diameter Ratio
17.9	**131.8**	**111.8**			**2.840**	**5.980**	**2.11**

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UNCONFINED COMPRESSION TEST

Client: Barge Waggoner Sumner & Cannon, Inc.
Project: Fort Knox 19th Engineering Battalion
Location: Fort Knox, Kentucky
Project Number: 100811079

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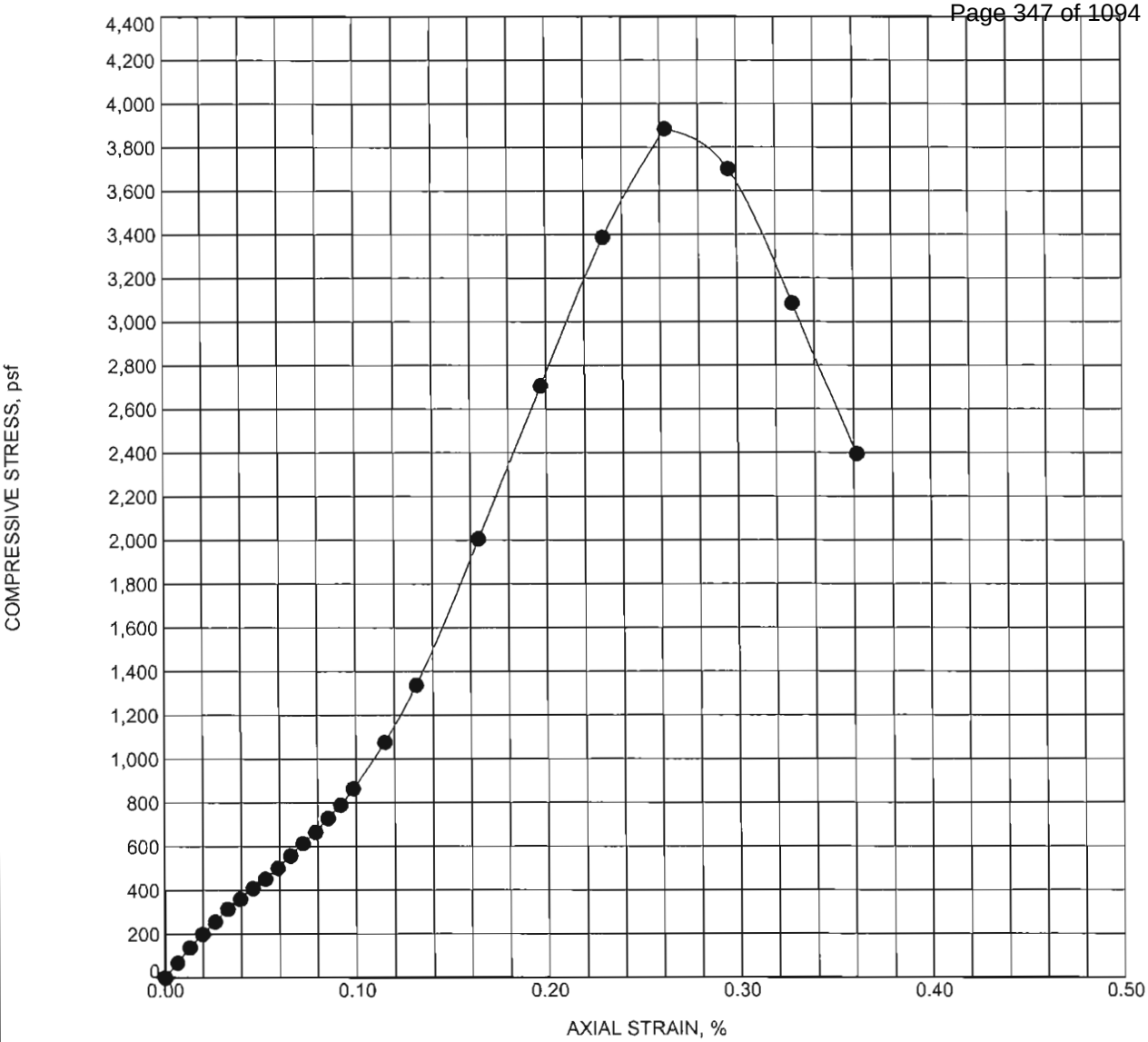

Boring ID	Sample Depth	Date Sampled	Date Tested
B-5	6 - 8 ft of 20 ft boring	6/20/2011	6/30/2011

Unconfined Strength (psf)	Undrained Shear Strength (psf)	Failure Strain (%)	Strain Rate (in./min.)	Test Method
3885.8	1942.9	0.3	0.060	ASTM D 2166

USCS Classification	Liquid Limit	Plastic Limit	Plastic Index	Specific Gravity	Type
Clay, silty, reddish-brown (CL)	---	---	---		Undisturbed

Water Content %	Wet Density (pcf)	Dry Density (pcf)	Saturation %	Void Ratio	Specimen Diameter (in.)	Specimen Height (in.)	Height/Diameter Ratio
22.5	124.9	101.9			2.850	5.990	2.10

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UNCONFINED COMPRESSION TEST

Client: Barge Waggoner Sumner & Cannon, Inc.
Project: Fort Knox 19th Engineering Battalion
Location: Fort Knox, Kentucky
Project Number: 100811079

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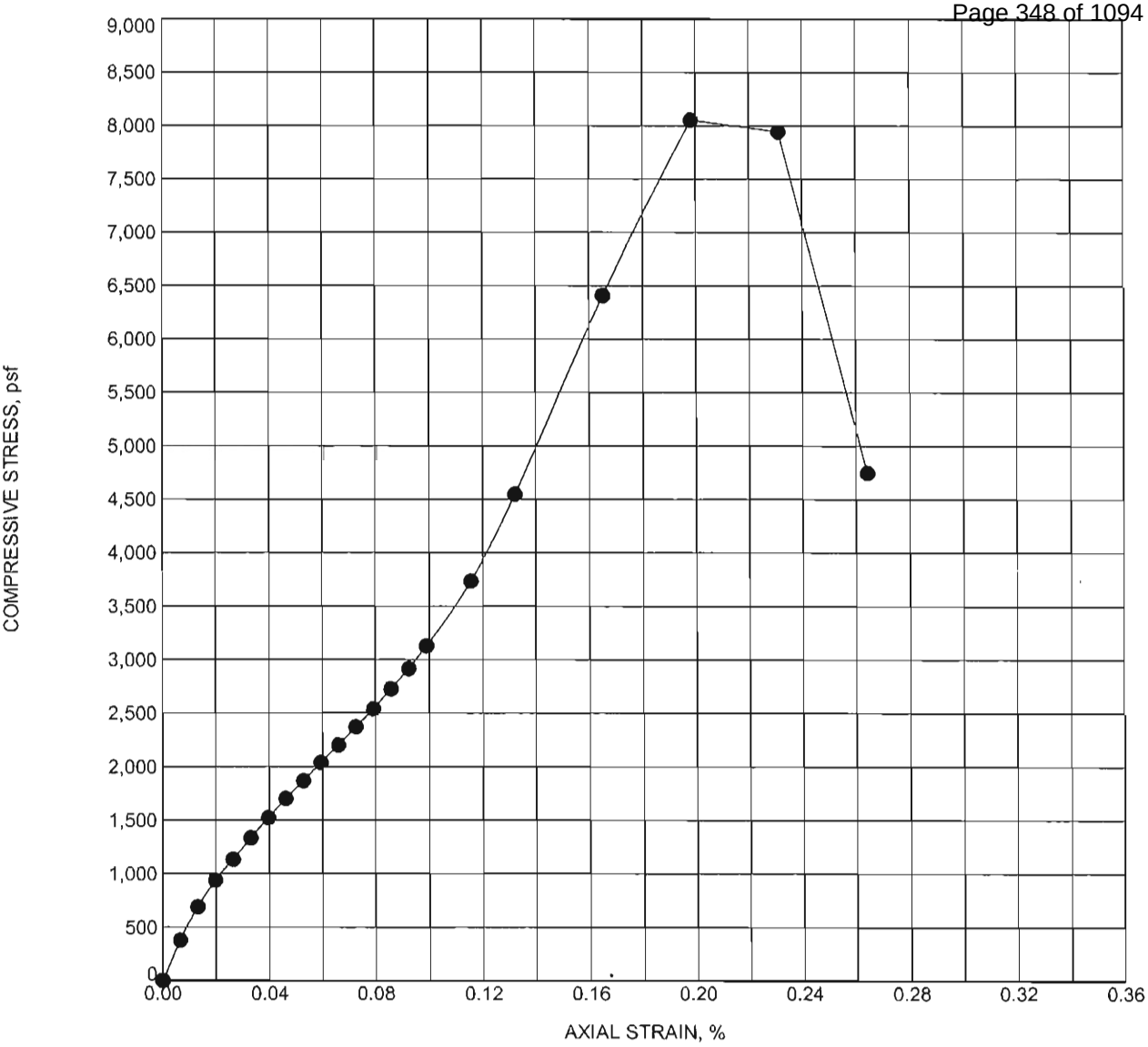

Boring ID	Sample Depth	Date Sampled	Date Tested
B-3	2 - 4 ft of 20 ft boring	6/20/2011	6/30/2011

Unconfined Strength (psf)	Undrained Shear Strength (psf)	Failure Strain (%)	Strain Rate (in./min.)	Test Method
8053.8	4026.9	0.2	0.040	ASTM D 2166

USCS Classification	Liquid Limit	Plastic Limit	Plastic Index	Specific Gravity	Type
Clay, silty, yellowish-red (CL)	---	---	---		Undisturbed

Water Content %	Wet Density (pcf)	Dry Density (pcf)	Saturation %	Void Ratio	Specimen Diameter (in.)	Specimen Height (in.)	Height/Diameter Ratio
23.7	123.9	100.1			2.840	5.960	2.10

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UNCONFINED COMPRESSION TEST

Client: Barge Waggoner Sumner & Cannon, Inc.
Project: Fort Knox 19th Engineering Battalion
Location: Fort Knox, Kentucky
Project Number: 100811079

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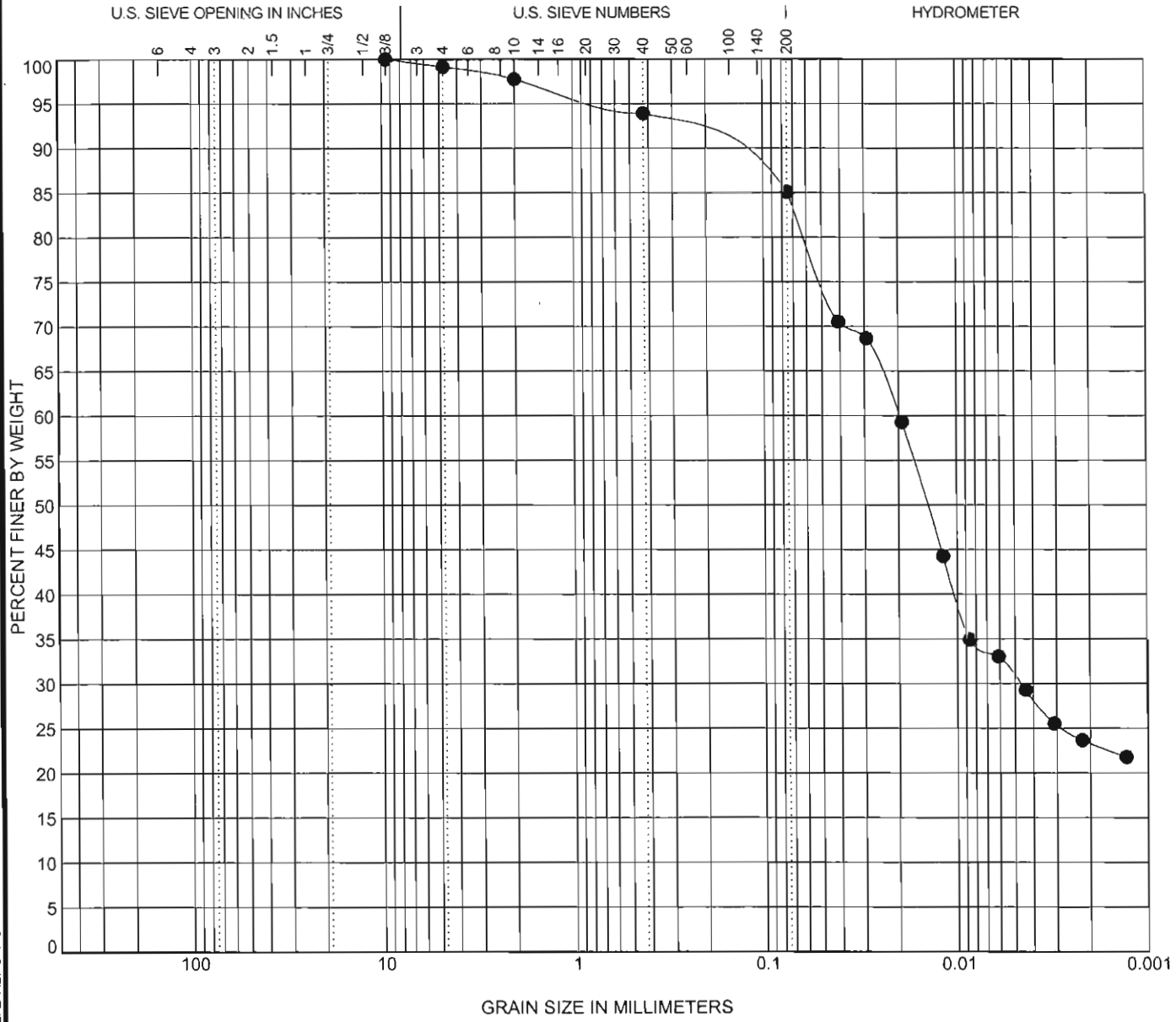
GRAIN SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample ID	**S-1** **0 - 2 feet**
Description	**Clay, silty, brown (CL)**
Sampled by:	**TTL, Inc.**
Sample Location:	**S-1**
Date Sampled:	**6/21/2011**

wc (%)	LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
						9.5	0	0		0.8	14.1	85.1	

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SIEVE ANALYSIS RESULTS

Client: Barge Waggoner Sumner & Cannon, Inc.
Project: Fort Knox 19th Engineering Battalion
Location: Fort Knox, Kentucky
Project Number: 100811079

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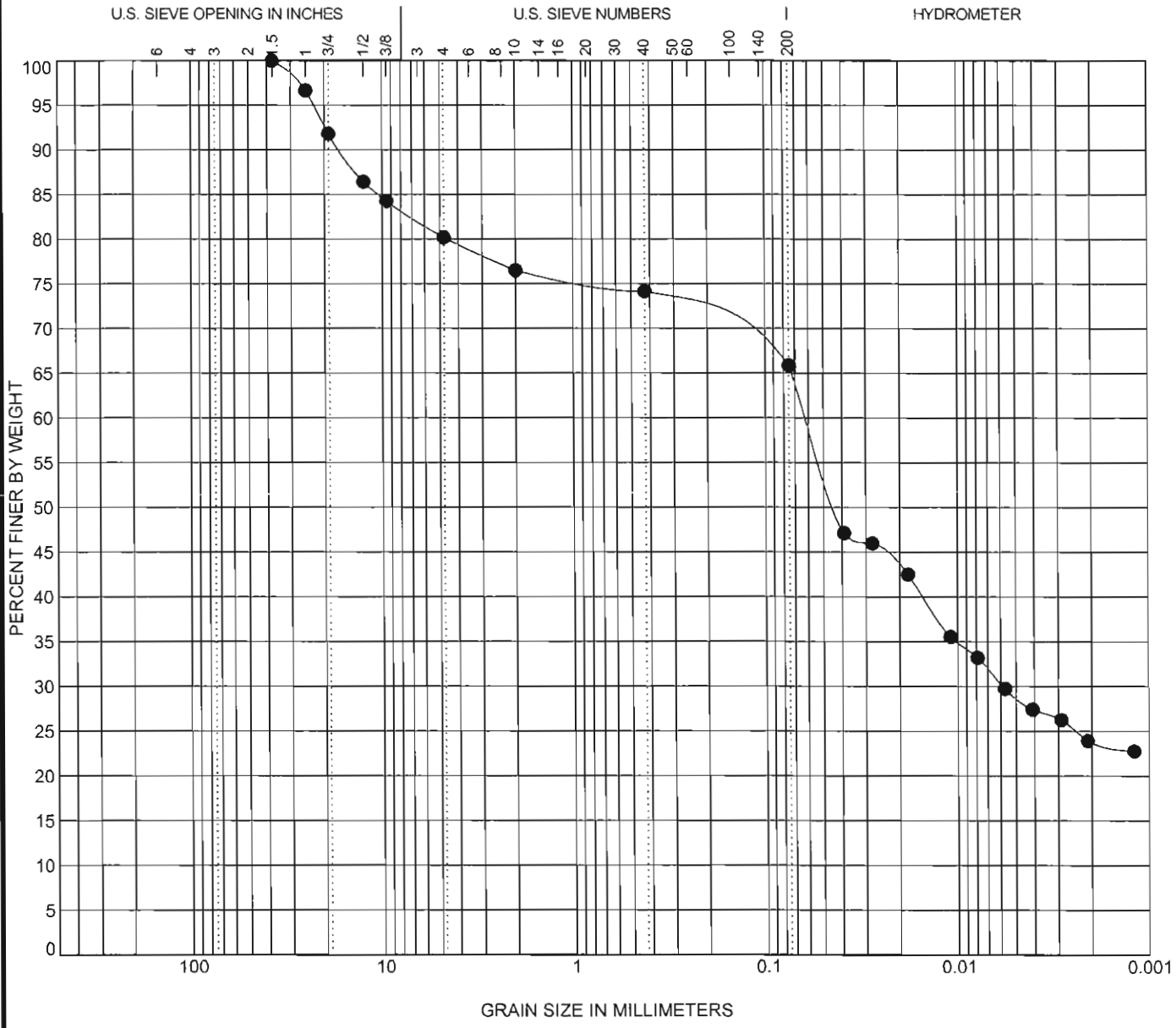
GRAIN SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample ID	**S-2** **2 - 4 feet**
Description	**Clay, silty, yellowish-red (CL)**
Sampled by:	**TTL, Inc.**
Sample Location:	**S-2**
Date Sampled:	**6/21/2011**

wc (%)	LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
						37.5	0.1	0		19.8	14.3	65.9	

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SIEVE ANALYSIS RESULTS

Client: Barge Waggoner Sumner & Cannon, Inc.
Project: Fort Knox 19th Engineering Battalion
Location: Fort Knox, Kentucky
Project Number: 100811079

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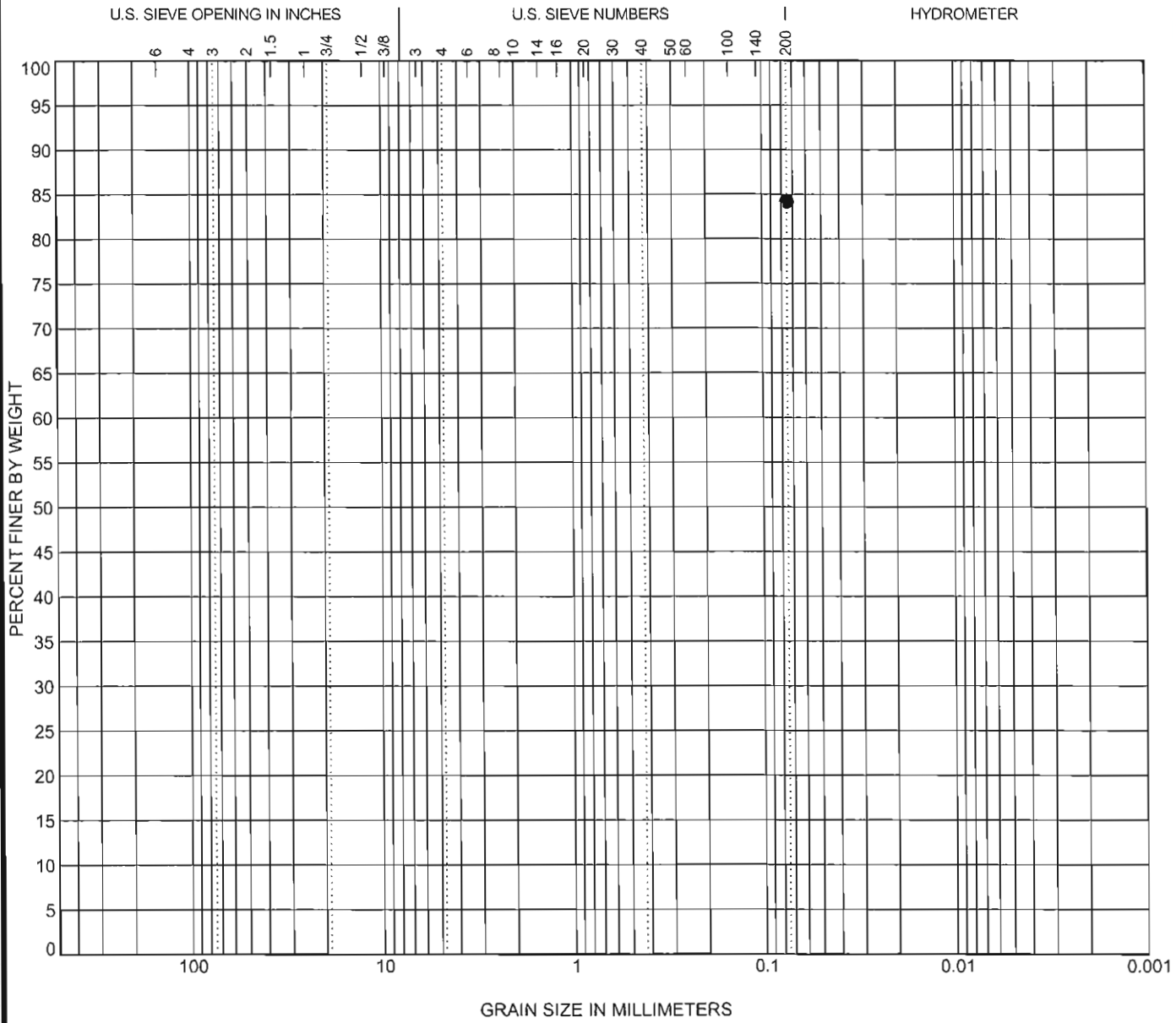
GRAIN SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample ID	**B-8** **3.5 - 5 feet**
Description	**Clay, lean, yellowish-brown (CL)**
Sampled by:	**TTL, Inc.**
Sample Location:	**B-8**
Date Sampled:	**6/20/2011**

wc (%)	LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
20	**41**	**16**	**25**			**0.1**				**0.0**	**0.0**	**84.2**	

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SIEVE ANALYSIS RESULTS

Client: Barge Waggoner Sumner & Cannon, Inc.
Project: Fort Knox 19th Engineering Battalion
Location: Fort Knox, Kentucky
Project Number: 100811079

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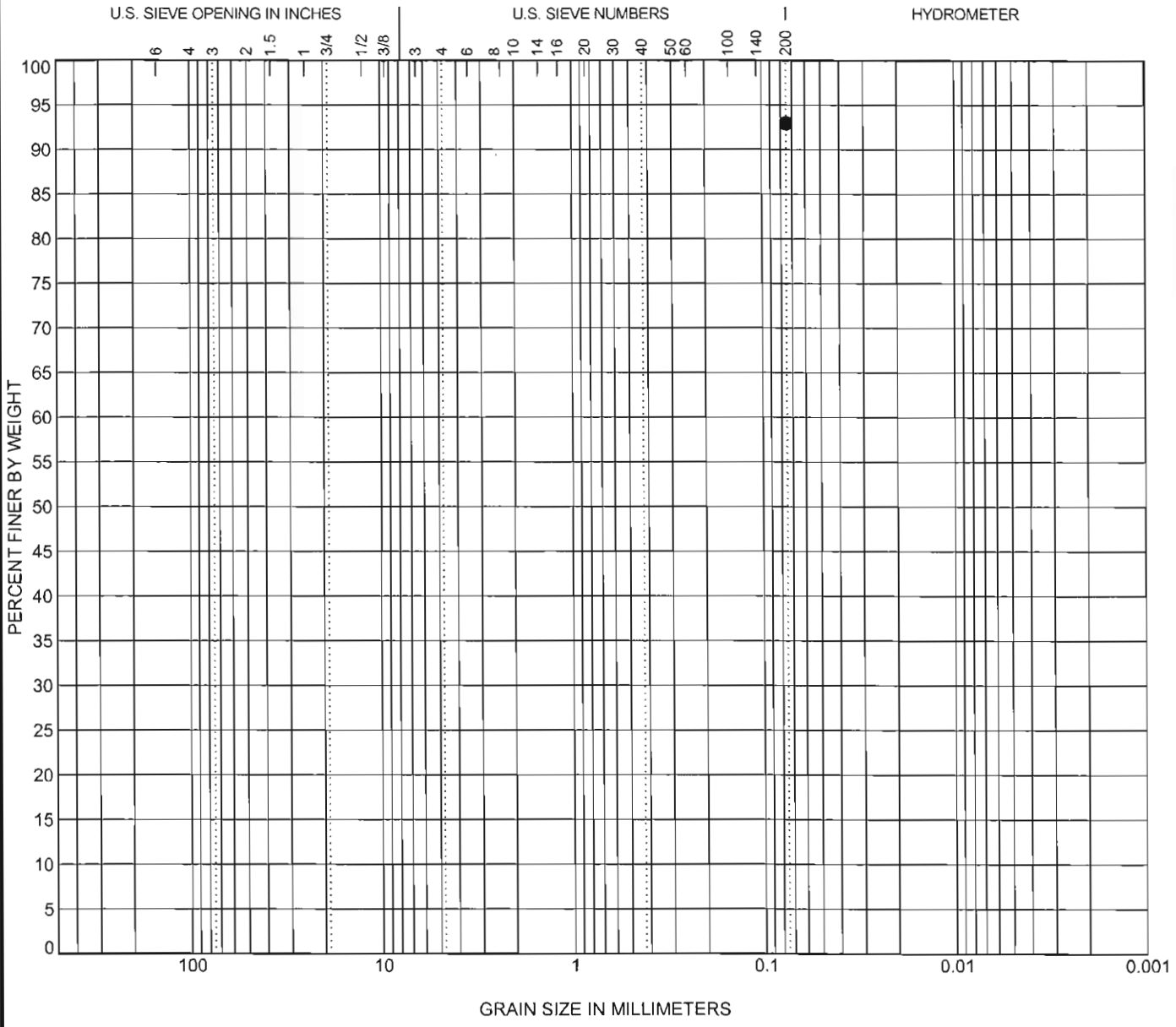
GRAIN SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample ID	**B-17** **1 - 2.5 feet**
Description	**Clay, lean, yellowish-brown (CL)**
Sampled by:	**TTL, Inc.**
Sample Location:	**B-17**
Date Sampled:	**6/20/2011**

wc (%)	LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
20	**38**	**19**	**19**			**0.1**				**0.0**	**0.0**	**93.0**	

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SIEVE ANALYSIS RESULTS

Client: Barge Waggoner Sumner & Cannon, Inc.
Project: Fort Knox 19th Engineering Battalion
Location: Fort Knox, Kentucky
Project Number: 100811079

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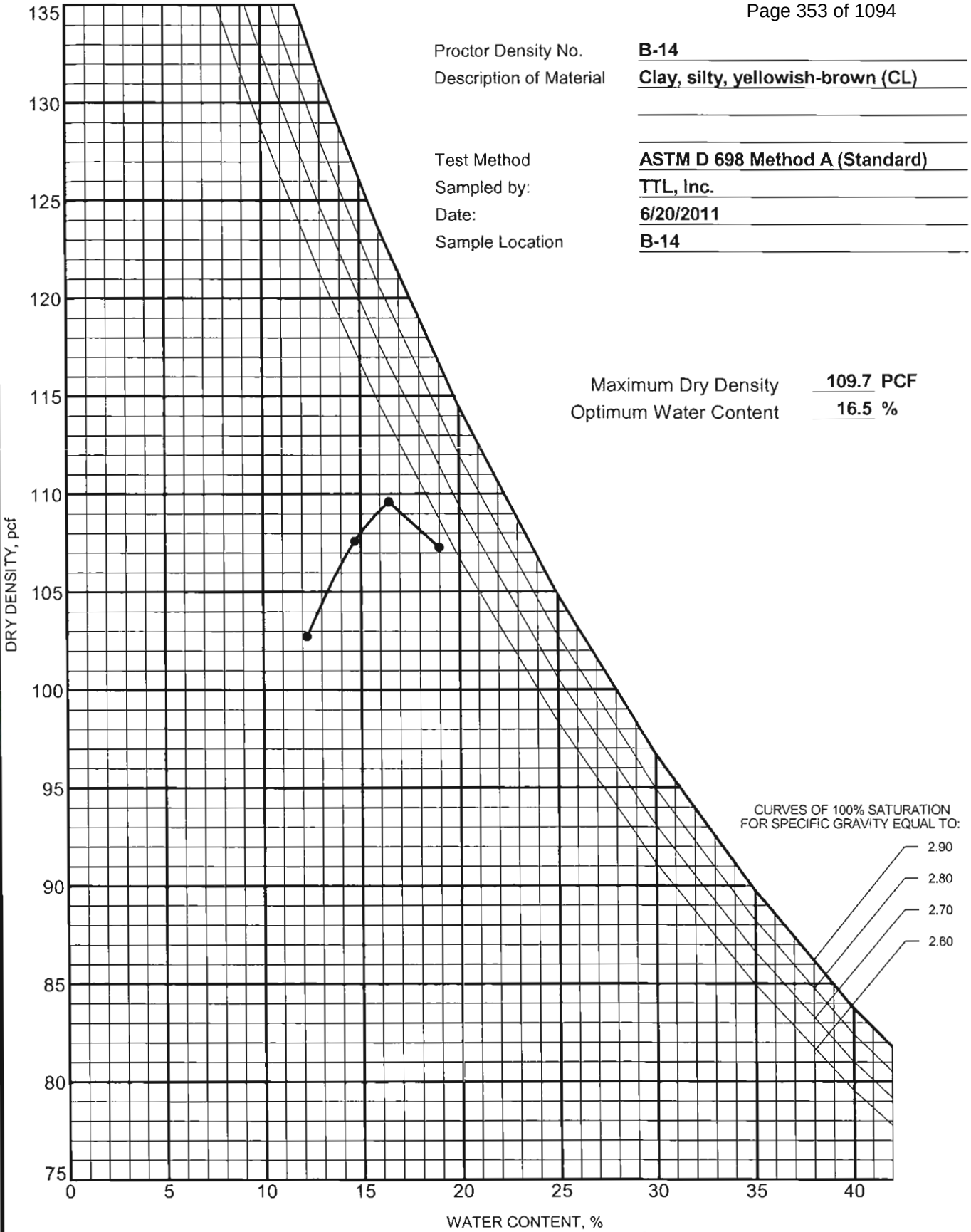

Proctor Density No.	**B-14**
Description of Material	**Clay, silty, yellowish-brown (CL)**
Test Method	**ASTM D 698 Method A (Standard)**
Sampled by:	**TTL, Inc.**
Date:	**6/20/2011**
Sample Location	**B-14**

Maximum Dry Density	**109.7 PCF**
Optimum Water Content	**16.5 %**

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PROCTOR MOISTURE-DENSITY RELATIONSHIP

Client: Barge Waggoner Sumner & Cannon, Inc.
Project: Fort Knox 19th Engineering Battalion
Location: Fort Knox, Kentucky
Project Number: 100811079

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ASTM G-57 Soil Resistivity

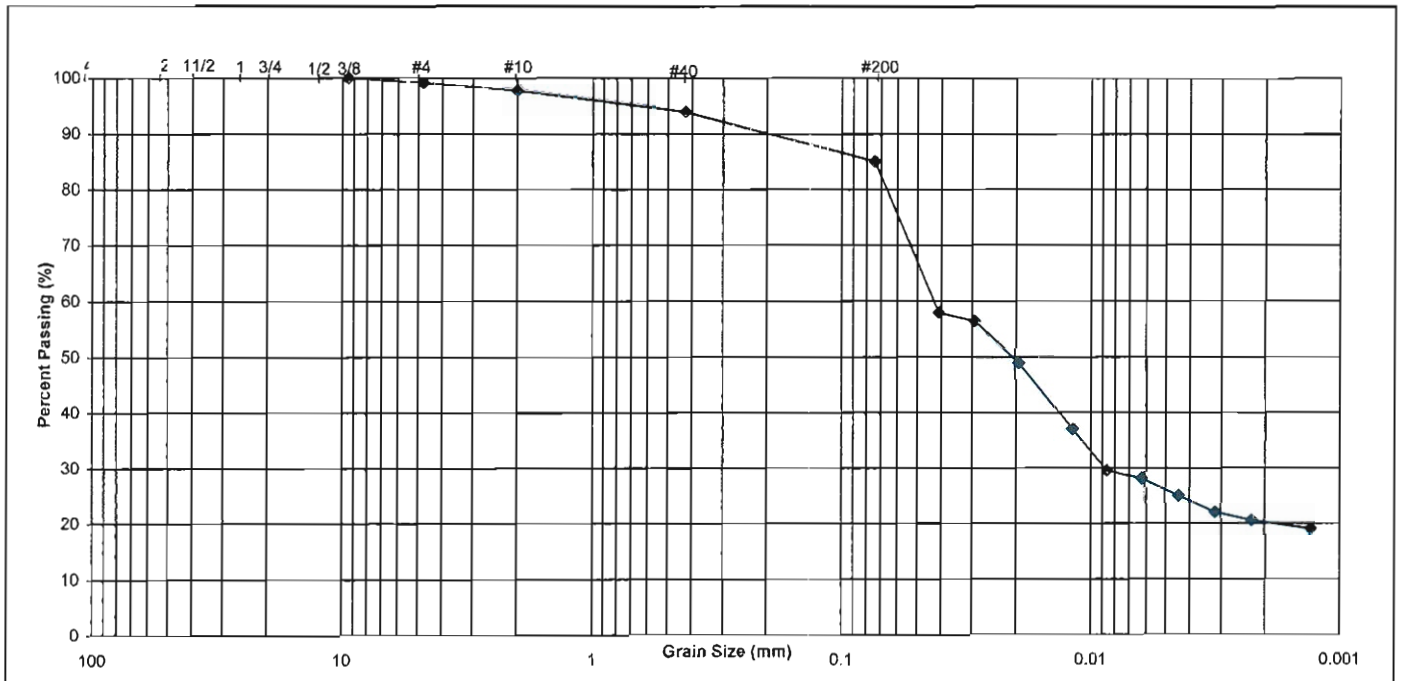
Project Name: Fort Knox 19th Engineering Battalion **Project No.** 100811079

Location: Fort Knox, Kentucky **Date** 7/7/2011

Boring	Depth (feet)	Natural Moisture Content (%)	Date Sampled	USCS Classification		R cm
B-4	1.0 - 2.5	15.3	6/20/2011	Clay, silty, brown with small rocks, chert	CL	6423.1
B-17	1.0 - 2.5	20.0	6/20/2011	Clay, lean, yellowish-brown	CL	6078.4

Hydrometer Analysis
(ASTM D 422)

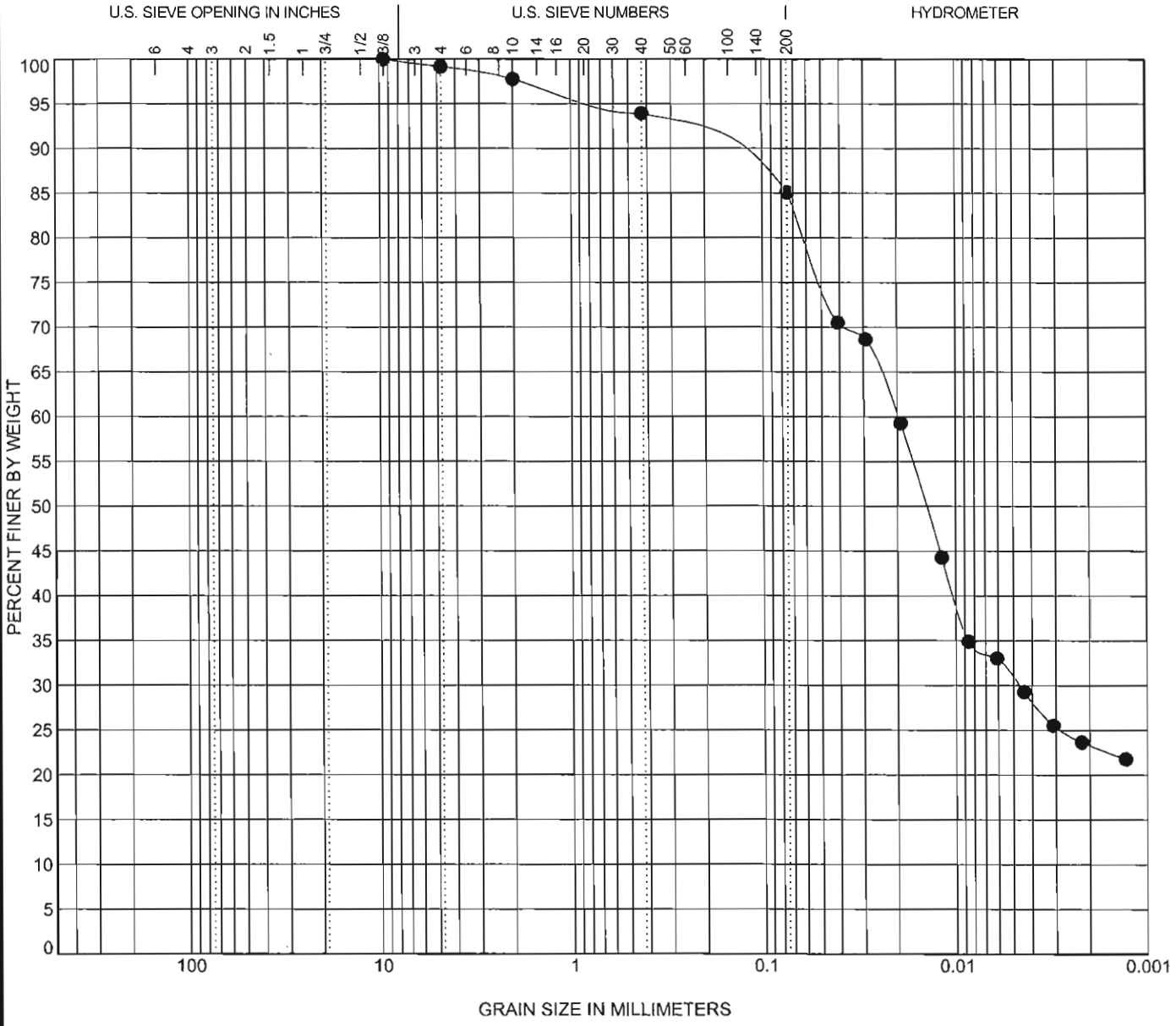
Grain Size (in)	Grain Size (mm)	Per Cent Finer
4	100	
2	50	
1 1/2	37.5	
1	25	
3/4	19	
1/2	12.5	
3/8	9.5	100
#4	4.76	99.2
#10	2	97.8
#40	0.425	93.9
#200	0.074	85.1
	0.0410	57.9
	0.0294	56.4
	0.0193	48.9
	0.0118	37.0
	0.0086	29.5
	0.0062	28.0
	0.0044	25.0
	0.0032	22.0
	0.0022	20.5
	0.0013	19.0



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	DEPTH	USCS CLASSIFICATION	% SAND	% SILT	% CLAY	USCS	
S-1	0.0' - 2.0'	Clay, silty, brown	14.1	60.1	25.0	CL	PROJECT: Fort Knox 19th Engineering Batta PROJECT NO: 100811079 DATE: 7/5/2011

GRAIN SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample ID	**S-1** **0 - 2 feet**
Description	**Clay, silty, brown (CL)**
Sampled by:	**TTL, Inc.**
Sample Location:	**S-1**
Date Sampled:	**6/21/2011**

wc (%)	LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
						9.5	**0**	**0**		**0.8**	**14.1**	**85.1**	

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SIEVE ANALYSIS RESULTS

Client: Barge Waggoner Sumner & Cannon, Inc.
Project: Fort Knox 19th Engineering Battalion
Location: Fort Knox, Tennessee
Project Number: 100811079

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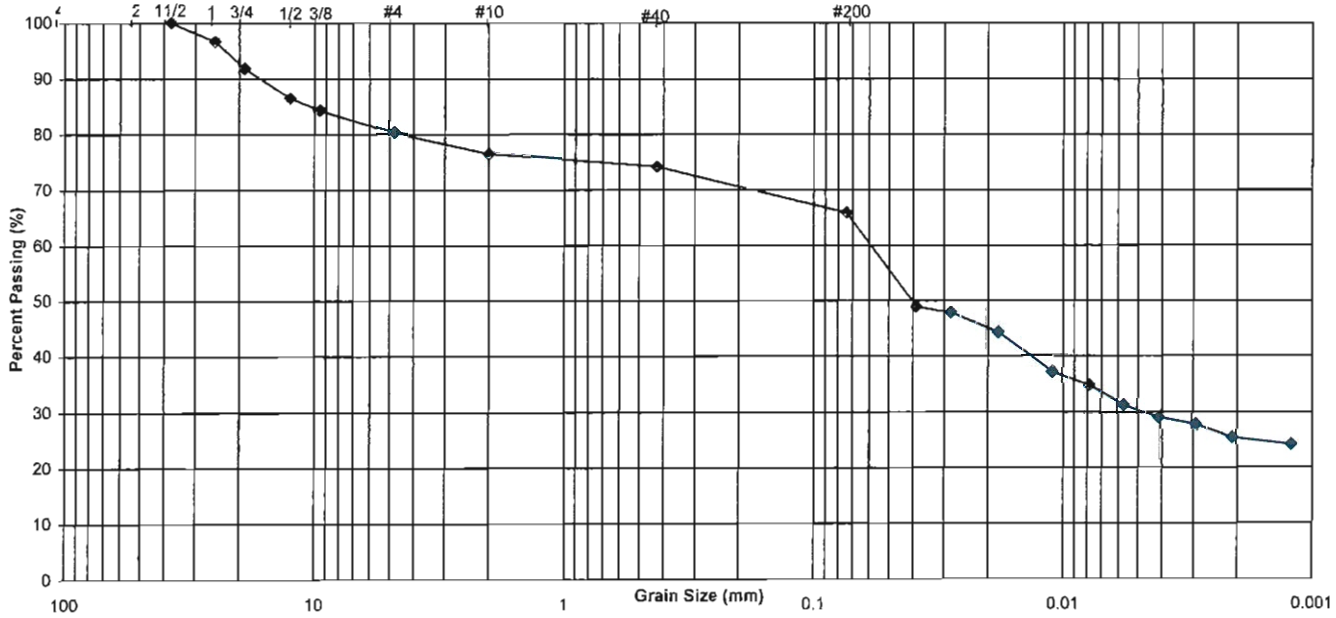
Hydrometer Analysis
(ASTM D 422)

Grain Size (in)	Grain Size (mm)	Per Cent Finer
4	100	
2	50	
1 1/2	37.5	100
1	25	96.66
3/4	19	91.81
1/2	12.5	86.44
3/8	9.5	84.27
#4	4.76	80.2
#10	2	76.5
#40	0.425	74.1
#200	0.074	65.9
	0.0387	48.8
	0.0277	47.7
	0.0180	44.2
	0.0109	37.1
	0.0078	34.8
	0.0057	31.3
	0.0041	28.9
	0.0029	27.8
	0.0021	25.4
	0.0012	24.2



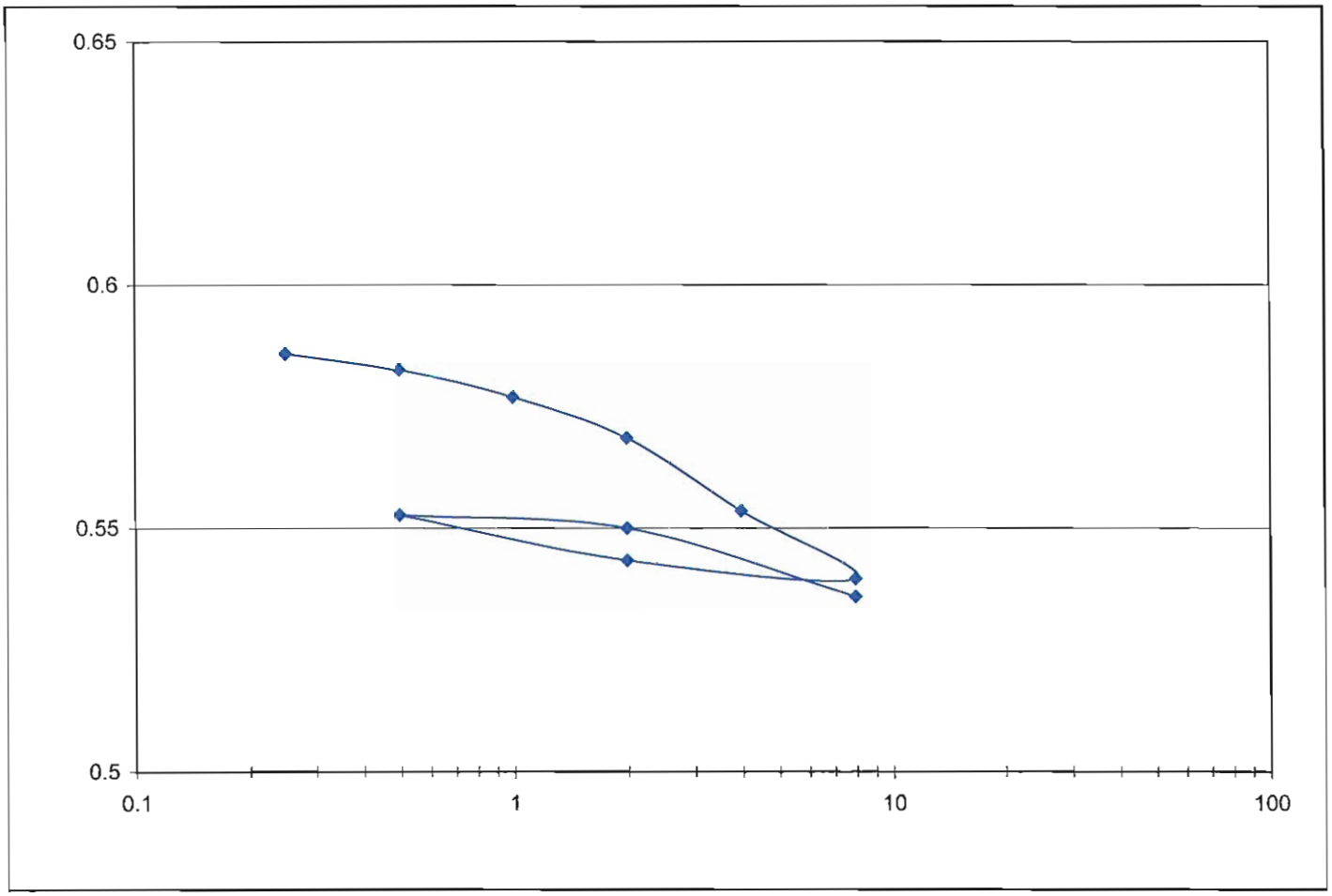
GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

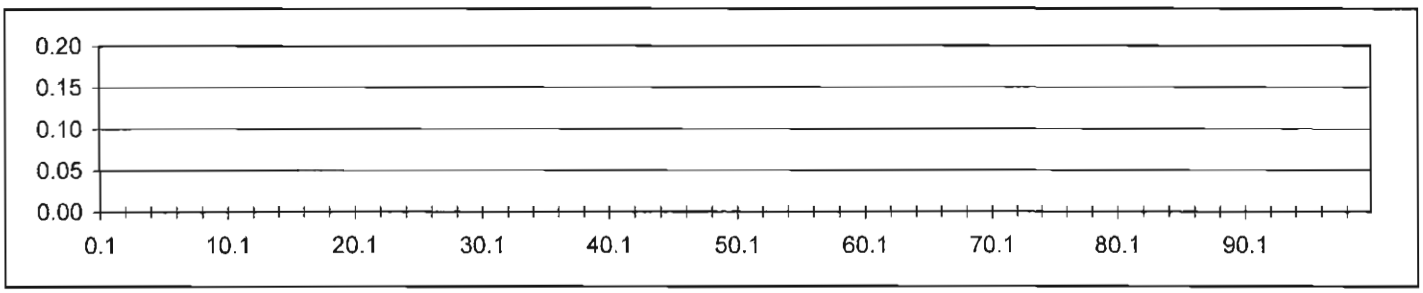
SAMPLE	DEPTH	USCS CLASSIFICATION	% SAND	% SILT	% CLAY	USCS	PROJECT: Fort Knox 19th Engineering Batta
S-2	2.0' - 4.0'	Clay, silty, yellowish-red	14.3	36.9	28.9	CL	PROJECT NO: 100811079
							DATE: 7/5/2011

CONSOLIDATION TEST

Project Name Fort Knox **Date** 7/7/2011
Project No. 100811079

Boring No B-12 **Depth** 4.0' - 6.0'





	Initial	Final		Initial	Final
Moisture Content (%)	20.2	20.1	Saturation (%)	91.3	110.9
Height (in)	0.78	0.73	Void Ratio	0.590	0.486
Dry Unit Weight (pcf)	104.8	112.4			

B-12

CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM D-1883

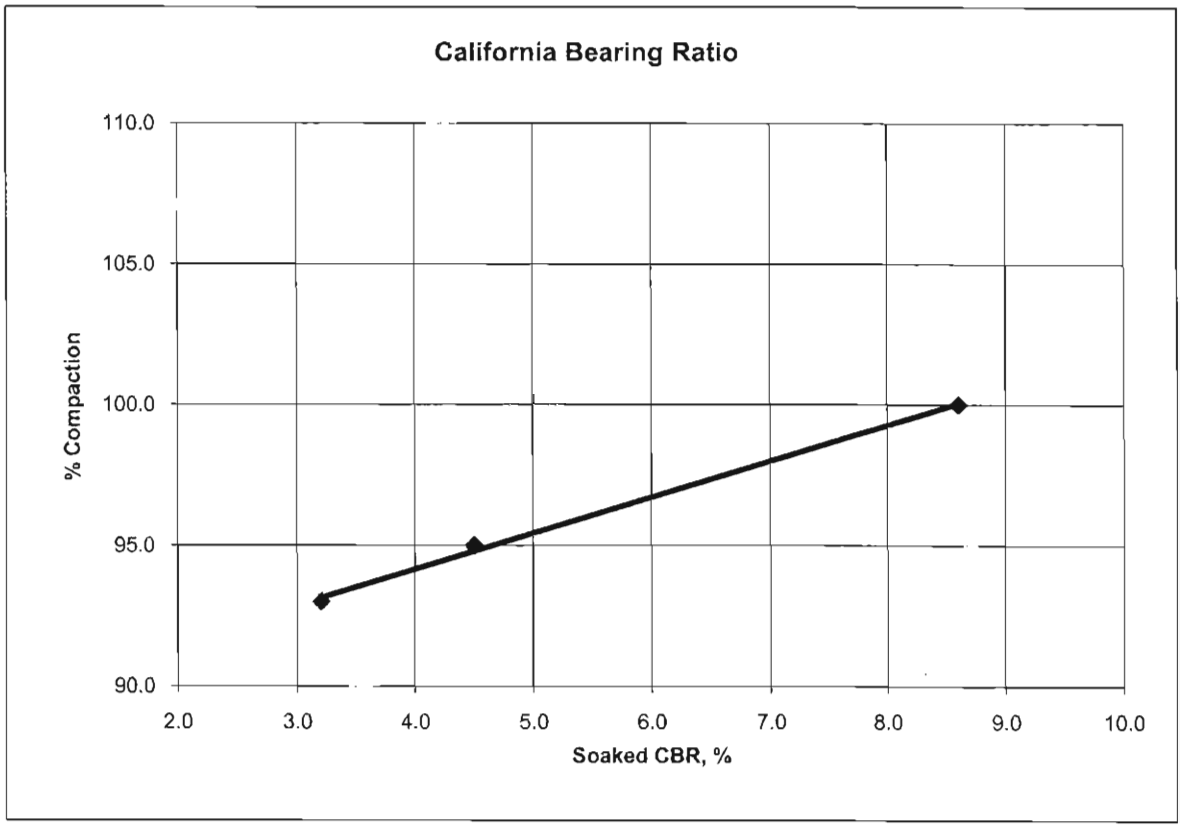
Project 19th Engineering Battalion

Date 7/10/2011

Project No. 11079

Sample ID Combined sample

Sample Desc. Clay, yellowish-brown



Method of Compaction:	ASTM-D698, Method A
Max. Dry Density (pcf):	109.7
Opt. Moisture (%):	16.5
Surcharge (lbs):	15

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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

(Refer to Appendix J – Drawings, Title Sheet)

APPENDIX C
Utility Connections

(Refer to Appendix J – Drawings, Utility Site Plan and Details)

APPENDIX D
Results of Fire Flow Tests

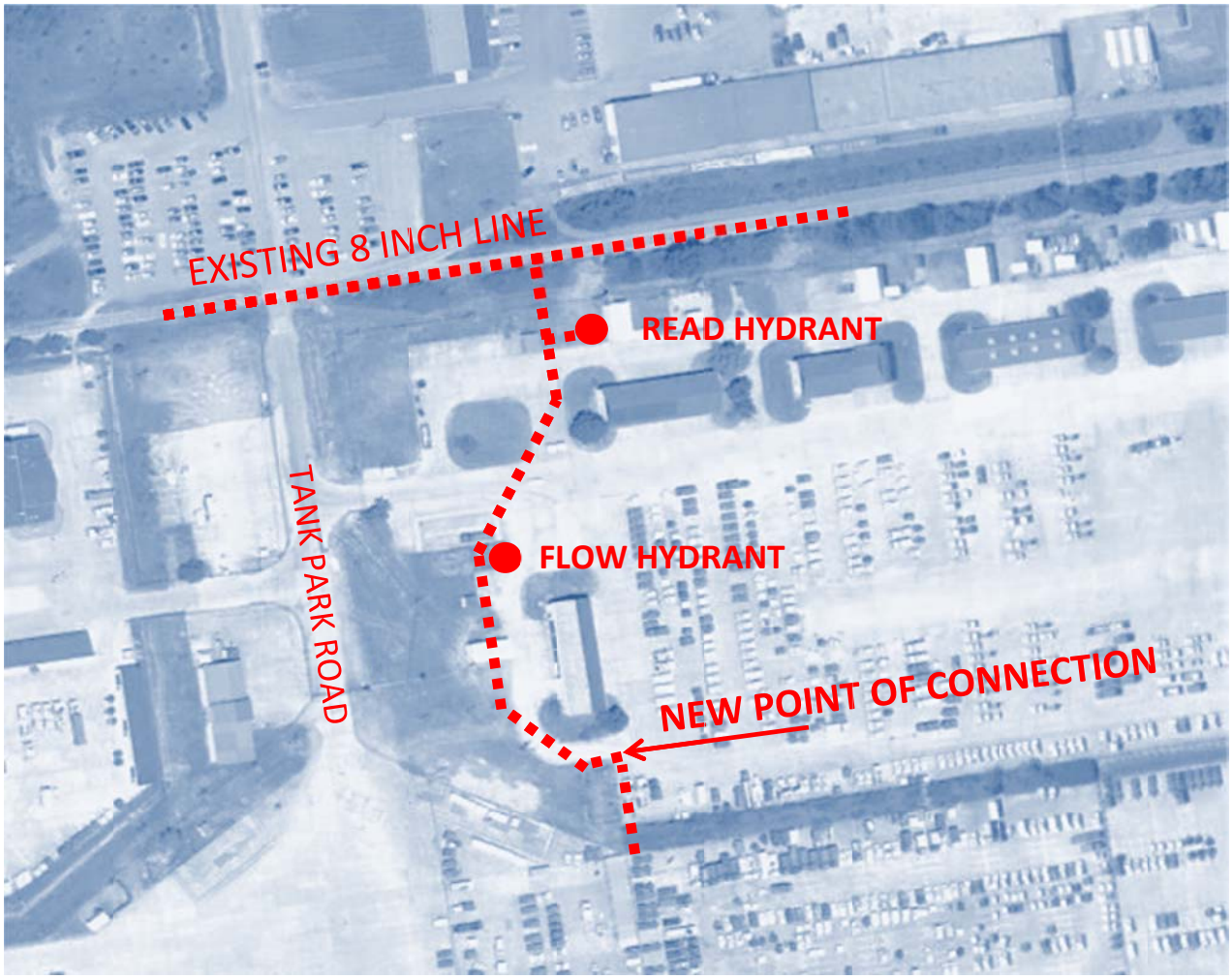
Water Flow Test

Date: 07/15/2011

Location: Site of new 19th Battalion Complex (along tank park road)

Witnessed By:
Bobby Patrick, PE – FireLogix Engineering, Ltd.
Mike Tucker – Fort Knox Fire Department

Flow Hydrant: (elevation 771 feet)
Read Hydrant: 539 (elevation 771 feet)
Hydrant Coefficient: .90 (smooth rounded outlet)
Static Pressure: 35 psi
Residual Pressure: 24 psi
Pitot Pressure (Butt 1 – 2.5 inches): 10 psi
Pitot Pressure (Butt 2 – 2.5 inches): 10 psi
Total Flow: 1,060 gpm



APPENDIX E
Environmental Information

APPENDIX E.1
Environmental Information

Record of Environmental Consideration

RECORD OF ENVIRONMENTAL CONSIDERATION
19th ENGINEER BATTALION COMPLEX
FORT KNOX, KENTUCKY

Date: 20 August 2010

PROJECT TITLE: 19th Engineer Battalion Complex

DESCRIPTION: The purpose of this project is to construct a standard design Battalion Complex in the eastern section of St Johns Motor Park (east of Bldg. #2959 and #2955). The primary facilities would include barracks, battalion headquarters, company operations with covered hardstand, classrooms, and storage, renovation of existing vehicle maintenance facilities, organizational vehicle parking and installation of Intrusion Detection System. Project would also include all site utilities and connections, site improvements, access roads and parking, paving, fencing and storm drainage. The existing hardstand would either be replaced/repaired where needed and green space added around the Battalion Headquarters and Barracks. This project was previously identified in BRAC Environmental Assessment. A drawing is attached as an enclosure.

This action is covered under 32 CFR Part 651, Environmental Analysis of Army Actions: Final Rule, (March 29, 2002), Appendix B – Categorical Exclusions, Section II: Paragraph (c) Construction and demolition: (1) Construction of an addition to an existing structure or new construction on a previously undisturbed site if the area to be disturbed has no more than 5.0 cumulative acres of new surface disturbance. This does not include construction of facilities for the transportation, distribution, use, storage, treatment, and disposal of solid waste, medical waste, and hazardous waste.

ANTICIPATED START DATE OF THE PROPOSED ACTION: October 2010

1. This action is not a major federal action significantly affecting the quality of the human environment. This action has not been segmented.

2. There are no exceptional circumstances that exist at the building sites.

3. There are no environmentally controversial changes to existing environmental conditions for the proposed demolition areas.

4. There are no extraordinary conditions associated with this project.

5. This project does not involve the use of unproven technology.

6. There is no reasonable likelihood of significant effects on public health, safety, or the environment.

7. There is no reasonable likelihood of significant environmental effects (direct, indirect, and cumulative).

RECORD OF ENVIRONMENTAL CONSIDERATION – 19TH ENGINEER BATTALION COMPLEX, FORT KNOX, KENTUCKY (Continued)

8. There is no imposition of uncertain or unique environmental risks.

9. The scope or size of this project is no greater than normal for this category of action.

10. The proposed action would not normally result in releases of petroleum, oils and lubricants (POL) except from a properly functioning engine or vehicle. Accidental release of POL products would be reported and cleaned up in accordance with EPA and Kentucky laws and regulations.

11. The use of pesticides or herbicides is prohibited without the approval of the Forestry Section, Environmental Management Division, Directorate of Public Works.

12. There is no reasonable likelihood of violating any federal, state or local laws or requirements imposed for the protection of the environment.

13. There is no potential of an already poor environment being further degraded.

14. This action does not establish a precedent for future or subsequent actions that is likely to have a future significant effect.

15. Potential Effect on Sensitive Resources:

a. Threatened and Endangered Species: Fort Knox has two federally listed endangered species that have been observed on the installation: Endangered – The Gray Bat (*Myotis grisescens*) and the Indiana Bat (*Myotis sodalis*); Fort Knox is located within the core boundary area for management of the federally endangered Indiana Bat. Trees 6 inches or above at breast height (dbh) can only be removed during the period 15 October – 31 March. Since no trees would be removed, there would be no adverse impact to the federally listed endangered or threatened species.

b. Cultural Resources: Section 106 of the National Historic Preservation Act requires federal agencies to take into account the effects of undertakings on historic properties. Historic properties include buildings, structures, sites, objects, and districts that are eligible for the National Register of Historic Places (NRHP). Projects that could potentially result in adverse effects on historic properties must be reviewed in consultation with the Kentucky State Historic Preservation Office (SHPO).

The proposed 19th Engineer Battalion Complex project does not have the potential to result in adverse effects to historic properties. The project area is located at St. Johns Motor Park. The project's footprint lies within the existing hardstand so there is no potential for impacts to archaeological resources, there are no historic properties located within the St. Johns Motor Park complex, and the project area is outside the Fort Knox Cantonment Historic District.

RECORD OF ENVIRONMENTAL CONSIDERATION – 19TH ENGINEER BATTALION COMPLEX, FORT KNOX, KENTUCKY (Continued)

Consequently, SHPO consultation is not necessary and the requirements of Section 106 have been fulfilled. No further review is necessary.

CONCLUSIONS: The proposed action as currently described would have no long-term cumulative effects on the environment. If the scope of the project changes, this REC would be reviewed to determine if the document fully complies with the intent of the National Environmental Policy Act.

THIS DOCUMENT *DOES NOT* RELIEVE THE PROPONENT OF COMPLIANCE WITH APPLICABLE FEDERAL AND STATE LAWS AND REGULATIONS.

PROPONENT:

_____ **Date** 2 Sep 10
DAVID BLANDFORD
Directorate of Public Works

CONCURRENCE BY OFFICE OF STAFF JUDGE ADVOCATE:

_____ **Date** 7 Sep 2010
FOR **J. PETER HILL**
Chief, Military Law and Ethics Division
Office of the Staff Judge Advocate
Jonathan Siegler, CPT, JA
MLE Attorney

APPROVED BY INSTALLATION ENVIRONMENTAL COORDINATOR:

_____ **Date** 17 Sep 2010
LINDA G. POLLOCK
Chief, Environmental Management Division
Directorate of Public Works

RECORD OF ENVIRONMENTAL CONSIDERATION – 19TH ENGINEER BATTALION COMPLEX, FORT KNOX, KENTUCKY (Continued)

CONCURRENCE BY DIRECTOR OF PUBLIC WORKS:

Patrick G. Walsh Date 9/23/10

PATRICK A. WALSH
Director of Public Works

Enclosure
- Drawing

APPENDIX E.2
Environmental Information

Commonwealth of Kentucky - Department of Environmental Protection
TNFA for Gasoline Can Storage Bldg Area & Area of Stressed Vegetation
(For Information Only)

ENERGY AND ENVIRONMENT CABINET

Steven L. Beshear
Governor

Department for Environmental Protection
Division of Waste Management
200 Fair Oaks Lane
Frankfort, Kentucky 40601-1190
www.kentucky.gov

Leonard K. Peters
Secretary

December 1, 2009

Mr. Patrick A. Walsh
Directorate of Base Operations Support
ATZK-PWE, Bldg. 1110
US Army Armor Center and Fort Knox
Fort Knox, Kentucky 40121

RE: Tentative No Further Action (TNFA)
St. John Tank Motor Park Remediation (AOC)
Gasoline Can Storage Bldg Area & Area of Stressed Vegetation
USAARMC and Ft. Knox
Ft. Knox, Hardin County, Kentucky
EPA ID#: KY6-210-020-479
AI#: 1642

Dear Mr. Walsh:

The Kentucky Division of Waste Management (Division), Hazardous Waste Branch has completed a review of the report entitled *St. John Tank Motor Park Remediation*. According to the data it appears that the remediated areas listed above require no further action (NFA). The Division has no further comments. The conclusion of this approval and NFA is contingent upon the fulfillment and finalization of all final public notice requirements and final permit modifications concerning this AOC.

This approval is based upon the information supplied by Ft. Knox. The Division reserves the right to require additional investigations or modification to this and/or future plan(s), should new information indicate it does not comply with applicable statutes or regulations.

If you have any questions or if we can be of further assistance, please contact Chris Jung at (502) 564-6716 extension 4716 or christopher.jung@ky.gov.

Sincerely,

April J. Webb, P.E., Manager
Hazardous Waste Branch

AJW/chj

ec: donnie.megar@us.army.mil
james.c.albright@us.army.mil
teasley.leonna@epa.gov
alan.freed@us.army.mil
walter.r.green@usace.army.mil

ST. JOHN TANK MOTOR PARK REMEDIATION
(SOIL REMOVAL AND ASSOCIATED TASKS)
FINAL REPORT

Prepared for

US Army Corps
of Engineers®

NASHVILLE DISTRICT

CONTRACT NO. W912P5-08-P-0203

Date: September 2009

ST. JOHN TANK MOTOR PARK REMEDIATION
(SOIL REMOVAL AND ASSOCIATED TASKS)
FORT KNOX, KENTUCKY

FINAL REPORT

Prepared for
U.S. Army Corps of Engineers
Nashville District
Under Contract No W912P5-08-80203

Prepared by
Chris Ward
TriEco LLC

TriEco

integrity • knowledge • imagination

Date: September 2009

ST. JOHN TANK MOTOR PARK REMEDIATION
(SOIL REMOVAL AND ASSOCIATED TASKS)
FORT KNOX, KENTUCKY

Contract No. W912P5-08-P-0203

Submitted by:

Chris Ward
Project Manager
TriEco LLC

Date

Accepted by:

Walter Green
Technical Coordinator for the Product
U.S. Army Corps of Engineers
Nashville District

Date

Doug Mullendore
Chief, Environmental Restoration Branch
U.S. Army Corps of Engineers
Nashville District

Date

ACRONYMS

BGS	Below Ground Surface
COE	Corps of Engineers
EPA	Environmental Protection Agency
GPS	Global Positioning System
KDEP	Kentucky Department of Environmental Protection
PAH	Polycyclic Aromatic Hydrocarbon
PID	Photoionization Detector
PRG	Preliminary Remediation Goal
SSHP	Site Safety and Health Plan
SW-846	Test Methods for Evaluating Solid Waste, Physical / Chemical Methods
TCLP	Toxicity Characteristic Leaching Procedure
USACE	U.S. Army Corps of Engineers

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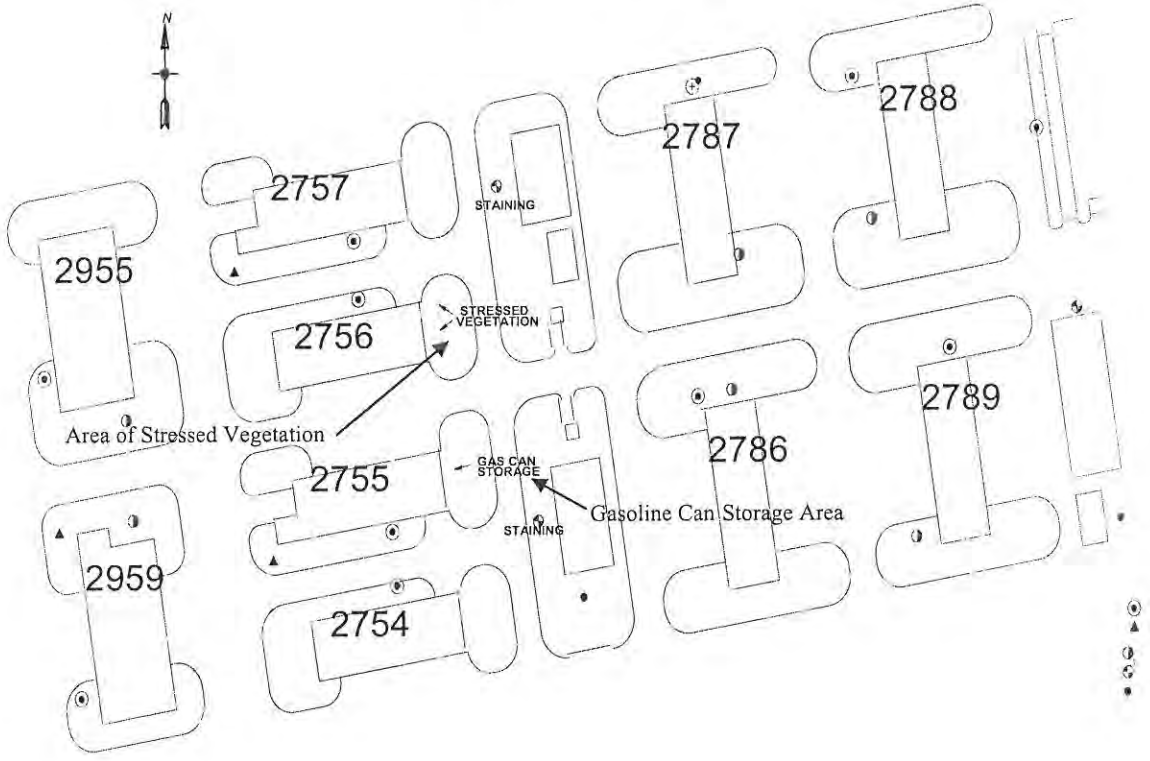
ST. JOHNS TANK MOTOR PARK
CONTRACT# W912P5-08-P-0203
FINAL REPORT

1.0 INTRODUCTION

The Fort Knox Military Reservation, occupying 109,270-acres of land in north-central Kentucky, is located about 30 miles south of Louisville and 18 miles north of Elizabethtown. Portions of Fort Knox are located in Hardin, Meade, and Bullitt Counties. Fort Knox is an active U.S. Army Armor Training Center. The site has been in use as a military installation since 1918, and was established as a permanent installation called Fort Knox in 1932.

The St. John Motor Park is located in the north-central portion of the containment area. The southeast quadrant of the motor park is planned for potential redevelopment. The project area is a rectangle bounded on the west by the grassy areas immediately west of Buildings 2955 and 2959, an the north by the limits of the grassy areas just north of Buildings 2955 and 2757, on the east by the fence running north-south just east of Buildings 2788 and 2789 and on the south by the fence running east-west just south of Buildings 2789 and 2959.

Figure 1
Location of Excavation Areas



2.0 PROJECT SCOPE

The purpose of this project was the removal and disposal of contaminated soil at two locations within the St. John Motor Park. The two areas are described as the "Gasoline Can Storage Bldg Area and the Area of Stressed Vegetation East of Bldg. 2756." (See Figure 1)

The scope included all necessary personnel, facilities, equipment, and materials required for the following associated activities:

- Excavation of contaminated soils (Approximately 44 yards);
- Transportation and disposal of excavated material;
- Collection and analysis of confirmatory samples;
- Backfilling of excavated areas;
- Seed and straw for vegetation of disturbed areas; and
- Preparation of a final report detailing the completion of project objectives for Ft. Knox submission to KDEP.

3.0 PURPOSE

The purpose of this document is to provide a narrative report detailing associated remedial activities, sampling actions, and laboratory data comparison utilized for the successful completion of all aspects related to Contract # W912P5-08-P-023.

4.0 SUMMARY OF PREVIOUS INVESTIGATIONS

The Nashville District, United States Army Corps of Engineers and its contractor, SAIC, performed an investigation and prepared a draft Confirmatory Sampling Report, dated March 2007, KDEP reviewed the report and did not have comments that impacted the recommendations.

The report determined that there is minor contamination at two locations: 1) the area around the gasoline can storage building east of the Building 2755, and 2) the area of stressed vegetation just east of Building 2756.

At each of these two sites, the 0-2 foot BGS interval was sampled. One (1) boring was advanced at each site.

At the area of stressed vegetation, the surface soil sample contained a detection of benzo(a)pyrene above both residential and industrial PRGs. This same sample contained magnesium detected above the residential but below the industrial PRG.

At the gasoline can storage area, the surface soil sample contained detections of benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene above both residential and industrial PRGs. Indeno(1,2,3-cd)pyrene exceeded the residential PRGs but not the industrial.

5.0 SUMMARY OF PROJECT ACTIVITIES PRIOR TO MOBILIZATION

The following project related activities were conducted prior to mobilization of personnel and equipment for the excavation and disposal operations:

- The Ft. Knox Directory of Public Works was contacted and the Utility Excavation Permit Procedure for the identification of underground utilities was implemented.
- A review of all previously collected analytical data was conducted. This review identified the following:
  - The area of distressed vegetation met all criteria for Non-Hazardous Special Waste under KDEP provisions.
  - The Gas Can Storage Area met all criteria for Non-Hazardous Special Waste under KDEP provisions with the exception of lead which showed a "total" value of 204 mg/kg.
  - In view of the high total lead value, the Gas Can Storage Area was representatively resampled for TCLP lead. The results obtained for this sampling event was 0.047 mg/L, well below the 5.0 mg/L TCLP limit established in 40 CFR 261.24. (See Attachment 1)
  - Based on the above verification the Gas Can Storage Area was deemed acceptable under the KDEP Special Waste Provisions.
  - A waste stream disposal profile for both areas was completed and submitted to the Waste Management Outerloop Landfill for approval.
  - The submitted profile was approved by Waste Management on July 7, 2009. (See Attachment 2)

6.0 EXCAVATION AND DISPOSAL

Upon receipt of the waste stream approval and all utility clearances project mobilization and remediation efforts were initiated on July 15, 2009 as follows:

- All personnel and equipment were mobilized to the project location.
- The "Gas Can Storage Area" was designated to be remediated first.
- The original "Sampling Point" was located utilizing GPS coordinates and historical photographic images from the former sampling event.
- Utilizing the original sampling location as a center point a 17' x 17' square was measured off and marked with pin flags to represent the area of excavation.
- A Cat 318 Trackhoe with a cutting edge bucket and a triaxle dump truck operated by Skaggs Trucking were positioned and the excavation phase began.
- Excavated soil was direct loaded into the awaiting transport vehicles.
- The excavated area was continually evaluated for areas of discoloration, odors and by use of a PID.
- Soil was removed from the designated area in approximately 6" lifts.
- At approximately the 1.5 foot level all soil appeared homogeneous with no visible discoloration, no petroleum odors and no appreciable PID readings.
- Excavation of the Gas Can Storage Area was halted and the Trackhoe bucket deconned in preparation for the excavation of the "Areas of Distressed Vegetation."
- The total weight of material removed from the Gas Can Storage Area was 17.41 tons (approximately 16 cu yds) which included the demolished storage shed. All material was disposed at the Waste Management Outerloop Facility.
- The excavated pit was then sampled for PAH compounds in accordance with confirmatory sampling requirements as follows:
  - JG-1 (South Wall)
  - JG-2 (West Wall)
  - JG-3 (East Wall)
  - JG-4 (North Wall)
  - JG-5 (Floor)

- The excavated pit was then secured via construction fencing and the "Area of Distressed Vegetation" was readied for excavation.
- Unlike the "Gas Can Storage Area" which was shaded with a good growth of grass, the "Area of Distressed Vegetation" was predominately gravel covered and extensively used for vehicle parking.
- Once again the original sample location was utilized as a center point and an 18' x 18' square area was delineated as the area to be excavated.
- The trackhoe and triaxle dump truck were positioned and the excavation initiated.
- All the excavated materials were directly loaded into the transport vehicle for disposal at the Waste Management Outerloop Facility.
- Material was excavated to an approximate depth of 2 feet. At this point most of the pit appeared homogeneous; however, a small 3' x 6' area exhibited signs of discoloration. In view of this, the 3' x 6' area was removed down to the 3.5 foot level at which point all material appeared homogeneous.
- The total weight of material removed was 51.16 tons (approximately 30 cu yds).
- The excavated pit was then sampled for PAH compounds in accordance with Confirmatory Sampling requirements as follows:
  - JD-1 (South Wall)
  - JD-2 (West Wall)
  - JD-3 (East Wall)
  - JD-4 (North Wall)
  - JD-5 (Floor)
- The excavated pit was then secured with construction fencing.
- The collected confirmatory samples from both excavations were packaged and sent to Empirical Labs in Nashville, TN for PAH analysis.
- The project was demobed until analytical data was received and verified for further excavation or backfill approval. (See Attachment 6 for Special Waste Tracking Documents and associated Waste Tickets.)

7.0 CONFIRMATORY SAMPLING, DATA VALIDATION AND EVALUATION

7.1 Confirmatory Sampling

Five (5) discrete samples were collected from each of the two excavated areas (four sidewalls and one bottom) for a total of ten confirmatory samples. (See Attachment 3)

The samples were secured in a cooler with ice to achieve laboratory acceptance criteria for PAH analysis.

A Chain of Custody form was completed and the samples were shipped Fed X to Empirical Laboratories in Nashville, TN the same day.

All ten confirmatory samples were sent to Empirical Laboratories, Nashville, TN a DOD QSM verified laboratory following Test Method for Evaluating Solid Waste, Physical/Chemical Methods, (SW-846) Protocols.

The ten samples were analyzed for PAH compounds (See Figure 2 below) utilizing SW-846 Method 3541/8270C with reporting limits at or below EPA Region 9 PRGS (2002). A complete Data Package is included as Attachment 4.

Figure 2- PAH Target Analyte List

PAH	CAS
Acenaphthene	83-32-9
Acenaphthylene	208-96-8
Anthracene	120-12-7
Benzo(a)anthracene	56-55-3
Benzo(b)fluoranthene	205-99-2
Benzo(k)fluoranthene	207-08-9
Benzo(ghi)perylene	191-24-2
Benzo(a)pyrene	50-32-8
Chrysene	218-01-9
Dibenz(a,h)anthracene	53-70-3
Fluoranthene	206-44-0
Fluorene	86-73-7
Indeno(1,2,3-cd)pyrene	193-39-5-
Naphthalene	91-20-3
Phenanthrene	85-01-8
Pyrene	129-00-0

7.2 Data Validation

All sample data was validated by Data Check following the logic identified in "The CLP National Functional Guidelines for Organic Data Review (June 2008)."

A Level III data validation was performed on all samples collected and all data was found acceptable for use as qualified. A copy of the Data Validation Report is included as Attachment 5.

7.3 Data Evaluation

The analytical results from the confirmatory sampling were evaluated against two sets of criteria:

- US EPA Region 9 Residential Soil PRGs
- US EPA Region 9 Industrial Soil PRGs

The results were initially compared to the most conservative criteria, US EPA Region 9 Residential Soil PRGs (2002). All sample results were found to be well below the established Residential PRG limits, therefore no further comparisons to the Industrial Soil PRGs were required. (See Tables 1 and 2)

Based on the Data Validation and subsequent evaluation, Mr. Walter Green with the USACE Nashville District was contacted with the above findings. It was at this time that approval to commence backfill operations was granted.

8.0 BACKFILL OPERATIONS

The two excavated pits were backfilled as follows:

- The "Gas Can Storage Area" was backfilled with an initial 6" layer of sand followed by a 1' mounded layer of topsoil. The area was then seeded utilizing 10 lbs of a rapid growth fescue mixture followed by a layer of straw to promote growth.
- The "Area of Stressed Vegetation" was backfilled with an initial 6" layer of sand followed by Dense Grade Aggregate (DGA) until filled. Left over DGA was spread over the remaining area to facilitate future vehicle parking. (See Attachment 7 for backfill receipts.)

9.0 PROJECT PHOTOGRAPHS

See Attachment 8.

Tables 1 & 2

Confirmation Sample Results

CONFIRMATORY SAMPLE RESULTS
GAS CAN STORAGE AREA
TABLE 1

PAH ANALYTE	RESIDENTIAL PRG	SAMPLE # JG-1	SAMPLE # JG-2	SAMPLE # JG-3	SAMPLE # JG-4	SAMPLE # JG-5
Acenaphthene	3.7E+06	1.4 U	1.3 U	1.4 U	1.7 U	1.3 U
Acenaphthylene	3.7E+06	1.3 UJ	1.2 UJ	1.3 UJ	1.6 UJ	1.2 U
Anthracene	2.2E+07	0.92 U	0.88 U	0.93 U	1.1 U	0.88 U
Benzo(a)anthracene	6.2E+02	1.6 U	12.0 J	1.6 U	2.0 U	1.5 U
Benzo(b)fluoranthene	6.2E+02	1.8 U	3.4 J	1.8 U	2.2 U	1.7 U
Benzo(k)fluoranthene	6.2E+03	1.5 U	1.4 U	1.5 U	1.8 U	1.4 U
Benzo(ghi)perylene	2.3E+06	1.7 U	1.6 U	1.7 U	2.1 U	1.6 U
Benzo(a)pyrene	6.2E+01	1.2 U	1.1 U	1.2 U	1.4 U	1.1 U
Chrysene	6.2E+04	1.2 U	6.3 J	1.2 U	1.5 U	1.2 U
Dibenz(a,h)anthracene	6.2E+01	1.8 U	1.7 U	1.8 U	2.2 U	1.7 U
Fluoranthene	2.3E+06	1.9 U	1.8 U	1.9 U	2.3 U	1.8 U
Fluorene	2.7E+06	1.4 U	1.3 U	1.4 U	1.7 U	1.3 U
Indeno(1,2,3-cd)pyrene	6.2E+02	1.8 U	30.0 J	1.8 U	2.2 U	1.7 U
Naphthalene	5.6E+04	2.7 U	2.6 U	2.7 U	3.3 U	2.6 U
Phenanthrene	2.3E+06	1.9 U	7.5 J	1.9 U	2.3 U	1.8 U
Pyrene	2.3E+06	1..8 U	1.7 U	1.8 U	2.2 U	1.7 U

All data in ug/kg
Shaded values are validated detections
J = Analyte was positively identified: The result is the approximate concentration
U = Analyte was analyzed for but not detected or the concentration of the analyte quantified below the MDL.
UJ = The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

CONFIRMATORY SAMPLE RESULTS
AREA OF DISTRESSED VEGITATION
TABLE 2

PAH ANALYTE	RESIDENTIAL PRG	SAMPLE # JD-1	SAMPLE # JD-2	SAMPLE # JD-3	SAMPLE # JD-4	SAMPLE # JD-5
Acenaphthene	3.7E+06	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U
Acenaphthylene	3.7E+06	1.4 UJ	1.4 UJ	1.4 UJ	1.3 UJ	1.3 UJ
Anthracene	2.2E+07	0.97 U	0.96 U	0.96 U	0.94 U	0.95 U
Benzo(a)anthracene	6.2E+02	1.7 U	1.7 U	9.0 J	9.9 J	1.6 U
Benzo(b)fluoranthene	6.2E+02	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U
Benzo(k)fluoranthene	6.2E+03	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U
Benzo(ghi)perylene	2.3E+06	1.8 U	1.8 U	1.8 U	1.7 U	1.7 U
Benzo(a)pyrene	6.2E+01	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U
Chrysene	6.2E+04	1.3 U	1.3 U	2.3 J	2.6 J	1.3 U
Dibenz(a,h)anthracene	6.2E+01	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U
Fluoranthene	2.3E+06	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Fluorene	2.7E+06	1.4 U	1.5 J	1.4 U	1.8 J	1.4 U
Indeno(1,2,3-cd)pyrene	6.2E+02	1.8 U	1.8 U	30.0 J	30.0 J	1.8 U
Naphthalene	5.6E+04	2.8 U	7.2 J	2.8 U	7.4 J	2.8 U
Phenanthrene	2.3E+06	2.5 J	2.7 J	6.8 J	5.6 J	2.0 U
Pyrene	2.3E+06	1..8 U	1.8 U	1.8 U	1.8 U	1.8 U

All data in ug/kg
Shaded values are validated detections
J = Analyte was positively identified: The result is the approximate concentration
U = Analyte was analyzed for but not detected or the concentration of the analyte quantified below the MDL.
UJ = The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

Attachment 1

"Gas Can Storage Area" TCLP Results

USEPA - CLP

-1-

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

Storage Shed

Lab Name: Empirical Laboratories Contract: TriEco

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: 0906251

Matrix (soil/water): TCLP Lab Sample ID: 0906251-01

Level (low/med): LOW Date Received: 06/26/09

% Solids: _____

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7439-92-1	Lead	46.9			P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

Form I - IN

CLIENT: Trieco
PROJECT: ST. JOHN'S TANK MOTOR PARK
DATE RECEIVED: 06/26/09
DATE REPORTED: 07/02/09

EMPIRICAL LABORATORIES SAMPLE NUMBER				0906251-01
CLIENT SAMPLE DESCRIPTION/SAMPLING DATE				Storage Shed 6/25/09 12:30
ANALYTES	REPORTING LIMITS	USEPA METHOD	UNITS	CONC
TCLP Lead	0.030	EPA 6010B	mg/L	0.047

See attached page for definitions of terms and qualifiers.

EMPIRICAL LABORATORIES

for

D. Rick Davis
Vice President

Empirical Laboratories, LLC

ANALYTICAL REPORT NOTES, TERMS AND QUALIFIERS (INORGANIC)

Notes:

The metals and cyanide reporting limits (RLs) have been statistically determined to be no less than three standard deviations as defined in 40 CFR 136, Appendix B, Revision 1.11. All other reporting limits are referenced from the specific analytical method.

Terms:

NA Not Applicable

NR Not Requested

Qualifiers:

B The reported value is less than the practical quantitation limit (PQL, project defined) but greater than or equal to the MDL.

E The reported value is estimated due to the presence of matrix interference.

N Predigested spike recovery not within control limits.

* RPD or absolute difference for Duplicate analysis not within control limits.

** Reference Standard Methods 19th edition.

(1) pH analyzed outside USEPA specified holding time. pH must be measured immediately after sample collection.

(2) The sample pH did not meet the preservation guidelines. Therefore the pH was adjusted upon receipt.

(3) Reference Standard Methods 17th edition for the distillation method.

(4) The sample was analyzed out of the USEPA holding time.

(5) The sample was received in the laboratory out of the USEPA holding time.

(6) The shipping cooler temperature exceeded 6°C upon receipt to Empirical Laboratories.

(7) Analysis was subcontracted

TriEco
integrity • knowledge • imagination

CONTACT: CHRIS WARD
(502)609-2630
EMAIL : CWARD@TRIECO.NET

CHAIN OF CUSTODY RECORD

Customer:	Project Name:	Project ID #:
FT. KNOX	ST JOHNS TANK MOTOR PARK	W912P5-08-P-0203

Samplers (Signature) Print Name:

Sample Number	Sample Location	Date	Time	Sample Type: Water Comp	Sample Type: Water Grab	Sample Type: Soil	No. of Cont.	Analysis Required
JG-TCLP	STORAGE SHED	6/25	12:30pm			✓	1	TCLP - LEAD - 01
								0906251

Relinquished by: (Signature) Chris Ward	**Received by:** (Signature)	**Date/Time**
Relinquished by: (Signature)	**Received by:** (Signature)	**Date/Time**
Relinquished by: (Signature)	**Received by:** (Signature)	**Date/Time**
Relinquished by: (Signature)	**Received by:** (Signature)	**Date/Time** 6/26/09 08:15
Conditions Upon Receipt: 19.6°C		**Remarks:**

EMPIRICAL LABORATORIES
COOLER RECEIPT FORM

LIMS Number: 0906251 Number of Coolers: 1 of 1

Client: Trieco Project: St. Johns Tank Motor Park

Date/Time Received: **06/26/09 08:15** Date cooler(s) opened: **06/26/09**

Opened By (print): **WILLIAM SCHWAB** (signature): [signature]

Circle response below as appropriate

1. How did the samples arrive?: FedEx UPS DHL Hand Delivered
EL Courier Other: _____

If applicable, enter airbill number here: 7607

2. Were custody seals on outside of cooler(s)? ..... Yes (No)

How many: — Seal date: — Seal Initials: —

3. Were custody seals unbroken and intact at the date and time of arrival?	Yes	No	(N/A)
4. Were custody papers sealed in a plastic bag included in the sample cooler?	(Yes)	No	N/A
5. Were custody papers filled out properly (ink, signed, etc.)?	(Yes)	No	N/A
6. Did you sign custody papers in the appropriate place for acceptance?	(Yes)	No	N/A
7. Was project identifiable from custody papers?	(Yes)	No	N/A
8. If required, was enough ice present in the cooler(s)?	Yes	No	(N/A)

Type of Coolant: WET DRY BLUE (NONE) Temperature of Samples upon Receipt: 19.6c

Dates samples were logged-in: **06/26/09**

9. Initial this form to acknowledge login of sample(s): (Name): **WILLIAM SCHWAB** (Initial): WS

10. Were all bottle lids intact and sealed tightly?	(Yes)	No	N/A
11. Did all bottles arrive unbroken?	(Yes)	No	N/A
12. Was all required bottle label information complete?	(Yes)	No	N/A
13. Did all bottle labels agree with custody papers?	(Yes)	No	N/A
14. Were correct containers used for the analyses indicated?	(Yes)	No	N/A
15. Were preservative levels correct in all applicable sample containers?	Yes	No	(N/A)
16. Was residual chlorine present in any applicable sample containers?	Yes	No	(N/A)
17. Was sufficient amount of sample sent for the analyses required?	(Yes)	No	N/A
18. Was headspace present in any included VOA vials?	Yes	No	(N/A)

If Non-Conformance issues were present, list by sample ID: _____

_____ CAR#: _____

Attachment 2

Approved Waste Profile

JUN-23-2008 12:18 From:DPW FORT 15026243000 FAX NO. 18025677299 P. 02
JUN-22-2008 MON 03:07 PM CHASE ENVIRONMENTAL

Generator's Nonhazardous Waste Profile Sheet

Requested Disposal Facility Outer Loop Recycling & Disposal Facility Profile Number 103735KY 1-6-10
☐ Renewal for Profile Number ____ Waste Approval Expiration Date ____

A. Waste Generator/Facility Information (must reflect location of waste generation/origin)

1. Generator Name: Fort Knox US Army Garrison
2. Site Address: St.John Tank Motor Park
3. City/ZIP: Fort Knox, 40121
4. State: KY
5. County: Meade
6. Contact Name/Title: Luther Jenkins
7. Email Address: ____
8. Phone: (502) 624-8378 9. FAX: (502) 624-3000
10. NAICS Code: 928110
11. Generator USEPA ID #: ____
12. State ID# (if applicable): ____

B. Customer Information ☐ same as above

P. O. Number ____

1. Customer Name: TRUECO LLC
2. Billing Address: 7710 Springvale Dr, Suite 201
3. City, State and ZIP: Louisville, KY, 40241
4. Contact Name: Chris Ward
5. Contact Email: cward@trueco.net
6. Phone: 502 609-2630 FAX: 502 267-7299
7. Transporter Name: ____
8. Transporter ID # (if appl): ____
9. Transporter Address: ____
10. City, State and ZIP: ____

C. Waste Stream Information

1. DESCRIPTION
   a. Common Waste Name: Petroleum Contaminated Soil
      State Waste Code(s): ____
   b. Describe Process Generating Waste or Source of Contamination:
      Remediation of Contaminated Soil at the St.John Tank Motor Park
   c. Typical Color(s): Soil
   d. Strong Odor? ☐ Yes ☑ No Describe: ____
   e. Physical State at 70°F: ☑ Solid ☐ Liquid ☐ Powder ☐ Semi-Solid or Sludge ☐ Other: ____
   f. Layers? ☑ Single Layer ☐ Multi-Layer ☐ NA
   g. Water Reactive? ☐ Yes ☑ No If Yes, Describe: ____
   h. Free Liquid Range (%): ____ to ____ ☑ NA(solid)
   i. pH Range: ☐ ≤2 ☑ 2.1-12.4 ☐ ≥12.5 ☐ NA(solid) ☐ Actual: ____
   j. Liquid Flash Point: ☐ < 140°F ☐ ≥ 140°F ☑ NA(solid) ☐ Actual: ____
   k. Flammable Solid: ☐ Yes ☑ No
   l. Physical Constituents: List all constituents of waste stream - (e.g. Soil 0-60%, Wood 0-20%): ☐ (See Attached)

Constituents (Total Composition Must Be = 100%)	Lower Range	Unit of Measure	Upper Range	Unit of Measure
1. Soil contaminated with diesel	95%			
2. Debris (stone,wood)	5%			
3.				
4.				
5.				
6.				

2. ESTIMATED QUANTITY OF WASTE AND SHIPPING INFORMATION
   a. ☑ One Time Event ☐ Base ☐ Repeat Event
   b. Estimated Annual Quantity: 44 ☐ Tons ☑ Cubic Yards ☐ Drums ☐ Gallons ☐ Other (specify): ____
   c. Shipping Frequency: ____ Units per ☐ Month ☐ Quarter ☐ Year ☑ One Time ☐ Other
   d. Is this a U.S. Department of Transportation (USDOT) Hazardous Material? (If yes, answer e.) ☐ Yes ☑ No
   e. USDOT Shipping Description (if applicable): ____
3. SAFETY REQUIREMENTS (Handling, PPE, etc.): n/a

JUN-22-2009 MON 03:08 PM CHASE ENVIROMENTAL FAX NO. 502 267 7288 P. 03

Generator's Nonhazardous Waste Profile Sheet

WM WASTE MANAGEMENT

10373GKY

B. Regulatory Status (Please check appropriate responses)

1. Is this a USEPA (40 CFR Part 261)/State hazardous waste? If yes, contact your sales representative. ☐ Yes ☑ No
2. Is this waste included in one or more of categories below (Check all that apply)? If yes, attach supporting documentation. ☐ Yes ☑ No
   - ☐ Delisted Hazardous Waste
   - ☐ Excluded Wastes Under 40 CFR 261.6
   - ☐ Treated Hazardous Waste Debris
   - ☐ Treated Characteristic Hazardous Waste
3. Is the waste from a Federal (40 CFR 300, Appendix B) or state mandated clean-up? If yes, see instructions. ☐ Yes ☑ No
4. Does the waste represented by this waste profile sheet contain radioactive material? ☐ Yes ☑ No
   a. If yes, is disposal regulated by the Nuclear Regulatory Commission? ☐ Yes ☐ No
   b. If yes, is disposal regulated by a State Agency for radioactive waste/NORM? ☐ Yes ☐ No
5. Does the waste represented by this waste profile sheet contain concentrations of regulated Polychlorinated Biphenyls (PCBs)? ☐ Yes ☑ No
   a. If yes, is disposal regulated under TSCA? ☐ Yes ☐ No
6. Does the waste contain untreated, regulated, medical or infectious waste? ☐ Yes ☑ No
7. Does the waste contain asbestos? If Yes, ☐ Friable ☐ Non Friable
8. Is this profile for remediation waste from a facility that is a major source of Hazardous Air Pollutants (Site Remediation NESHAP, 40 CFR 63 subpart GGGGG)? ☐ Yes ☑ No
   If yes, does the waste contain <500 ppmw VOHAPs at the point of determination? ☐ Yes ☐ No

C. Generator Certification (Please read and certify by signature below)

By signing this Generator's Waste Profile Sheet, I hereby certify that all:

1. Information submitted in this profile and all attached documents contain true and accurate descriptions of the waste material;
2. Relevant information within the possession of the Generator regarding known or suspected hazards pertaining to this waste has been disclosed to WM/the Contractor;
3. Analytical data attached pertaining to the profiled waste was derived from testing a representative sample in accordance with 40 CFR 261.20(c) or equivalent rules; and
4. Changes that occur in the character of the waste (i.e. changes in the process or new analytical) will be identified by the Generator and disclosed to WM (and the Contractor if applicable) prior to providing the waste to WM (and the Contractor if applicable).
5. Check all that apply:
   - ☐ Attached analytical pertains to the waste. Identify laboratory & sample ID #'s and parameters tested: _____ # Pages: _____
   - ☐ Only the analyses identified on the attachment pertain to the waste (identify by laboratory & sample ID #'s and parameters tested). Attachment #: _____
   - ☑ Additional information necessary to characterize the profiled waste has been attached (other than analytical). Indicate the number of attached pages: _____
   - ☐ I am an agent signing on behalf of the Generator, and the delegation of authority to me from the Generator for this signature is available upon request.
   - ☐ By Generator process knowledge, the following waste is not a listed waste and is below all TCLP regulatory limits.

Certification Signature: _____ Title: Chief, Compliance Br, EMD

Company Name: US Army Garrison, Ft Knox Name (Print): Donnie McGar

Date: 6/23/09

FOR WM USE ONLY

Management Method: ☒ Landfill ☐ Bioremediation ☐ Non-hazardous solidification ☐ Other: _____

Approval Decision: ☒ Approved ☐ Not Approved

Waste Approval Expiration Date: 1-6-10

Management Facility Precautions, Special Handling Procedures or Limitation on approval:

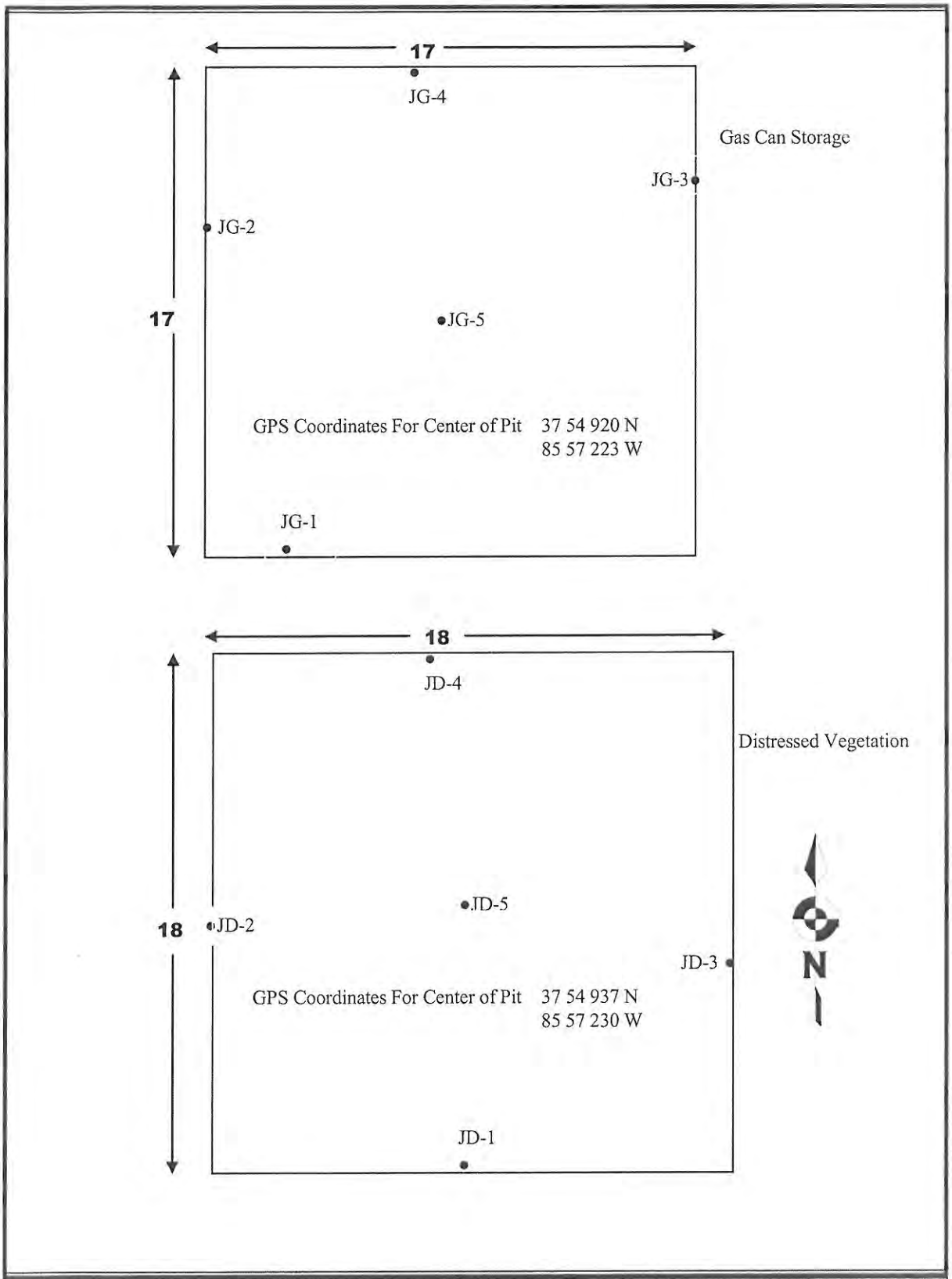
- ☐ Shall not contain free liquid
- ☐ Shipment must be scheduled into disposal facility
- ☐ Approval Number must accompany each shipment
- ☐ Waste Manifest must accompany load

WM Authorization Name / Title: Sara Adams Date: 1-6-09

State Authorization (if Required): _____ Date: _____

Attachment 3

Diagrams of Confirmatory Sample Locations



TriEco	Title **Figure 1** Site Map Confirmatory Sampling Locations

SCALE 1 in = 5 ft
ST. John Tank Motor Park
Excavations

Attachment 4

Confirmatory Sample Data Package

Analytical Report

Main Data Package – PAH

Trieco, LLC.
Chris Ward
11450 Watterson Ct.
Louisville, KY 40299

WO #0907151

Empirical Laboratories, LLC
621 Mainstream Drive, Suite 270
Nashville, TN 37228
615-345-1115

Ashley Bester
Project Manager

July 28, 2009

THIS DOCUMENT MEETS NELAC STANDARDS
NELAC Certification #TN473

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WO #0907151

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ORGANIC CASE NARRATIVE
Trieco
Work Orders: 0907151

Sampled	Rec'd	Lab ID	Client ID
07/15/09	07/16/09	0907151-01	JG-1
07/15/09	07/16/09	0907151-02	JG-2
07/15/09	07/16/09	0907151-03	JG-3
07/15/09	07/16/09	0907151-04	JG-4
07/15/09	07/16/09	0907151-05	JG-5
07/15/09	07/16/09	0907151-06	JD-1
07/15/09	07/16/09	0907151-07	JD-2
07/15/09	07/16/09	0907151-08	JD-3
07/15/09	07/16/09	0907151-09	JD-4
07/15/09	07/16/09	0907151-10	JD-5

PAH Samples

Method: The samples were analyzed by USEPA SW-846 Methods 3541/8270C (automated soxhlet extraction followed by capillary column GC/MS using selected ion monitoring or SIM) for soils upon receipt to the laboratory in satisfactory condition.

Comments: The analyses for these samples were satisfactorily completed within sample holding times and met the corresponding specifications with the following exceptions:

- DFTPP Tuning: All method tuning criteria were met.
- Initial Calibration Criteria: All initial calibration criteria were met.
- Continuing Calibration Verification: In the continuing calibration verification analyzed on 07/21/09 at 2111, acenaphthylene exceeded 20% difference with a positive bias of 26%. No positive results for acenaphthylene were detected in the associated samples and all other continuing calibration criteria were met.
- Method Blank Results: No target analytes were detected in the method blanks.
- Surrogate Recoveries: In spike SBLK0720BS1LCS the surrogate terphenyl-d14 exceeded the limit of 129% at 165%. All other surrogate recoveries were within limits.
- SBLK0720BS1LCS Results: All recoveries were within limits.
- JG-3MS/MSD Results: All recoveries and relative percent differences were within limits.
- Internal Standard Area Counts: All area counts were within limits.
- Dilutions: Samples were analyzed without dilution

I certify that, to the best of my knowledge and based upon my inquiry of those individuals immediately responsible for obtaining the information, the data package is in compliance with the terms and conditions of the contract, both technically and for completeness, with the exception of the conditions detailed in the case narrative, as verified by the following signature.

Marcia K. McGinnity
Senior Project Manager

ANALYTICAL REPORT TERMS AND QUALIFIERS (ORGANIC)

MDL: The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The MDL is determined from analysis of a sample containing the analyte in a given matrix.

EQL: The estimated quantitation limit (EQL), also known as reporting limit (RL), is defined as the estimated concentration above which quantitative results can be obtained with a specific degree of confidence. Empirical Laboratories defines the EQL to be at or near the lowest standard of the calibration curve.

U: The presence of a "U" indicates that the analyte was analyzed for but was not detected or the concentration of the analyte quantitated below the MDL.

B: The presence of a "B" to the right of an analytical value indicates that this compound was also detected in the method blank and the data should be interpreted with caution. One should consider the possibility that the correct sample result might be less than the reported result and, perhaps, zero.

D: When a sample (or sample extract) is rerun diluted because one of the compound concentrations exceeded the highest concentration range for the standard curve, all of the values obtained in the dilution run will be flagged with a "D".

E: The concentration for any compound found which exceeds the highest concentration level on the standard curve for that compound will be flagged with an "E". Usually the sample will be rerun at a dilution to quantitate the flagged compound.

J: The presence of a "J" to the right of an analytical result indicates that the reported result is estimated. The mass spectral data pass the identification criteria showing that the compound is present, but the calculated result is less than the EQL. One should feel confident that the result is greater than zero and less than the EQL.

P: The associated numerical value is an estimated quantity. There is greater than a 40% difference between the two GC columns for the detected concentrations. The higher of the two values is reported unless matrix interference is obvious.

EMPIRICAL LABORATORIES, LLC - CHAIN OF CUSTODY RECORD

SHIP TO: 621 Mainstream Drive, Suite 270 ♦ Nashville, TN 37228 ♦ 615-345-1115 ♦ (fax) 615-846-5426

6840

Send Results to:	Send Invoice to:
Name CHRIS WARD	Name CHRIS WARD
Company TRIECO LLC	Company TRIECO LLC
Address 11450 WATTERSON CT	Address 7710 SPRING VALE DR
City LOUISVILLE	City LOUISVILLE
State, Zip KY 40299	State, Zip KY 40241
Phone (502) 609-2630	Phone (502) 609-2630
Fax (502) 267-7299	Fax (502) 267-7299
E-mail CWARD@TRIECO.NET	E-mail CWARD@TRIECO.NET
Project No./Name:	**Sampler's (Signature):**

Analysis Requirements: PAH (8270)

Lab Use Only:

	Y	N	NA
VOA Headspace	Y	N	(NA)
Field Filtered	Y	(N)	NA
Correct Containers	(Y)	N	NA
Discrepancies	Y	(N)	NA
Cust. Seals Intact	(Y)	N	NA
Containers Intact	(Y)	N	NA

Airbill #: 9750

CAR #: —

Lab Use Only Lab #	Date/Time Sampled	Sample Description	Sample Matrix	Comments	No. of Bottles	Lab Use Only Containers/Pres.
0907151-01	7/15 11AM	JG-1	SOIL	SW-846(8270)	1	IM
-02	"	JG-2	"	"	1	
-03	"	JG-3	"	"	1	
-04	"	JG-4	"	"	1	
-05	"	JG-5	"	"	1	
-06	7/15 3pm	JD-1	SOIL	"	1	IM
-07	"	JD-2	"	"	1	
-08	"	JD-3	"	"	1	
-09	"	JD-4	"	"	1	
-10	"	JD-5	"	"	1	

	Date/Time		
Sample Kit Prep'd by: (Signature)		Received By: (Signature)	
Relinquished by: (Signature) C. Ward		Received By: (Signature)	
Relinquished by: (Signature)		Received By: (Signature)	
Received for Laboratory by: (Signature)	7/16/09	Temperature 3.9°C	

REMARKS:
ALL REPORTING LIMITS MUST BE AT OR BELOW EPA REGION 9 PRG's (2002)

Details:
Page ____ of ____
Cooler No. ____ of ____
Date Shipped ____
Shipped By ____
Turnaround ____

Distribution: Original and yellow copies accompany sample shipment to laboratory; Pink retained by samplers.

8X:30

Section: APPENDIX E
W912QR-12-R-0030
Page 405 of 1094
Wednesday, April 11, 2012

EMPIRICAL LABORATORIES
COOLER RECEIPT FORM

LIMS Number: 0907151 Number of Coolers: 1 of 1

Client: Trieco LLC Project: –

Date/Time Received: **07/16/09 08:30** Date cooler(s) opened: **07/16/09**

Opened By (print): **WILLIAM SCHWAB** (signature): [signature]

Circle response below as appropriate

1. How did the samples arrive?: FedEx UPS DHL Hand Delivered
EL Courier Other: _____

If applicable, enter airbill number here: 9750

2. Were custody seals on outside of cooler(s)? ..... (Yes) No

How many: 4 Seal date: 7/15/09 Seal Initials: CW

3. Were custody seals unbroken and intact at the date and time of arrival? ..... (Yes) No N/A
4. Were custody papers sealed in a plastic bag included in the sample cooler? ..... (Yes) No N/A
5. Were custody papers filled out properly (ink, signed, etc.)? ..... (Yes) No N/A
6. Did you sign custody papers in the appropriate place for acceptance? ..... (Yes) No N/A
7. Was project identifiable from custody papers? ..... Yes (No) N/A
8. If required, was enough ice present in the cooler(s)? ..... (Yes) No N/A

Type of Coolant: (WET) DRY BLUE NONE Temperature of Samples upon Receipt: 3.9°C

Dates samples were logged-in: **07/16/09**

9. Initial this form to acknowledge login of sample(s): (Name): **WILLIAM SCHWAB** (Initial): WS
10. Were all bottle lids intact and sealed tightly? ..... (Yes) No N/A
11. Did all bottles arrive unbroken? ..... (Yes) No N/A
12. Was all required bottle label information complete? ..... (Yes) No N/A
13. Did all bottle labels agree with custody papers? ..... (Yes) No N/A
14. Were correct containers used for the analyses indicated? ..... (Yes) No N/A
15. Were preservative levels correct in all applicable sample containers? ..... Yes No (N/A)
16. Was residual chlorine present in any applicable sample containers? ..... Yes No (N/A)
17. Was sufficient amount of sample sent for the analyses required? ..... (Yes) No N/A
18. Was headspace present in any included VOA vials? ..... Yes No (N/A)

If Non-Conformance issues were present, list by sample ID: _____

_____ CAR#: _____

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

JG-1

Lab Name: EMPIRICAL LABS Contract: TRIECO

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TRI.B07151

Matrix: (soil/water) SOIL Lab Sample ID: 0907151-01

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 0715101

% Moisture: 14 decanted: (Y/N) N Date Sampled: 07/15/09 11:00

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:07/20/09

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 07/22/09 00:46

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	54		U
208-96-8	Acenaphthylene	1.3	54		U
120-12-7	Anthracene	0.92	54		U
56-55-3	Benzo(a)anthracene	1.6	54		U
205-99-2	Benzo(b)fluoranthene	1.8	54		U
207-08-9	Benzo(k)fluoranthene	1.5	54		U
191-24-2	Benzo(g,h,i)perylene	1.7	54		U
50-32-8	Benzo(a)pyrene	1.2	27		U
218-01-9	Chrysene	1.2	54		U
53-70-3	Dibenz(a,h)anthracene	1.8	27		U
206-44-0	Fluoranthene	1.9	54		U
86-73-7	Fluorene	1.4	54		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	54		U
91-20-3	Naphthalene	2.7	54		U
85-01-8	Phenanthrene	1.9	54		U
129-00-0	Pyrene	1.8	54		U

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

JG-2

Lab Name: EMPIRICAL LABS Contract: TRIECO

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TRI.B07151

Matrix: (soil/water) SOIL Lab Sample ID: 0907151-02

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 0715102

% Moisture: 9 decanted: (Y/N) N Date Sampled: 07/15/09 11:00

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:07/20/09

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 07/22/09 01:21

Injection Volume: 0.5(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.3	51		U
208-96-8	Acenaphthylene	1.2	51		U
120-12-7	Anthracene	0.88	51		U
56-55-3	Benzo(a)anthracene	1.5	51	12	J
205-99-2	Benzo(b)fluoranthene	1.7	51	3.4	J
207-08-9	Benzo(k)fluoranthene	1.4	51		U
191-24-2	Benzo(g,h,i)perylene	1.6	51		U
50-32-8	Benzo(a)pyrene	1.1	26		U
218-01-9	Chrysene	1.2	51	6.3	J
53-70-3	Dibenz(a,h)anthracene	1.7	26		U
206-44-0	Fluoranthene	1.8	51		U
86-73-7	Fluorene	1.3	51		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.7	51	30	J
91-20-3	Naphthalene	2.6	51		U
85-01-8	Phenanthrene	1.8	51	7.5	J
129-00-0	Pyrene	1.7	51		U

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.
JG-3

Lab Name: EMPIRICAL LABS Contract: TRIECO

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TRI.B07151

Matrix: (soil/water) SOIL Lab Sample ID: 0907151-03

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 0715103

% Moisture: 14 decanted: (Y/N) N Date Sampled: 07/15/09 11:00

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:07/20/09

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 07/22/09 01:57

Injection Volume: 0.5(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	54		U
208-96-8	Acenaphthylene	1.3	54		U
120-12-7	Anthracene	0.93	54		U
56-55-3	Benzo(a)anthracene	1.6	54		U
205-99-2	Benzo(b)fluoranthene	1.8	54		U
207-08-9	Benzo(k)fluoranthene	1.5	54		U
191-24-2	Benzo(g,h,i)perylene	1.7	54		U
50-32-8	Benzo(a)pyrene	1.2	27		U
218-01-9	Chrysene	1.2	54		U
53-70-3	Dibenz(a,h)anthracene	1.8	27		U
206-44-0	Fluoranthene	1.9	54		U
86-73-7	Fluorene	1.4	54		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	54		U
91-20-3	Naphthalene	2.7	54		U
85-01-8	Phenanthrene	1.9	54		U
129-00-0	Pyrene	1.8	54		U

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.
JG-4

Lab Name: EMPIRICAL LABS Contract: TRIECO

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TRI.B07151

Matrix: (soil/water) SOIL Lab Sample ID: 0907151-04

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 0715104

% Moisture: 29 decanted: (Y/N) N Date Sampled: 07/15/09 11:00

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:07/20/09

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 07/22/09 02:33

Injection Volume: 0.5(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.7	66		U
208-96-8	Acenaphthylene	1.6	66		U
120-12-7	Anthracene	1.1	66		U
56-55-3	Benzo(a)anthracene	2.0	66		U
205-99-2	Benzo(b)fluoranthene	2.2	66		U
207-08-9	Benzo(k)fluoranthene	1.8	66		U
191-24-2	Benzo(g,h,i)perylene	2.1	66		U
50-32-8	Benzo(a)pyrene	1.4	33		U
218-01-9	Chrysene	1.5	66		U
53-70-3	Dibenz(a,h)anthracene	2.2	33		U
206-44-0	Fluoranthene	2.3	66		U
86-73-7	Fluorene	1.7	66		U
193-39-5	Indeno(1,2,3-cd)pyrene	2.2	66		U
91-20-3	Naphthalene	3.3	66		U
85-01-8	Phenanthrene	2.3	66		U
129-00-0	Pyrene	2.2	66		U

FORM I SV

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.
JG-5

Lab Name: EMPIRICAL LABS Contract: TRIECO

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TRI.B07151

Matrix: (soil/water) SOIL Lab Sample ID: 0907151-05

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 0715105

% Moisture: 9 decanted: (Y/N) N Date Sampled: 07/15/09 11:00

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:07/20/09

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 07/22/09 03:09

Injection Volume: 0.5(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.3	51		U
208-96-8	Acenaphthylene	1.2	51		U
120-12-7	Anthracene	0.88	51		U
56-55-3	Benzo(a)anthracene	1.5	51		U
205-99-2	Benzo(b)fluoranthene	1.7	51		U
207-08-9	Benzo(k)fluoranthene	1.4	51		U
191-24-2	Benzo(g,h,i)perylene	1.6	51		U
50-32-8	Benzo(a)pyrene	1.1	26		U
218-01-9	Chrysene	1.2	51		U
53-70-3	Dibenz(a,h)anthracene	1.7	26		U
206-44-0	Fluoranthene	1.8	51		U
86-73-7	Fluorene	1.3	51		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.7	51		U
91-20-3	Naphthalene	2.6	51		U
85-01-8	Phenanthrene	1.8	51		U
129-00-0	Pyrene	1.7	51		U

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.
JD-1

Lab Name: EMPIRICAL LABS Contract: TRIECO

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TRI.B07151

Matrix: (soil/water) SOIL Lab Sample ID: 0907151-06

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 0715106

% Moisture: 18 decanted: (Y/N) N Date Sampled: 07/15/09 15:00

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:07/20/09

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 07/22/09 03:45

Injection Volume: 0.5(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	56		U
208-96-8	Acenaphthylene	1.4	56		U
120-12-7	Anthracene	0.97	56		U
56-55-3	Benzo(a)anthracene	1.7	56		U
205-99-2	Benzo(b)fluoranthene	1.8	56		U
207-08-9	Benzo(k)fluoranthene	1.5	56		U
191-24-2	Benzo(g,h,i)perylene	1.8	56		U
50-32-8	Benzo(a)pyrene	1.2	28		U
218-01-9	Chrysene	1.3	56		U
53-70-3	Dibenz(a,h)anthracene	1.8	28		U
206-44-0	Fluoranthene	2.0	56		U
86-73-7	Fluorene	1.4	56		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	56		U
91-20-3	Naphthalene	2.8	56		U
85-01-8	Phenanthrene	2.0	56	2.5	J
129-00-0	Pyrene	1.8	56		U

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.
JD-2

Lab Name: EMPIRICAL LABS Contract: TRIECO

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TRI.B07151

Matrix: (soil/water) SOIL Lab Sample ID: 0907151-07

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 0715107

% Moisture: 16 decanted: (Y/N) N Date Sampled: 07/15/09 15:00

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:07/20/09

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 07/22/09 04:20

Injection Volume: 0.5(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	56		U
208-96-8	Acenaphthylene	1.4	56		U
120-12-7	Anthracene	0.96	56		U
56-55-3	Benzo(a)anthracene	1.7	56		U
205-99-2	Benzo(b)fluoranthene	1.8	56		U
207-08-9	Benzo(k)fluoranthene	1.5	56		U
191-24-2	Benzo(g,h,i)perylene	1.8	56		U
50-32-8	Benzo(a)pyrene	1.2	28		U
218-01-9	Chrysene	1.3	56		U
53-70-3	Dibenz(a,h)anthracene	1.8	28		U
206-44-0	Fluoranthene	2.0	56		U
86-73-7	Fluorene	1.4	56	1.5	J
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	56		U
91-20-3	Naphthalene	2.8	56	7.2	J
85-01-8	Phenanthrene	2.0	56	2.7	J
129-00-0	Pyrene	1.8	56		U

FORM I SV

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.
JD-3

Lab Name: EMPIRICAL LABS Contract: TRIECO

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TRI.B07151

Matrix: (soil/water) SOIL Lab Sample ID: 0907151-08

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 0715108

% Moisture: 17 decanted: (Y/N) N Date Sampled: 07/15/09 15:00

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:07/20/09

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 07/22/09 04:56

Injection Volume: 0.5(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	56		U
208-96-8	Acenaphthylene	1.4	56		U
120-12-7	Anthracene	0.96	56		U
56-55-3	Benzo(a)anthracene	1.7	56	9.0	J
205-99-2	Benzo(b)fluoranthene	1.8	56		U
207-08-9	Benzo(k)fluoranthene	1.5	56		U
191-24-2	Benzo(g,h,i)perylene	1.8	56		U
50-32-8	Benzo(a)pyrene	1.2	28		U
218-01-9	Chrysene	1.3	56	2.3	J
53-70-3	Dibenz(a,h)anthracene	1.8	28		U
206-44-0	Fluoranthene	2.0	56		U
86-73-7	Fluorene	1.4	56		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	56	30	J
91-20-3	Naphthalene	2.8	56		U
85-01-8	Phenanthrene	2.0	56	6.8	J
129-00-0	Pyrene	1.8	56		U

FORM I SV

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.
JD-4

Lab Name: EMPIRICAL LABS Contract: TRIECO

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TRI.B07151

Matrix: (soil/water) SOIL Lab Sample ID: 0907151-09

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 0715109

% Moisture: 15 decanted: (Y/N) N Date Sampled: 07/15/09 15:00

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:07/20/09

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 07/22/09 05:32

Injection Volume: 0.5(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	55		U
208-96-8	Acenaphthylene	1.3	55		U
120-12-7	Anthracene	0.94	55		U
56-55-3	Benzo(a)anthracene	1.6	55	9.9	J
205-99-2	Benzo(b)fluoranthene	1.8	55		U
207-08-9	Benzo(k)fluoranthene	1.5	55		U
191-24-2	Benzo(g,h,i)perylene	1.7	55		U
50-32-8	Benzo(a)pyrene	1.2	28		U
218-01-9	Chrysene	1.3	55	2.6	J
53-70-3	Dibenz(a,h)anthracene	1.8	28		U
206-44-0	Fluoranthene	2.0	55		U
86-73-7	Fluorene	1.4	55	1.8	J
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	55	30	J
91-20-3	Naphthalene	2.8	55	7.4	J
85-01-8	Phenanthrene	2.0	55	5.6	J
129-00-0	Pyrene	1.8	55		U

FORM I SV

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.
JD-5

Lab Name: EMPIRICAL LABS Contract: TRIECO

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TRI.B07151

Matrix: (soil/water) SOIL Lab Sample ID: 0907151-10

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 0715110

% Moisture: 16 decanted: (Y/N) N Date Sampled: 07/15/09 15:00

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:07/20/09

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 07/22/09 06:08

Injection Volume: 0.5(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	55		U
208-96-8	Acenaphthylene	1.3	55		U
120-12-7	Anthracene	0.95	55		U
56-55-3	Benzo(a)anthracene	1.6	55		U
205-99-2	Benzo(b)fluoranthene	1.8	55		U
207-08-9	Benzo(k)fluoranthene	1.5	55		U
191-24-2	Benzo(g,h,i)perylene	1.7	55		U
50-32-8	Benzo(a)pyrene	1.2	28		U
218-01-9	Chrysene	1.3	55		U
53-70-3	Dibenz(a,h)anthracene	1.8	28		U
206-44-0	Fluoranthene	2.0	55		U
86-73-7	Fluorene	1.4	55		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	55		U
91-20-3	Naphthalene	2.8	55		U
85-01-8	Phenanthrene	2.0	55		U
129-00-0	Pyrene	1.8	55		U

FORM 2
SOIL SEMIVOLATILE SURROGATE RECOVERY

Lab Name: EMPIRICAL LABS Contract: TRIECO

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TRI.B07151

Level: (low/med) LOW

	CLIENT SAMPLE NO.	S1 (TBP) #	S2 (FBP) #	S3 (TPH) #	S4 #	S5 #	S6 #	S7 #	S8 #	TOT OUT
01	SBLK0720BS1	55	49	165*						1
02	SBLK0720BS1L	60	52	97						0
03	JG-1	80	64	84						0
04	JG-2	53	46	63						0
05	JG-3	80	60	82						0
06	JG-4	66	49	66						0
07	JG-5	71	53	84						0
08	JD-1	69	45	67						0
09	JD-2	76	55	78						0
10	JD-3	68	45	74						0
11	JD-4	62	47	54						0
12	JD-5	76	56	74						0
13	JG-3MS	59	43	58						0
14	JG-3MSD	70	52	71						0
15										
16										
17										
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	EL QC LIMITS	SPIKE CONC (UG/KG)
S1 (TBP) = 2,4,6-Tribromophenol	(14-129)	6700
S2 (FBP) = 2-Fluorobiphenyl	(14-129)	3300
S3 (TPH) = Terphenyl-d14	(14-129)	3300

Column to be used to flag recovery values
* Values outside of contract required QC limits
D Surrogate results reported from a diluted analysis

FORM 3
SOIL SEMIVOLATILE LAB CONTROL SAMPLE

Lab Name: EMPIRICAL LABS Contract: TRIECO

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TRI.B07151

Matrix Spike - Client Sample No.: SBLK0720BS1 Level:(low/med) LOW

COMPOUND	SPIKE ADDED (ug/Kg)	SAMPLE CONCENTRATION (ug/Kg)	LCS CONCENTRATION (ug/Kg)	LCS % REC #	QC. LIMITS REC.
Acenaphthene	3333	0.0000	1914	57	28-110
Acenaphthylene	3333	0.0000	2954	89	23-126
Anthracene	3333	0.0000	2163	65	28-136
Benzo(a)anthracene	3333	0.0000	2550	76	31-146
Benzo(b)fluoranthene	3333	0.0000	2363	71	30-139
Benzo(k)fluoranthene	3333	0.0000	2370	71	42-129
Benzo(g,h,i)perylene	3333	0.0000	1556	47	21-149
Benzo(a)pyrene	3333	0.0000	2358	71	28-128
Chrysene	3333	0.0000	1742	52	39-134
Dibenz(a,h)anthracene	3333	0.0000	1985	60	30-138
Fluoranthene	3333	0.0000	2388	72	30-142
Fluorene	3333	0.0000	2078	62	27-116
Indeno(1,2,3-cd)pyrene	3333	0.0000	1891	57	17-164
Naphthalene	3333	0.0000	3549	106	29-106
Phenanthrene	3333	0.0000	2033	61	32-127
Pyrene	3333	0.0000	2397	72	28-130

Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits

RPD: 0 out of 0 outside limits
Spike Recovery: 0 out of 16 outside limits

COMMENTS: _____

FORM 3
SOIL SEMIVOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: EMPIRICAL LABS Contract: TRIECO

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TRI.B07151

Matrix Spike - Client Sample No.: JG-3 Lab Sample ID: 0907151-03

Level: (low/med) LOW

COMPOUND	SPIKE ADDED (UG/KG)	SAMPLE CONCENTRATION (UG/KG)	MS CONCENTRATION (UG/KG)	MS % REC #	QC. LIMITS REC.
Acenaphthene	3862	0.0000	1906	49	28-110
Acenaphthylene	3862	0.0000	2390	62	23-126
Anthracene	3862	0.0000	2288	59	28-136
Benzo(a)anthracene	3862	0.0000	2628	68	31-146
Benzo(b)fluoranthene	3862	0.0000	2497	65	30-139
Benzo(k)fluoranthene	3862	0.0000	2592	67	42-129
Benzo(g,h,i)perylene	3862	0.0000	1753	45	21-149
Benzo(a)pyrene	3862	0.0000	2339	60	28-128
Chrysene	3862	0.0000	1768	46	39-134
Dibenz(a,h)anthracene	3862	0.0000	2060	53	30-138
Fluoranthene	3862	0.0000	2690	70	30-142
Fluorene	3862	0.0000	2082	54	27-116
Indeno(1,2,3-cd)pyrene	3862	0.0000	2076	54	17-164
Naphthalene	3862	0.0000	2916	76	29-106
Phenanthrene	3862	0.0000	2172	56	32-127
Pyrene	3862	0.0000	2670	69	28-130

Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits

COMMENTS: _____

FORM 3
SOIL SEMIVOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: EMPIRICAL LABS Contract: TRIECO

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TRI.B07151

Matrix Spike - Client Sample No.: JG-3 Lab Sample ID: 0907151-03

Level: (low/med) LOW

COMPOUND	SPIKE ADDED (UG/KG)	MSD CONCENTRATION (UG/KG)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
Acenaphthene	3862	2276	59	18	50	28-110
Acenaphthylene	3862	2866	74	18	50	23-126
Anthracene	3862	2623	68	14	50	28-136
Benzo(a)anthracene	3862	3165	82	18	50	31-146
Benzo(b)fluoranthene	3862	3056	79	20	50	30-139
Benzo(k)fluoranthene	3862	3181	82	20	50	42-129
Benzo(g,h,i)perylene	3862	2081	54	17	50	21-149
Benzo(a)pyrene	3862	2772	72	17	50	28-128
Chrysene	3862	2074	54	16	50	39-134
Dibenz(a,h)anthracene	3862	2596	67	23	50	30-138
Fluoranthene	3862	2934	76	9	50	30-142
Fluorene	3862	2409	62	14	50	27-116
Indeno(1,2,3-cd)pyrene	3862	2677	69	25	50	17-164
Naphthalene	3862	3762	97	25	50	29-106
Phenanthrene	3862	2526	65	15	50	32-127
Pyrene	3862	2974	77	11	50	28-130

Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits

RPD: 0 out of 16 outside limits
Spike Recovery: 0 out of 32 outside limits

COMMENTS: _____

FORM 4
SEMIVOLATILE METHOD BLANK SUMMARY

CLIENT SAMPLE NO.

SBLK0720BS1

Lab Name: EMPIRICAL LABS Contract: TRIECO

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TRI.B07151

Lab File ID: S1BS0720 Lab Sample ID: SBLK0720BS1

Instrument ID: BNA4 Date Extracted: 07/20/09

Matrix: (soil/water) SOIL Date Analyzed: 07/21/09

Level: (low/med) LOW GPC Cleanup: (Y/N) N Time Analyzed: 2334

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS and MSD:

	SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED
01	SBLK0720BS1L	SBLK0720BS1LCS	S1LS0720	07/22/09
02	JG-1	0907151-01	0715101	07/22/09
03	JG-2	0907151-02	0715102	07/22/09
04	JG-3	0907151-03	0715103	07/22/09
05	JG-4	0907151-04	0715104	07/22/09
06	JG-5	0907151-05	0715105	07/22/09
07	JD-1	0907151-06	0715106	07/22/09
08	JD-2	0907151-07	0715107	07/22/09
09	JD-3	0907151-08	0715108	07/22/09
10	JD-4	0907151-09	0715109	07/22/09
11	JD-5	0907151-10	0715110	07/22/09
12	JG-3MS	0907151-03MS	0715103M	07/22/09
13	JG-3MSD	0907151-03MSD	0715103S	07/22/09
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COMMENTS:

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FORM IV SV

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.
SBLK0720BS1

Lab Name: EMPIRICAL LABS Contract: TRIECO

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TRI.B07151

Matrix: (soil/water) SOIL Lab Sample ID: SBLK0720BS1

Sample wt/vol: 15.0 (g/mL) G Lab File ID: S1BS0720

% Moisture: 0 decanted: (Y/N) N Date Sampled: _____

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:07/20/09

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 07/21/09 23:34

Injection Volume: 0.5(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.2	47		U
208-96-8	Acenaphthylene	1.1	47		U
120-12-7	Anthracene	0.80	47		U
56-55-3	Benzo(a)anthracene	1.4	47		U
205-99-2	Benzo(b)fluoranthene	1.5	47		U
207-08-9	Benzo(k)fluoranthene	1.3	47		U
191-24-2	Benzo(g,h,i)perylene	1.5	47		U
50-32-8	Benzo(a)pyrene	1.0	23		U
218-01-9	Chrysene	1.1	47		U
53-70-3	Dibenz(a,h)anthracene	1.5	23		U
206-44-0	Fluoranthene	1.7	47		U
86-73-7	Fluorene	1.2	47		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.5	47		U
91-20-3	Naphthalene	2.3	47		U
85-01-8	Phenanthrene	1.7	47		U
129-00-0	Pyrene	1.5	47		U

FORM I SV

FORM 5
SEMIVOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK
DECAFLUOROTRIPHENYLPHOSPHINE (DFTPP)

Lab Name: EMPIRICAL LABS Contract:

Lab Code: Case No.: NA SAS No.: NA SDG No.: SDGA39443R

Lab File ID: DF0714B1 DFTPP Injection Date: 07/14/09

Instrument ID: BNA4 DFTPP Injection Time: 1409

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
51	30.0 - 60.0% of mass 198	37.0
68	Less than 2.0% of mass 69	0.6 (1.4)1
69	Mass 69 relative abundance	40.8
70	Less than 2.0% of mass 69	0.2 (0.5)1
127	40.0 - 60.0% of mass 198	53.5
197	Less than 1.0% of mass 198	0.4
198	Base Peak, 100% relative abundance	100.0
199	5.0 to 9.0% of mass 198	6.8
275	10.0 - 30.0% of mass 198	23.5
365	Greater than 1.0% of mass 198	3.66
441	Present, but less than mass 443	15.2
442	Greater than 40.0% of mass 198	107.1
443	17.0 - 23.0% of mass 442	21.5 (20.1)2

1-Value is % mass 69 2-Value is % mass 442

THIS CHECK APPLIES TO THE FOLLOWING SAMPLES, MS, MSD, BLANKS, AND STANDARDS:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
01	STD0.5PPM	STD0.5PPM	CAL1G	07/14/09	1651
02	STD1.0PPM	STD1.0PPM	CAL2	07/14/09	1727
03	STD2.0PPM	STD2.0PPM	CAL3	07/14/09	1803
04	STD5.0PPM	STD5.0PPM	CAL4	07/14/09	1839
05	STD10PPM	STD10PPM	CAL5	07/14/09	1915
06	STD20PPM	STD20PPM	CAL6	07/14/09	1951
07	STD40PPM	STD40PPM	CAL7	07/14/09	2027
08	STD50PPM	STD50PPM	CAL8	07/14/09	2103
09	STD60PPM	STD60PPM	CAL9	07/14/09	2139
10	STD80PPM	STD80PPM	CAL10	07/14/09	2215
11	STD100PPM	STD100PPM	CAL11	07/14/09	2251
12	STD50PPM	STD50PPM	ICV50A	07/15/09	0654
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					

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FORM V SV

FORM 5
SEMIVOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK
DECAFLUOROTRIPHENYLPHOSPHINE (DFTPP)

Lab Name: EMPIRICAL LABS Contract:

Lab Code: Case No.: NA SAS No.: NA SDG No.: SDGA39443R1

Lab File ID: DF0714B2 DFTPP Injection Date: 07/15/09

Instrument ID: BNA4 DFTPP Injection Time: 0038

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
51	30.0 - 60.0% of mass 198	33.4
68	Less than 2.0% of mass 69	0.5 (1.4)1
69	Mass 69 relative abundance	37.5
70	Less than 2.0% of mass 69	0.2 (0.4)1
127	40.0 - 60.0% of mass 198	51.6
197	Less than 1.0% of mass 198	0.5
198	Base Peak, 100% relative abundance	100.0
199	5.0 to 9.0% of mass 198	6.6
275	10.0 - 30.0% of mass 198	24.8
365	Greater than 1.0% of mass 198	4.16
441	Present, but less than mass 443	18.7
442	Greater than 40.0% of mass 198	131.3
443	17.0 - 23.0% of mass 442	26.4 (20.1)2

1-Value is % mass 69 2-Value is % mass 442

THIS CHECK APPLIES TO THE FOLLOWING SAMPLES, MS, MSD, BLANKS, AND STANDARDS:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
01	STD1.0PPM	STD1.0PPM	CAL2A	07/15/09	0055
02	STD2.0PPM	STD2.0PPM	CAL3A	07/15/09	0131
03	STD5.0PPM	STD5.0PPM	CAL4A	07/15/09	0207
04	STD10PPM	STD10PPM	CAL5A	07/15/09	0243
05	STD20PPM	STD20PPM	CAL6A	07/15/09	0319
06	STD40PPM	STD40PPM	CAL7A	07/15/09	0355
07	STD50PPM	STD50PPM	CAL8A	07/15/09	0430
08	STD60PPM	STD60PPM	CAL9A	07/15/09	0506
09	STD80PPM	STD80PPM	CAL10A	07/15/09	0542
10	STD100PPM	STD100PPM	CAL11A	07/15/09	0618
11	STD50PPM	STD50PPM	ICV50A	07/15/09	0654
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					

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FORM V SV

FORM 5
SEMIVOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK
DECAFLUOROTRIPHENYLPHOSPHINE (DFTPP)

Lab Name: EMPIRICAL LABS Contract: TRIECO

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TRI.B07151

Lab File ID: DF0721B2 DFTPP Injection Date: 07/21/09

Instrument ID: BNA4 DFTPP Injection Time: 2053

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
51	30.0 - 60.0% of mass 198	39.9
68	Less than 2.0% of mass 69	0.7 (1.5)1
69	Mass 69 relative abundance	45.4
70	Less than 2.0% of mass 69	0.2 (0.5)1
127	40.0 - 60.0% of mass 198	57.6
197	Less than 1.0% of mass 198	0.5
198	Base Peak, 100% relative abundance	100.0
199	5.0 to 9.0% of mass 198	7.0
275	10.0 - 30.0% of mass 198	22.5
365	Greater than 1.0% of mass 198	3.21
441	Present, but less than mass 443	11.7
442	Greater than 40.0% of mass 198	81.7
443	17.0 - 23.0% of mass 442	17.3 (21.1)2

1-Value is % mass 69 2-Value is % mass 442

THIS CHECK APPLIES TO THE FOLLOWING SAMPLES, MS, MSD, BLANKS, AND STANDARDS:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
01	STD5PPM	STD5PPM	CCV1E	07/21/09	2111
02	SBLK0720BS1	SBLK0720BS1	S1BS0720	07/21/09	2334
03	SBLK0720BS1L	SBLK0720BS1LCS	S1LS0720	07/22/09	0010
04	JG-1	0907151-01	0715101	07/22/09	0046
05	JG-2	0907151-02	0715102	07/22/09	0121
06	JG-3	0907151-03	0715103	07/22/09	0157
07	JG-4	0907151-04	0715104	07/22/09	0233
08	JG-5	0907151-05	0715105	07/22/09	0309
09	JD-1	0907151-06	0715106	07/22/09	0345
10	JD-2	0907151-07	0715107	07/22/09	0420
11	JD-3	0907151-08	0715108	07/22/09	0456
12	JD-4	0907151-09	0715109	07/22/09	0532
13	JD-5	0907151-10	0715110	07/22/09	0608
14	JG-3MS	0907151-03MS	0715103M	07/22/09	0756
15	JG-3MSD	0907151-03MSD	0715103S	07/22/09	0832
16					
17					
18					
19					
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22					

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FORM V SV

FORM 8
SEMIVOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab Name: EMPIRICAL LABS Contract: TRIECO

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TRI.B07151

Lab File ID (Standard): CCV1E Date Analyzed: 07/21/09

Instrument ID: BNA4 Time Analyzed: 2111

		IS1(PHN) AREA #	RT #	IS2(PRY) AREA #	RT #	AREA #	RT #
	12 HOUR STD	24584	13.04	11844	24.81		
	UPPER LIMIT	49168	13.54	23688	25.31		
	LOWER LIMIT	12292	12.54	5922	24.31		
	CLIENT SAMPLE NO.						
01	SBLK0720BS1	24384	13.04	7318	24.82		
02	SBLK0720BS1L	24431	13.05	12136	24.82		
03	JG-1	23431	13.04	9849	24.81		
04	JG-2	27472	13.04	13609	24.80		
05	JG-3	25181	13.04	11875	24.80		
06	JG-4	26895	13.04	12799	24.80		
07	JG-5	28687	13.04	11902	24.80		
08	JD-1	34527	13.04	16296	24.80		
09	JD-2	25996	13.04	11883	24.80		
10	JD-3	29014	13.04	13243	24.80		
11	JD-4	30889	13.04	18806	24.81		
12	JD-5	26131	13.04	12286	24.80		
13	JG-3MS	31132	13.05	16527	24.81		
14	JG-3MSD	32470	13.05	15801	24.81		
15							
16							
17							
18							
19							
20							
21							
22							

IS1 (PHN) = Phenanthrene-d10
IS2 (PRY) = Perylene-d12

AREA UPPER LIMIT = +100% of internal standard area
AREA LOWER LIMIT = - 50% of internal standard area
RT UPPER LIMIT = + 0.50 minutes of internal standard RT
RT LOWER LIMIT = - 0.50 minutes of internal standard RT

Column used to flag internal standard area values with an asterisk.
* Values outside of QC limits.

page 1 of 1

FORM VIII SV

FORM 6
SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

1X3N4.M

Lab Name: EMPIRICAL LABS Contract: ppbna3.sw6(w)

Lab Code: Case No.: NA SAS No.: NA SDG No.: SDGA29527

Instrument ID: BNA4 Calibration Date(s): 07/14/09 07/14/09

Column: FUSED SILICA ID: 0.25 (mm) Calibration Time(s): 1651 2251

LAB FILE ID: RF0.5: CAL1G RF1: CAL2 RF2: CAL3
RF5: CAL4 RF10: CAL5

COMPOUND	RF0.5	RF1	RF2	RF5	RF10
Acenaphthene	1.211	1.166	1.193	1.201	1.170
Acenaphthylene	1.349	1.339	1.490	1.643	1.653
Acetophenone	1.738	1.598	1.541	1.801	1.744
Aniline		1.277	1.476	1.396	1.304
Anthracene	1.164	1.115	0.976	1.074	1.095
Benzoic acid				0.043	0.065
Benzo(a)anthracene	1.019	1.083	1.052	1.099	1.005
Benzo(b)fluoranthene	0.938	0.903	1.069	1.343	1.385
Benzo(k)fluoranthene	1.363	1.634	1.744	1.740	1.764
Benzo(g,h,i)perylene	0.833	1.066	0.821	1.121	1.116
Benzo(a)pyrene	0.702	0.780	1.000	1.259	1.338
Benzyl alcohol		0.611	0.715	0.805	0.793
1,1'-Biphenyl	1.645	1.588	1.618	1.603	1.585
bis(2-Chloroethoxy)methane	0.426	0.408	0.432	0.438	0.436
bis(2-Chloroethyl)ether	1.472	1.175	1.132	1.391	1.436
bis(2-Chloroisopropyl)ether	1.940	1.677	1.706	1.830	1.802
Bis(2-ethylhexyl)phthalate	0.213	0.196	0.266	0.481	0.702
4-Bromophenyl-phenylether	0.186	0.196	0.215	0.223	0.220
Butylbenzylphthalate	0.185	0.199	0.279	0.480	0.624
Caprolactam	0.026	0.032	0.050	0.068	0.089
Carbazole	0.690	0.684	0.839	0.957	1.017
4-Chloroaniline	0.338	0.313	0.347	0.375	0.381
4-Chloro-3-methylphenol	0.131	0.136	0.188	0.233	0.261
2-Chloronaphthalene	1.250	1.208	1.231	1.238	1.197
2-Chlorophenol	1.298	1.167	1.173	1.392	1.430
4-Chlorophenyl-phenylether	0.603	0.534	0.569	0.570	0.563
Chrysene	1.019	1.083	1.052	1.099	1.074
Dibenz(a,h)anthracene	0.353	0.400	0.577	0.891	0.978
Dibenzofuran	1.678	1.598	1.664	1.674	1.645
1,4-Dichlorobenzene	1.829	1.618	1.510	1.685	1.594
1,2-Dichlorobenzene	1.418	1.258	1.173	1.285	1.278
1,3-Dichlorobenzene	1.533	1.456	1.517	1.439	1.429
2,4-Dichlorophenol	0.146	0.171	0.210	0.244	0.260
Diethylphthalate	0.909	0.948	1.130	1.233	1.322
2,4-Dimethylphenol		0.219	0.254	0.266	0.280
Dimethylphthalate	1.140	1.132	1.196	1.292	1.330
Di-n-butylphthalate		0.553	0.857	1.247	1.481

FORM VI SV

FORM 6
SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: EMPIRICAL LABS Contract:

Lab Code: Case No.: NA SAS No.: NA SDG No.: SDGA29527

Instrument ID: BNA4 Calibration Date(s): 07/14/09 07/14/09

Column: FUSED SILICA ID: 0.25 (mm) Calibration Time(s): 1651 2251

LAB FILE ID: RF0.5: CAL1G RF1: CAL2 RF2: CAL3
RF5: CAL4 RF10: CAL5

COMPOUND	RF0.5	RF1	RF2	RF5	RF10
4,6-Dinitro-2-methylphenol		0.004	0.014	0.030	0.061
2,4-Dinitrophenol			0.010	0.021	0.040
2,4-Dinitrotoluene	0.088	0.115	0.196	0.296	0.359
2,6-Dinitrotoluene	0.111	0.129	0.186	0.238	0.273
1,2-Diphenylhydrazine	0.808	0.925	1.038	1.067	1.063
Di-n-octylphthalate				0.704	1.244
Fluoranthene	0.650	0.683	0.816	0.946	1.040
Fluorene	1.142	1.120	1.235	1.268	1.274
Hexachlorobenzene	0.273	0.292	0.288	0.277	0.268
Hexachlorobutadiene	0.135	0.135	0.150	0.146	0.143
Hexachlorocyclopentadiene	0.045	0.057	0.075	0.086	0.101
Hexachloroethane	0.537	0.480	0.499	0.544	0.550
Indeno(1,2,3-cd)pyrene	0.314	0.716	0.820	1.108	1.211
Isophorone	0.488	0.505	0.583	0.618	0.610
2-Methylnaphthalene	0.508	0.495	0.540	0.532	0.544
1-Methylnaphthalene	0.516	0.479	0.525	0.519	0.519
Naphthalene	1.036	0.986	1.004	0.987	0.994
4-Methylphenol			0.881	1.002	1.094
3-Methylphenol			0.881	1.002	1.094
2-Methylphenol	0.948	0.828	0.891	1.070	1.132
2-Nitroaniline	0.129	0.163	0.223	0.295	0.341
3-Nitroaniline	0.122	0.119	0.199	0.264	0.295
4-Nitroaniline	0.072	0.083	0.144	0.192	0.240
Nitrobenzene	0.290	0.314	0.343	0.357	0.368
2-Nitrophenol		0.071	0.113	0.147	0.173
4-Nitrophenol	0.052	0.047	0.068	0.104	0.139
N-Nitroso-di-methylamine	0.506	0.547	0.548	0.568	0.546
N-Nitrosodiphenylamine	0.468	0.510	0.575	0.620	0.618
N-Nitroso-di-n-propylamine	0.762	0.662	0.703	0.816	0.916
Pentachlorophenol				0.054	0.088
Phenanthrene	1.164	1.115	1.185	1.202	1.176
Phenol	1.518	1.456	1.600	1.498	1.469
Pyrene	1.193	1.414	1.452	1.474	1.409
Pyridine	1.298	1.056	1.353	1.407	1.600
1,2,4,5-Tetrachlorobenzene	0.239	0.226	0.234	0.244	0.245
1,2,4-Trichlorobenzene	0.286	0.293	0.297	0.291	0.286
2,4,5-Trichlorophenol	0.125	0.162	0.224	0.294	0.342

FORM VI SV

FORM 6
SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: EMPIRICAL LABS Contract:

Lab Code: Case No.: NA SAS No.: NA SDG No.: SDGA29527

Instrument ID: BNA4 Calibration Date(s): 07/14/09 07/14/09

Column: FUSED SILICA ID: 0.25 (mm) Calibration Time(s): 1651 2251

LAB FILE ID: RF0.5: CAL1G RF1: CAL2 RF2: CAL3
RF5: CAL4 RF10: CAL5

COMPOUND	RF0.5	RF1	RF2	RF5	RF10
2,4,6-Trichlorophenol		0.141	0.235	0.296	0.334
1,4-Dioxane	0.627	0.618	0.584	0.460	0.536
2-Fluorophenol	1.283	1.228	1.368	1.481	1.416
Phenol-d6	1.274	1.133	1.211	1.550	1.595
Nitrobenzene-d5	0.260	0.265	0.301	0.323	0.349
2-Fluorobiphenyl	1.401	1.348	1.388	1.379	1.345
2,4,6-Tribromophenol		0.038	0.067	0.093	0.110
Terphenyl-d14	0.943	0.903	0.890	0.912	0.877

FORM VI SV

FORM 6
SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: EMPIRICAL LABS Contract:

Lab Code: Case No.: NA SAS No.: NA SDG No.: SDGA29527

Instrument ID: BNA4 Calibration Date(s): 07/14/09 07/14/09

Column: FUSED SILICA ID: 0.25 (mm) Calibration Time(s): 1651 2251

LAB FILE ID: RF20: CAL6 RF30: RF40: CAL7
RF50: CAL8 RF60: CAL9

COMPOUND	RF20	RF30	RF40	RF50	RF60
Acenaphthene	1.105		1.144	1.090	1.028
Acenaphthylene	1.559		1.635	1.557	1.483
Acetophenone	1.648		1.667	1.633	1.523
Aniline	1.286		1.342	1.267	1.154
Anthracene	1.065		1.041	0.999	0.950
Benzoic acid	0.103		0.185	0.208	0.214
Benzo(a)anthracene	1.030		1.050	0.993	1.002
Benzo(b)fluoranthene	1.352		1.431	1.427	1.340
Benzo(k)fluoranthene	1.446		1.521	1.518	1.373
Benzo(g,h,i)perylene	1.021		0.971	0.954	0.798
Benzo(a)pyrene	1.216		1.279	1.253	1.142
Benzyl alcohol	0.785		0.909	0.870	0.780
1,1'-Biphenyl	1.488		1.499	1.418	1.345
bis(2-Chloroethoxy)methane	0.378		0.417	0.416	0.398
bis(2-Chloroethyl)ether	1.485		1.389	1.509	1.576
bis(2-Chloroisopropyl)ether	1.860		1.852	1.687	1.522
Bis(2-ethylhexyl)phthalate	0.882		0.920	0.893	0.898
4-Bromophenyl-phenylether	0.210		0.213	0.205	0.193
Butylbenzylphthalate	0.750		0.767	0.769	0.744
Caprolactam	0.106		0.118	0.109	0.117
Carbazole	0.998		0.962	0.931	0.919
4-Chloroaniline	0.354		0.374	0.371	0.370
4-Chloro-3-methylphenol	0.257		0.282	0.280	0.269
2-Chloronaphthalene	1.114		1.146	1.074	1.010
2-Chlorophenol	1.380		1.187	1.102	1.046
4-Chlorophenyl-phenylether	0.527		0.541	0.509	0.502
Chrysene	1.037		1.027	0.970	0.976
Dibenz(a,h)anthracene	0.924		0.939	0.925	0.793
Dibenzofuran	1.574		1.611	1.502	1.476
1,4-Dichlorobenzene	1.511		1.418	1.303	1.210
1,2-Dichlorobenzene	1.314		1.410	1.359	1.246
1,3-Dichlorobenzene	1.308		1.379	1.345	1.266
2,4-Dichlorophenol	0.246		0.280	0.276	0.261
Diethylphthalate	1.309		1.358	1.231	1.194
2,4-Dimethylphenol	0.262		0.269	0.277	0.278
Dimethylphthalate	1.294		1.362	1.273	1.215
Di-n-butylphthalate	1.542		1.482	1.412	1.345

FORM VI SV

FORM 6
SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: EMPIRICAL LABS Contract:

Lab Code: Case No.: NA SAS No.: NA SDG No.: SDGA29527

Instrument ID: BNA4 Calibration Date(s): 07/14/09 07/14/09

Column: FUSED SILICA ID: 0.25 (mm) Calibration Time(s): 1651 2251

LAB FILE ID: RF20: CAL6 RF30: RF40: CAL7
RF50: CAL8 RF60: CAL9

COMPOUND	RF20	RF30	RF40	RF50	RF60
4,6-Dinitro-2-methylphenol	0.094		0.119	0.123	0.125
2,4-Dinitrophenol	0.073		0.122	0.127	0.139
2,4-Dinitrotoluene	0.385		0.413	0.375	0.399
2,6-Dinitrotoluene	0.282		0.307	0.291	0.279
1,2-Diphenylhydrazine	0.958		1.011	0.979	0.882
Di-n-octylphthalate	1.506		1.924	2.069	1.931
Fluoranthene	1.032		0.986	0.968	0.902
Fluorene	1.241		1.258	1.173	1.118
Hexachlorobenzene	0.242		0.238	0.231	0.216
Hexachlorobutadiene	0.131		0.138	0.131	0.127
Hexachlorocyclopentadiene	0.108		0.152	0.165	0.150
Hexachloroethane	0.552		0.593	0.571	0.537
Indeno(1,2,3-cd)pyrene	1.169		1.147	1.124	0.958
Isophorone	0.545		0.601	0.567	0.563
2-Methylnaphthalene	0.496		0.524	0.499	0.492
1-Methylnaphthalene	0.485		0.499	0.478	0.471
Naphthalene	0.934		0.968	0.899	0.854
4-Methylphenol	1.240		1.083	1.131	1.093
3-Methylphenol	1.240		1.083	1.131	1.093
2-Methylphenol	1.183		1.137	1.099	1.068
2-Nitroaniline	0.359		0.386	0.377	0.367
3-Nitroaniline	0.316		0.348	0.334	0.339
4-Nitroaniline	0.252		0.300	0.280	0.301
Nitrobenzene	0.340		0.324	0.333	0.339
2-Nitrophenol	0.173		0.184	0.177	0.176
4-Nitrophenol	0.195		0.224	0.216	0.216
N-Nitroso-di-methylamine	0.565		0.569	0.534	0.483
N-Nitrosodiphenylamine	0.592		0.580	0.574	0.526
N-Nitroso-di-n-propylamine	0.904		0.910	0.860	0.774
Pentachlorophenol	0.114		0.132	0.132	0.128
Phenanthrene	1.114		1.075	1.035	0.980
Phenol	1.794		1.337	1.532	1.545
Pyrene	1.392		1.334	1.302	1.255
Pyridine	1.480		1.316	1.281	1.256
1,2,4,5-Tetrachlorobenzene	0.231		0.246	0.234	0.230
1,2,4-Trichlorobenzene	0.269		0.293	0.281	0.270
2,4,5-Trichlorophenol	0.340		0.374	0.369	0.374

FORM VI SV

FORM 6
SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: EMPIRICAL LABS Contract:

Lab Code: Case No.: NA SAS No.: NA SDG No.: SDGA29527

Instrument ID: BNA4 Calibration Date(s): 07/14/09 07/14/09

Column: FUSED SILICA ID: 0.25 (mm) Calibration Time(s): 1651 2251

LAB FILE ID: RF20: CAL6 RF30: RF40: CAL7
RF50: CAL8 RF60: CAL9

COMPOUND	RF20	RF30	RF40	RF50	RF60
2,4,6-Trichlorophenol	0.334		0.364	0.356	0.347
1,4-Dioxane	0.566		0.622	0.578	0.529
2-Fluorophenol	1.300		1.162	1.093	1.072
Phenol-d6	1.378		1.477	1.298	1.169
Nitrobenzene-d5	0.336		0.352	0.347	0.341
2-Fluorobiphenyl	1.244		1.289	1.225	1.172
2,4,6-Tribromophenol	0.112		0.117	0.118	0.114
Terphenyl-d14	0.883		0.858	0.824	0.805

FORM VI SV

FORM 6
SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: EMPIRICAL LABS Contract:

Lab Code: Case No.: NA SAS No.: NA SDG No.: SDGA29527

Instrument ID: BNA4 Calibration Date(s): 07/14/09 07/14/09

Column: FUSED SILICA ID: 0.25 (mm) Calibration Time(s): 1651 2251

LAB FILE ID: RF70: RF80: CAL10 RF100: CAL11

COMPOUND	RF70	RF80	RF100
Acenaphthene		1.042	1.018
Acenaphthylene		1.490	1.452
Acetophenone		1.186	1.166
Aniline		1.122	0.983
Anthracene		0.931	0.853
Benzoic acid		0.223	0.219
Benzo(a)anthracene		0.920	0.954
Benzo(b)fluoranthene		1.372	1.355
Benzo(k)fluoranthene		1.372	1.271
Benzo(g,h,i)perylene			
Benzo(a)pyrene		1.153	1.109
Benzyl alcohol		0.717	
1,1'-Biphenyl		1.313	1.275
bis(2-Chloroethoxy)methane		0.357	0.349
bis(2-Chloroethyl)ether		1.055	1.050
bis(2-Chloroisopropyl)ether		1.236	
Bis(2-ethylhexyl)phthalate		0.857	0.865
4-Bromophenyl-phenylether		0.183	0.180
Butylbenzylphthalate		0.710	0.726
Caprolactam			
Carbazole		0.892	0.862
4-Chloroaniline		0.366	0.339
4-Chloro-3-methylphenol		0.278	0.262
2-Chloronaphthalene		1.020	0.957
2-Chlorophenol		0.958	
4-Chlorophenyl-phenylether		0.498	0.485
Chrysene		0.920	0.911
Dibenz(a,h)anthracene		0.772	0.772
Dibenzofuran		1.455	1.374
1,4-Dichlorobenzene		1.142	
1,2-Dichlorobenzene		0.989	0.827
1,3-Dichlorobenzene			
2,4-Dichlorophenol		0.250	0.257
Diethylphthalate		1.208	1.095
2,4-Dimethylphenol		0.262	0.246
Dimethylphthalate		1.296	1.164
Di-n-butylphthalate			

FORM VI SV

FORM 6
SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: EMPIRICAL LABS Contract:

Lab Code: Case No.: NA SAS No.: NA SDG No.: SDGA29527

Instrument ID: BNA4 Calibration Date(s): 07/14/09 07/14/09

Column: FUSED SILICA ID: 0.25 (mm) Calibration Time(s): 1651 2251

LAB FILE ID: RF70: RF80: CAL10 RF100: CAL11

COMPOUND	RF70	RF80	RF100
4,6-Dinitro-2-methylphenol		0.127	0.125
2,4-Dinitrophenol		0.160	0.169
2,4-Dinitrotoluene		0.418	0.383
2,6-Dinitrotoluene		0.313	
1,2-Diphenylhydrazine		0.825	0.820
Di-n-octylphthalate		2.068	2.004
Fluoranthene		0.868	0.828
Fluorene		1.118	1.048
Hexachlorobenzene		0.204	0.201
Hexachlorobutadiene		0.125	0.120
Hexachlorocyclopentadiene		0.153	0.162
Hexachloroethane		0.468	0.419
Indeno(1,2,3-cd)pyrene		0.908	0.810
Isophorone		0.567	0.546
2-Methylnaphthalene		0.476	0.459
1-Methylnaphthalene		0.462	0.432
Naphthalene		0.853	0.827
4-Methylphenol		0.828	0.830
3-Methylphenol		0.828	0.830
2-Methylphenol		0.922	0.807
2-Nitroaniline		0.382	0.366
3-Nitroaniline		0.374	0.334
4-Nitroaniline		0.330	0.319
Nitrobenzene		0.326	0.279
2-Nitrophenol		0.188	0.176
4-Nitrophenol		0.226	0.212
N-Nitroso-di-methylamine		0.425	0.419
N-Nitrosodiphenylamine		0.483	0.477
N-Nitroso-di-n-propylamine		0.724	0.599
Pentachlorophenol		0.128	0.125
Phenanthrene		0.931	0.877
Phenol			
Pyrene		1.175	1.212
Pyridine		1.125	1.124
1,2,4,5-Tetrachlorobenzene		0.229	0.219
1,2,4-Trichlorobenzene		0.257	0.244
2,4,5-Trichlorophenol		0.362	0.354

FORM VI SV

FORM 6
SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: EMPIRICAL LABS Contract:

Lab Code: Case No.: NA SAS No.: NA SDG No.: SDGA29527

Instrument ID: BNA4 Calibration Date(s): 07/14/09 07/14/09

Column: FUSED SILICA ID: 0.25 (mm) Calibration Time(s): 1651 2251

LAB FILE ID: RF70: RF80: CAL10 RF100: CAL11

COMPOUND	RF70	RF80	RF100
2,4,6-Trichlorophenol		0.362	0.365
1,4-Dioxane		0.446	0.400
2-Fluorophenol		0.967	
Phenol-d6		1.077	
Nitrobenzene-d5		0.342	0.314
2-Fluorobiphenyl		1.187	1.128
2,4,6-Tribromophenol		0.109	0.111
Terphenyl-d14		0.754	0.765

FORM VI SV

FORM 6
SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: EMPIRICAL LABS Contract:

Lab Code: Case No.: NA SAS No.: NA SDG No.: SDGA29527

Instrument ID: BNA4 Calibration Date(s): 07/14/09 07/14/09

Column: FUSED SILICA ID: 0.25 (mm) Calibration Time(s): 1651 2251

COMPOUND	CURVE	COEFFICENTS A0	A1	A2	%RSD OR R^2
Acenaphthene	AVRG		1.12445396		6.4
Acenaphthylene	AVRG		1.51374727		7.2
Acetophenone	AVRG		1.56771173		13.5
Aniline	AVRG		1.26069359		11.3
Anthracene	AVRG		1.02392313		8.9
Benzoic acid	LINR	7.51122560	0.24056043		0.995
Benzo(a)anthracene	AVRG		1.01903416		5.2
Benzo(b)fluoranthene	LINR	-6.5e-002	1.36876475		0.999
Benzo(k)fluoranthene	AVRG		1.52233261		11.5
Benzo(g,h,i)perylene	AVRG		0.96673325		13.0
Benzo(a)pyrene	LINR	-1.0582789	1.13805621		0.996
Benzyl alcohol	AVRG		0.77619729		11.3
1,1'-Biphenyl	AVRG		1.48886749		8.9
bis(2-Chloroethoxy)methane	AVRG		0.40517269		7.7
bis(2-Chloroethyl)ether	AVRG		1.33378353		14.5
bis(2-Chloroisopropyl)ether	AVRG		1.71113129		12.0
Bis(2-ethylhexyl)phthalate	LINR	0.77634670	0.88407105		0.998
4-Bromophenyl-phenylether	AVRG		0.20230200		7.5
Butylbenzylphthalate	LINR	0.49603347	0.73716275		0.998
Caprolactam	LINR	1.42370569	0.11787845		0.997
Carbazole	AVRG		0.88644319		12.6
4-Chloroaniline	AVRG		0.35703172		5.9
4-Chloro-3-methylphenol	LINR	0.19924388	0.27139329		0.998
2-Chloronaphthalene	AVRG		1.13150156		9.1
2-Chlorophenol	AVRG		1.21338873		13.0
4-Chlorophenyl-phenylether	AVRG		0.53651183		6.9
Chrysene	AVRG		1.01553656		6.3
Dibenz(a,h)anthracene	2ORDR	0.56461929	0.93075074	4.89e-003	0.996
Dibenzofuran	AVRG		1.56838060		6.5
1,4-Dichlorobenzene	AVRG		1.48211294		14.6
1,2-Dichlorobenzene	AVRG		1.23252152		14.5
1,3-Dichlorobenzene	AVRG		1.40802989		6.5
2,4-Dichlorophenol	LINR	-0.1536799	0.25870865		0.997
Diethylphthalate	AVRG		1.17623143		12.4
2,4-Dimethylphenol	AVRG		0.26139218		7.0
Dimethylphthalate	AVRG		1.24475085		6.4
Di-n-butylphthalate	LINR	-9.93e-002	1.40216620		0.996

FORM VI SV

FORM 6
SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: EMPIRICAL LABS Contract:

Lab Code: Case No.: NA SAS No.: NA SDG No.: SDGA29527

Instrument ID: BNA4 Calibration Date(s): 07/14/09 07/14/09

Column: FUSED SILICA ID: 0.25 (mm) Calibration Time(s): 1651 2251

COMPOUND	CURVE	COEFFICENTS A0	A1	A2	%RSD OR R^2
4,6-Dinitro-2-methylphenol	LINR	3.32219775	0.13057825		0.998
2,4-Dinitrophenol	2ORDR	5.41527360	7.63881030	-0.1263404	0.996
2,4-Dinitrotoluene	LINR	0.77658670	0.40104592		0.996
2,6-Dinitrotoluene	LINR	1.10386971	0.30586141		0.996
1,2-Diphenylhydrazine	AVRG		0.94337898		10.4
Di-n-octylphthalate	LINR	3.99532589	2.12665741		0.998
Fluoranthene	AVRG		0.88363819		14.8
Fluorene	AVRG		1.18148398		6.5
Hexachlorobenzene	AVRG		0.24836618		13.4
Hexachlorobutadiene	AVRG		0.13462386		6.8
Hexachlorocyclopentadiene	LINR	2.40564294	0.16262475		0.996
Hexachloroethane	AVRG		0.52284200		9.8
Indeno(1,2,3-cd)pyrene	2ORDR	1.78718975	0.42431259	9.348e-003	0.995
Isophorone	AVRG		0.56315013		7.2
2-Methylnaphthalene	AVRG		0.50604371		5.3
1-Methylnaphthalene	AVRG		0.48951998		5.9
Naphthalene	AVRG		0.94018213		7.6
4-Methylphenol	AVRG		1.02017952		14.2
3-Methylphenol	AVRG		1.02017952		14.2
2-Methylphenol	AVRG		1.00782445		13.2
2-Nitroaniline	LINR	0.52902730	0.37563695		0.999
3-Nitroaniline	LINR	1.10559310	0.35205412		0.995
4-Nitroaniline	LINR	2.37029487	0.32474152		0.996
Nitrobenzene	AVRG		0.32849737		8.0
2-Nitrophenol	LINR	0.64842606	0.18138291		0.998
4-Nitrophenol	LINR	1.58990207	0.22249345		0.998
N-Nitroso-di-methylamine	AVRG		0.51910978		10.5
N-Nitrosodiphenylamine	AVRG		0.54753735		10.3
N-Nitroso-di-n-propylamine	AVRG		0.78471473		13.6
Pentachlorophenol	LINR	1.89396490	0.13086142		0.997
Phenanthrene	AVRG		1.07771917		10.2
Phenol	AVRG		1.52749634		8.1
Pyrene	AVRG		1.32824757		8.1
Pyridine	AVRG		1.29972246		12.4
1,2,4,5-Tetrachlorobenzene	LINR	-0.8033972	0.22443858		0.998
1,2,4-Trichlorobenzene	AVRG		0.27864803		6.1
2,4,5-Trichlorophenol	LINR	0.34446046	0.36350362		0.999

FORM VI SV

FORM 6
SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: EMPIRICAL LABS Contract:

Lab Code: Case No.: NA SAS No.: NA SDG No.: SDGA29527

Instrument ID: BNA4 Calibration Date(s): 07/14/09 07/14/09

Column: FUSED SILICA ID: 0.25 (mm) Calibration Time(s): 1651 2251

COMPOUND	CURVE	COEFFICENTS A0	A1	A2	%RSD OR R^2
2,4,6-Trichlorophenol	LINR	1.03602765	0.36544294		0.999
1,4-Dioxane	AVRG		0.54253414		14.2
2-Fluorophenol	AVRG		1.23704935		13.2
Phenol-d6	AVRG		1.31624943		13.6
Nitrobenzene-d5	AVRG		0.32083785		10.2
2-Fluorobiphenyl	AVRG		1.28239481		7.5
2,4,6-Tribromophenol	LINR	0.20008763	0.11254874		0.998
Terphenyl-d14	AVRG		0.85592292		7.2

FORM VI SV

FORM 6
SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: EMPIRICAL LABS Contract: Scomp.sub (w) 1X BNA.m

Lab Code: Case No.: NA SAS No.: NA SDG No.: SDGA29527A

Instrument ID: BNA4 Calibration Date(s): 06/01/09 07/15/09

Column: FUSED SILICA ID: 0.25 (mm) Calibration Time(s): 1547 0618

LAB FILE ID: RF1: CAL2A RF2: CAL3A RF5: CAL4A
RF10: CAL5A RF20: CAL6A

COMPOUND	RF1	RF2	RF5	RF10	RF20
Atrazine	0.129	0.133	0.156	0.180	0.206
Benzaldehyde	0.821	0.810	0.808	0.794	0.942
Benzidine	0.176	0.263	0.335	0.486	0.747
3,3'-Dichlorobenzidine	0.145	0.211	0.241	0.358	0.502
2,3,4,6-Tetrachlorophenol	0.053	0.044	0.099	0.095	0.195

FORM VI SV

FORM 6
SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: EMPIRICAL LABS Contract:

Lab Code: Case No.: NA SAS No.: NA SDG No.: SDGA29527A

Instrument ID: BNA4 Calibration Date(s): 06/01/09 07/15/09

Column: FUSED SILICA ID: 0.25 (mm) Calibration Time(s): 1547 0618

LAB FILE ID: RF30: RF40: CAL7A RF50: CAL8A
RF60: CAL9A RF70:

COMPOUND	RF30	RF40	RF50	RF60	RF70
Atrazine		0.208	0.204	0.204	
Benzaldehyde		0.849	0.816	0.866	
Benzidine		0.870	0.894	0.936	
3,3'-Dichlorobenzidine		0.536	0.531	0.541	
2,3,4,6-Tetrachlorophenol		0.223	0.222	0.221	

FORM VI SV

FORM 6
SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: EMPIRICAL LABS Contract:

Lab Code: Case No.: NA SAS No.: NA SDG No.: SDGA29527A

Instrument ID: BNA4 Calibration Date(s): 06/01/09 07/15/09

Column: FUSED SILICA ID: 0.25 (mm) Calibration Time(s): 1547 0618

LAB FILE ID: RF80: CAL10A RF100: CAL11A

COMPOUND	RF80	RF100
Atrazine	0.194	0.200
Benzaldehyde	0.808	0.821
Benzidine	0.901	
3,3'-Dichlorobenzidine	0.542	
2,3,4,6-Tetrachlorophenol	0.218	0.234

FORM VI SV

FORM 6
SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: EMPIRICAL LABS Contract:

Lab Code: Case No.: NA SAS No.: NA SDG No.: SDGA29527A

Instrument ID: BNA4 Calibration Date(s): 06/01/09 07/15/09

Column: FUSED SILICA ID: 0.25 (mm) Calibration Time(s): 1547 0618

COMPOUND	CURVE	COEFFICENTS A0	COEFFICENTS A1	%RSD OR R^2
Atrazine	LINR	0.27758463	0.20121973	0.999
Benzaldehyde	AVRG		0.83344996	5.2
Benzidine	LINR	2.77566973	0.94588354	0.997
3,3'-Dichlorobenzidine	LINR	2.00219063	0.55663637	0.999
2,3,4,6-Tetrachlorophenol	LINR	3.01437654	0.23554192	0.997

FORM VI SV

SEMIVOLATILE INITIAL CALIBRATION VERIFICATION

Lab Name: EMPIRICAL LABS Contract: /cv1

Lab Code: Case No.: NA SAS No.: NA SDG No.: SDGA29527R

Instrument ID: BNA4 Calibration Date: 07/15/09 Time: 0654

Lab File ID: ICV50A Init. Calib. Date(s): 06/01/09 07/15/09

Init. Calib. Times: 1547 0618

COMPOUND	$\overline{RRF}$	RRF50	CURVE AMOUNT	CCAL AMOUNT	MIN RRF	CURVE	%D	MAX %D	
Acenaphthene	1.124	1.173	50.00	52.14		AVRG	4.3	25.0	
Acenaphthylene	1.514	1.840	50.00	60.78		AVRG	21.6	25.0	
Acetophenone	1.568	1.633	50.00	0.0000		AVRG	4.1	25.0	
Aniline	1.261	1.926	50.00	76.37		AVRG	52.7	25.0	<
Anthracene	1.024	1.081	50.00	52.81		AVRG	5.6	25.0	
Benzaldehyde	0.834	0.816	50.00	0.0000		AVRG	-2.1	25.0	
Benzoic acid	0.158	0.185	50.00	45.99		LINR	-8.0	25.0	
Benzo(a)anthracene	1.019	1.063	50.00	52.17		AVRG	4.3	25.0	
Benzo(b)fluoranthene	1.265	1.506	50.00	54.96		LINR	9.9	25.0	
Benzo(k)fluoranthene	1.522	1.506	50.00	49.47		AVRG	-1.0	25.0	
Benzo(g,h,i)perylene	0.967	0.980	50.00	50.68		AVRG	1.4	25.0	
Benzo(a)pyrene	1.112	1.278	50.00	55.12		LINR	10.2	25.0	
Benzyl alcohol	0.776	0.967	50.00	62.32		AVRG	24.6	25.0	
1,1'-Biphenyl	1.489	1.418	50.00	0.0000		AVRG	-4.8	25.0	
bis(2-Chloroethoxy)methane	0.405	0.439	50.00	54.14		AVRG	8.3	25.0	
bis(2-Chloroethyl)ether	1.334	1.593	50.00	59.72		AVRG	19.4	25.0	
bis(2-Chloroisopropyl)ether	1.711	1.995	50.00	58.29		AVRG	16.6	25.0	
Bis(2-ethylhexyl)phthalate	0.652	1.003	50.00	57.51		LINR	15.0	25.0	
4-Bromophenyl-phenylether	0.202	0.180	50.00	44.46		AVRG	-11.1	25.0	
Butylbenzylphthalate	0.567	0.849	50.00	58.06		LINR	16.1	25.0	
Carbazole	0.886	0.868	50.00	48.98		AVRG	-2.0	25.0	
4-Chloroaniline	0.357	0.379	50.00	53.13		AVRG	6.3	25.0	
4-Chloro-3-methylphenol	0.234	0.271	50.00	50.05		LINR	0.1	25.0	
2-Chloronaphthalene	1.131	1.223	50.00	54.04		AVRG	8.1	25.0	
2-Chlorophenol	1.213	1.306	50.00	53.82		AVRG	7.6	25.0	
4-Chlorophenyl-phenylether	0.536	0.546	50.00	50.87		AVRG	1.7	25.0	
Chrysene	1.015	1.063	50.00	52.35		AVRG	4.7	25.0	
Dibenz(a,h)anthracene	0.757	0.974	50.00	57.48		2ORDR	15.0	25.0	
Dibenzofuran	1.568	1.603	50.00	51.09		AVRG	2.2	25.0	
1,3-Dichlorobenzene	1.408	1.759	50.00	62.46		AVRG	24.9	25.0	
1,4-Dichlorobenzene	1.482	1.545	50.00	52.12		AVRG	4.2	25.0	
1,2-Dichlorobenzene	1.232	1.494	50.00	60.60		AVRG	21.2	25.0	
2,4-Dichlorophenol	0.236	0.266	50.00	51.32		LINR	2.6	25.0	

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ICV SV

SEMIVOLATILE INITIAL CALIBRATION VERIFICATION

Lab Name: EMPIRICAL LABS Contract:

Lab Code: Case No.: NA SAS No.: NA SDG No.: SDGA29527R

Instrument ID: BNA4 Calibration Date: 07/15/09 Time: 0654

Lab File ID: ICV50A Init. Calib. Date(s): 06/01/09 07/15/09

Init. Calib. Times: 1547 0618

COMPOUND	$\overline{RRF}$	RRF50	CURVE AMOUNT	CCAL AMOUNT	MIN RRF	CURVE	%D	MAX %D	
Diethylphthalate	1.176	1.357	50.00	57.68		AVRG	15.4	25.0	
2,4-Dimethylphenol	0.261	0.333	50.00	63.68		AVRG	27.4	25.0	<
Dimethylphthalate	1.245	1.370	50.00	55.02		AVRG	10.0	25.0	
Di-n-butylphthalate	1.240	1.455	50.00	51.80		LINR	3.6	25.0	
4,6-Dinitro-2-methylphenol	0.082	0.117	50.00	48.24		LINR	-3.5	25.0	
2,4-Dinitrophenol	0.096	0.140	50.00	52.81	0.050	2ORDR	5.6	25.0	
2,4-Dinitrotoluene	0.312	0.412	50.00	52.11		LINR	4.2	25.0	
2,6-Dinitrotoluene	0.241	0.311	50.00	52.00		LINR	4.0	25.0	
Di-n-octylphthalate	1.681	2.109	50.00	53.58		LINR	7.2	25.0	
1,2-Diphenylhydrazine	0.943	0.955	50.00	50.63		AVRG	1.3	25.0	
Fluoranthene	0.884	1.012	50.00	57.25		AVRG	14.5	25.0	
Fluorene	1.181	1.277	50.00	54.05		AVRG	8.1	25.0	
Hexachlorobenzene	0.248	0.238	50.00	47.90		AVRG	-4.2	25.0	
Hexachlorobutadiene	0.135	0.151	50.00	56.14		AVRG	12.3	25.0	
Hexachlorocyclopentadiene	0.114	0.207	50.00	66.00	0.050	LINR	32.0	25.0	<
Hexachloroethane	0.523	0.631	50.00	60.38		AVRG	20.8	25.0	
Indeno(1,2,3-cd)pyrene	0.935	1.161	50.00	57.95		2ORDR	15.9	25.0	
Isophorone	0.563	0.628	50.00	55.77		AVRG	11.5	25.0	
2-Methylnaphthalene	0.506	0.520	50.00	51.40		AVRG	2.8	25.0	
1-Methylnaphthalene	0.490	0.475	50.00	48.53		AVRG	-2.9	25.0	
4-Methylphenol	1.020	1.255	50.00	61.51		AVRG	23.0	25.0	
3-Methylphenol	1.020	1.255	50.00	61.51		AVRG	23.0	25.0	
2-Methylphenol	1.008	1.185	50.00	58.79		AVRG	17.6	25.0	
Naphthalene	0.940	1.002	50.00	53.30		AVRG	6.6	25.0	
2-Nitroaniline	0.308	0.368	50.00	49.52		LINR	-1.0	25.0	
3-Nitroaniline	0.277	0.332	50.00	48.22		LINR	-3.6	25.0	
4-Nitroaniline	0.228	0.308	50.00	49.74		LINR	-0.5	25.0	
Nitrobenzene	0.328	0.347	50.00	52.79		AVRG	5.6	25.0	
2-Nitrophenol	0.158	0.171	50.00	47.84		LINR	-4.3	25.0	
4-Nitrophenol	0.154	0.215	50.00	49.95	0.050	LINR	-0.1	25.0	
N-Nitroso-di-methylamine	0.519	0.611	50.00	58.86		AVRG	17.7	25.0	
N-Nitrosodiphenylamine(1)	0.548	0.562	50.00	51.37		AVRG	2.7	25.0	
N-Nitroso-di-n-propylamine	0.784	0.965	50.00	61.47	0.050	AVRG	22.9	25.0	
Pentachlorophenol	0.113	0.126	50.00	50.16		LINR	0.3	25.0	
Phenanthrene	1.078	1.081	50.00	50.17		AVRG	0.3	25.0	
Phenol	1.528	1.801	50.00	58.95		AVRG	17.9	25.0	

(1) Cannot be separated from Diphenylamine

SEMIVOLATILE INITIAL CALIBRATION VERIFICATION

Lab Name: EMPIRICAL LABS Contract: ICV1

Lab Code: Case No.: NA SAS No.: NA SDG No.: SDGA29527R

Instrument ID: BNA4 Calibration Date: 07/15/09 Time: 0654

Lab File ID: ICV50A Init. Calib. Date(s): 06/01/09 07/15/09

Init. Calib. Times: 1547 0618

COMPOUND	$\overline{RRF}$	RRF50	CURVE AMOUNT	CCAL AMOUNT	MIN RRF	CURVE	%D	MAX %D
Pyrene	1.328	1.455	50.00	54.77		AVRG	9.5	25.0
Pyridine	1.300	1.515	50.00	58.29		AVRG	16.6	25.0
1,2,4-Trichlorobenzene	0.279	0.291	50.00	52.19		AVRG	4.4	25.0
2,4,5-Trichlorophenol	0.302	0.353	50.00	48.93		LINR	-2.1	25.0
2,4,6-Trichlorophenol	0.313	0.383	50.00	53.38		LINR	6.8	25.0
1,4-Dioxane	0.542	0.584	50.00	53.85	0.050	AVRG	7.7	25.0

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ICV SV

FORM 7
SEMIVOLATILE CONTINUING CALIBRATION CHECK

Lab Name: EMPIRICAL LABS Contract: TRIECO

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TRI.B07151

Instrument ID: BNA4 Calibration Date: 07/21/09 Time: 2111

Lab File ID: CCV1E Init. Calib. Date(s): 07/14/09 07/14/09

Init. Calib. Times: 1427 2103

COMPOUND	$\overline{RRF}$	RRF5	CURVE AMOUNT	CCAL AMOUNT	MIN RRF	CURVE	%D	MAX %D	
Acenaphthene	0.970	1.060	5.000	5.464		AVRG	9.3	20.0	
Acenaphthylene	1.194	1.504	5.000	6.301		AVRG	26.0	20.0	
Anthracene	0.956	1.305	5.000	5.647		LINR	12.9	20.0	
Benzo(a)anthracene	1.369	1.687	5.000	5.542		LINR	10.8	20.0	
Benzo(b)fluoranthene	1.252	1.596	5.000	5.342		LINR	6.8	20.0	
Benzo(k)fluoranthene	1.612	1.788	5.000	4.106		2ORDR	-17.9	20.0	
Benzo(g,h,i)perylene	1.233	1.145	5.000	4.435		LINR	-11.3	20.0	
Benzo(a)pyrene	1.045	1.339	5.000	4.955		LINR	-0.9	20.0	
Chrysene	2.175	1.821	5.000	4.186		AVRG	-16.3	20.0	
Dibenz(a,h)anthracene	0.800	0.911	5.000	4.416		LINR	-11.7	20.0	
Fluoranthene	0.879	1.214	5.000	5.722		LINR	14.4	20.0	
Fluorene	0.946	1.117	5.000	5.904		AVRG	18.1	20.0	
Indeno(1,2,3-cd)pyrene	0.688	0.869	5.000	4.794		LINR	-4.1	20.0	
Naphthalene	2.021	2.047	5.000	5.460		2ORDR	9.2	20.0	
Phenanthrene	1.259	1.390	5.000	5.521		AVRG	10.4	20.0	
Pyrene	0.907	1.230	5.000	5.618		LINR	12.4	20.0	
2,4,6-Tribromophenol	0.089	0.178	10.00	12.28	0.050	LINR	22.8		<
2-Fluorobiphenyl	1.215	1.303	5.000	5.361		AVRG	7.2		
Terphenyl-d14	1.193	1.097	5.000	5.960		LINR	19.2		

FORM VII SV

cal level	LAB_CHEM	MANUALS
cal1g	Hexachloroethane	A
cal1g	Indeno(1,2,3-cd)pyrene	B
cal1g	4-Methylphenol	D
cal1g	3-Methylphenol	D
cal1-3	Benzoic acid	A
cal1-3	2,4-Dinitrophenol	A
cal1-4	2,4-Dinitrophenol	A
cal1-4	Benzoic acid	A
cal1-4	Naphthalene-d8	A
cal1-5	Benzoic acid	A
cal1-6	Benzoic acid	A
cal1-7	Benzoic acid	A
cal1-8	Benzoic acid	A
cal1-9	Benzoic acid	A
cal1-10	Benzoic acid	A
cal1-10	Naphthalene-d8	A
cal1-11	Naphthalene-d8	A
cal1-11	Benzoic acid	A
cal1-2a	2,3,4,6-Tetrachlorophenol	A
cal1-2a	Atrazine	A
cal1-3a	2,3,4,6-Tetrachlorophenol	A
cal1-3a	Atrazine	A
ICV50A	1,4-Dichlorobenzene-d4	A
ICV50A	Phenol	A
ICV50A	Aniline	B
ICV50A	bis(2-Chloroethyl) ether	A
ICV50A	Naphthalene-d8	A
ICV50A	Benzoic acid	A
ICV50A	2,6-Dinitrotoluene	A
ICV50A	3-Nitroaniline	A
ICV50A	4,6-Dinitro-2-methylphenol	A

Sequence Name: C:\msdchem\1\sequence\071409b4.S
Comment: SIM EPA8270
Operator: ADM
Data Path: D:\DATA\071409b4\
strument Control Pre-Seq Cmd:
ta Analysis Pre-Seq Cmd:

strument Control Post-Seq Cmd:
ta Analysis Post-Seq Cmd:

Method Sections To Run
(X) Full Method
( ) Reprocessing Only

On A Barcode Mismatch
(X) Inject Anyway
( ) Don't Inject

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'Sim/scan'

Line		Sample Name/Misc Info		
) Sample	1	DF0714B1	DFTPPBN4	DF0714B1;;;;;14:09, 7/14
) Sample	2	cal1c	IXBN4	STD0.025PPM;;;;;1c
) Sample	3	cal1d	IXBN4	STD0.05PPM;;;;;1d
) Sample	4	cal1e	IXBN4	STD0.1PPM;;;;;1e
) Sample	5	cal1f	IXBN4	STD0.25PPM;;;;;1f
) Sample	6	cal1g	IXBN4	STD0.5PPM;;;;;1g
) Sample	7	cal2	IXBN4	STD1.0PPM;;;;;2
) Sample	8	cal3	IXBN4	STD2.0PPM;;;;;3
) Sample	9	cal4	IXBN4	STD5.0PPM;;;;;4
) Sample	10	cal5	IXBN4	STD10PPM;;;;;5
) Sample	11	cal6	IXBN4	STD20PPM;;;;;6
) Sample	12	cal7	IXBN4	STD40PPM;;;;;7
) Sample	13	cal8	IXBN4	STD50PPM;;;;;8
) Sample	14	cal9	IXBN4	STD60PPM;;;;;9
) Sample	15	cal10	IXBN4	STD80PPM;;;;;10
) Sample	16	cal11	IXBN4	STD100PPM;;;;;11
) Sample	17	ICV5a	IXBN4	icv-5PPM;;;;;
) Sample	18	ICV5b	IXBN4	icv-5PPM;;;;;
) Sample	1	DF0714B2	DFTPPBN4	DF0714B2;;;;;7/15, 00:38
) Sample	19	cal2a	IXBN4	STD1.0PPM;;;;;2a
) Sample	20	cal3a	IXBN4	STD2.0PPM;;;;;3a
) Sample	21	cal4a	IXBN4	STD5.0PPM;;;;;4a
) Sample	22	cal5a	IXBN4	STD10PPM;;;;;5a
) Sample	23	cal6a	IXBN4	STD20PPM;;;;;6a
) Sample	24	cal7a	IXBN4	STD40PPM;;;;;7a
) Sample	25	cal8a	IXBN4	STD50PPM;;;;;8a
) Sample	26	cal9a	IXBN4	STD60PPM;;;;;9a
) Sample	27	cal10a	IXBN4	STD80PPM;;;;;10a
Sample	28	cal11a	IXBN4	STD100PPM;;;;;11a
Sample	29	ICV50A	IXBN4	STD50PPM;;;;; (lcs1)
Sample	30	ICV50B	IXBN4	STD50PPM;;;;; (lcs2)
) Sample	31	benzicv	IXBN4	STD50PPM;;;;; (benzidines)

SCAN

RL, mm lost.

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```
  Sequence Name: C:\msdchem\1\sequence\071409b4.S
        Comment: SIM EPA8270
       Operator: ADM
      Data Path: D:\DATA\071409b4\
nstrument Control  Pre-Seq Cmd:
ata Analysis       Pre-Seq Cmd:

nstrument Control Post-Seq Cmd:
ata Analysis      Post-Seq Cmd:

 Method Sections To Run      On A Barcode Mismatch
  (X) Full Method              (X) Inject Anyway
  ( ) Reprocessing Only        ( ) Don't Inject

-------------------------------------------------------------------------
Line                    Sample Name/Misc Info
-------------------------------------------------------------------------
1   Type: Sample        DF0714B1;;;;;
    Vial: 1             ;3;DFTPP;;;;all.sub
    Method   : DFTPPBN4.M
    Datafile: DF0714B1.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
2   Type: Sample        STD0.025PPM;;;;;1c
    Vial: 2             ;;;;;;ppbna.sub
    Method   : IXBN4.M
    Datafile: cal1c.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
3   Type: Sample        STD0.05PPM;;;;;1d
    Vial: 3             ;;;;;;ppbna.sub
    Method   : IXBN4.M
    Datafile: cal1d.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
4   Type: Sample        STD0.1PPM;;;;;1e
    Vial: 4             ;;;;;;ppbna.sub
    Method   : IXBN4.M
    Datafile: cal1e.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
5   Type: Sample        STD0.25PPM;;;;;1f
    Vial: 5             ;;;;;;ppbna.sub
    Method   : IXBN4.M
    Datafile: cal1f.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
6   Type: Sample        STD0.5PPM;;;;;1g
    Vial: 6             ;;;;;;ppbna.sub
    Method   : IXBN4.M
    Datafile: cal1g.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
```

0907151 PAH

Sequence Last Modified Thu Jul 16 13:44:46 2009 Page: 1

```
    CR Database      :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------
 7  Type: Sample       STD1.0PPM;;;;;2
    Vial: 7            ;;;;;;ppbna.sub
    Method  : IXBN4.M
    Datafile: cal2.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------
 8  Type: Sample       STD2.0PPM;;;;;3
    Vial: 8            ;;;;;;ppbna.sub
    Method  : IXBN4.M
    Datafile: cal3.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------
 9  Type: Sample       STD5.0PPM;;;;;4
    Vial: 9            ;;;;;;ppbna.sub
    Method  : IXBN4.M
    Datafile: cal4.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------
10  Type: Sample      STD10PPM;;;;;5
    Vial: 10          ;;;;;;ppbna.sub
    Method  : IXBN4.M
    Datafile: cal5.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------
11  Type: Sample      STD20PPM;;;;;6
    Vial: 11          ;;;;;;ppbna.sub
    Method  : IXBN4.M
    Datafile: cal6.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------
12  Type: Sample      STD40PPM;;;;;7
    Vial: 12          ;;;;;;ppbna.sub
    Method  : IXBN4.M
    Datafile: cal7.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------
13  Type: Sample      STD50PPM;;;;;8
    Vial: 13          ;;;;;;ppbna.sub
    Method  : IXBN4.M
    Datafile: cal8.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------
14  Type: Sample      STD60PPM;;;;;9
    Vial: 14          ;;;;;;ppbna.sub
    Method  : IXBN4.M
    Datafile: cal9.D
```

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```
     Bar Code:                          Samp Amt: 0          Multiplr: 1
     Area% Report      :per Method       Lib. Search Rep :per Method
     Quant Report      :per Method       Post-Quant Macro:per Method
     CR Database       :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
 15  Type: Sample        STD80PPM;;;;;10
     Vial: 15            ;;;;;;ppbna.sub
     Method  : IXBN4.M
     Datafile: cal10.D
     Bar Code:                          Samp Amt: 0          Multiplr: 1
     Area% Report      :per Method       Lib. Search Rep :per Method
     Quant Report      :per Method       Post-Quant Macro:per Method
     CR Database       :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
 16  Type: Sample        STD100PPM;;;;;11
     Vial: 16            ;;;;;;ppbna.sub
     Method  : IXBN4.M
     Datafile: cal11.D
     Bar Code:                          Samp Amt: 0          Multiplr: 1
     Area% Report      :per Method       Lib. Search Rep :per Method
     Quant Report      :per Method       Post-Quant Macro:per Method
     CR Database       :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
 17  Type: Sample        icv-5PPM;;;;;
     Vial: 17            ;;;;;;ppbna.sub
     Method  : IXBN4.M
     Datafile: ICV5a.D
     Bar Code:                          Samp Amt: 0          Multiplr: 1
     Area% Report      :per Method       Lib. Search Rep :per Method
     Quant Report      :per Method       Post-Quant Macro:per Method
     CR Database       :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
 18  Type: Sample        icv-5PPM;;;;;
     Vial: 18            ;;;;;;ppbna.sub
     Method  : IXBN4.M
     Datafile: ICV5b.D
     Bar Code:                          Samp Amt: 0          Multiplr: 1
     Area% Report      :per Method       Lib. Search Rep :per Method
     Quant Report      :per Method       Post-Quant Macro:per Method
     CR Database       :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
 19  Type: Sample        DF0714B2;;;;;
     Vial: 1             ;3;DFTPP;;;;all.sub
     Method  : DFTPPBN4.M
     Datafile: DF0714B2.D
     Bar Code:                          Samp Amt: 0          Multiplr: 1
     Area% Report      :per Method       Lib. Search Rep :per Method
     Quant Report      :per Method       Post-Quant Macro:per Method
     CR Database       :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
 20  Type: Sample        STD1.0PPM;;;;;2a
     Vial: 19            ;;;;;;ppbna.sub
     Method  : IXBN4.M
     Datafile: cal2a.D
     Bar Code:                          Samp Amt: 0          Multiplr: 1
     Area% Report      :per Method       Lib. Search Rep :per Method
     Quant Report      :per Method       Post-Quant Macro:per Method
     CR Database       :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
 21  Type: Sample        STD2.0PPM;;;;;3a
     Vial: 20            ;;;;;;ppbna.sub
     Method  : IXBN4.M
     Datafile: cal3a.D
     Bar Code:                          Samp Amt: 0          Multiplr: 1
     Area% Report      :per Method       Lib. Search Rep :per Method
     Quant Report      :per Method       Post-Quant Macro:per Method
     CR Database       :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
 22  Type: Sample        STD5.0PPM;;;;;4a
```

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```
     Vial: 21            ;;;;;;ppbna.sub
     Method  : IXBN4.M
     Datafile: cal4a.D
     Bar Code:                        Samp Amt: 0          Multiplr: 1
     Area% Report      :per Method       Lib. Search Rep :per Method
     Quant Report      :per Method       Post-Quant Macro:per Method
     CR Database       :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
23   Type: Sample        STD10PPM;;;;;5a
     Vial: 22            ;;;;;;ppbna.sub
     Method  : IXBN4.M
     Datafile: cal5a.D
     Bar Code:                        Samp Amt: 0          Multiplr: 1
     Area% Report      :per Method       Lib. Search Rep :per Method
     Quant Report      :per Method       Post-Quant Macro:per Method
     CR Database       :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
24   Type: Sample        STD20PPM;;;;;6a
     Vial: 23            ;;;;;;ppbna.sub
     Method  : IXBN4.M
     Datafile: cal6a.D
     Bar Code:                        Samp Amt: 0          Multiplr: 1
     Area% Report      :per Method       Lib. Search Rep :per Method
     Quant Report      :per Method       Post-Quant Macro:per Method
     CR Database       :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
25   Type: Sample        STD40PPM;;;;;7a
     Vial: 24            ;;;;;;ppbna.sub
     Method  : IXBN4.M
     Datafile: cal7a.D
     Bar Code:                        Samp Amt: 0          Multiplr: 1
     Area% Report      :per Method       Lib. Search Rep :per Method
     Quant Report      :per Method       Post-Quant Macro:per Method
     CR Database       :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
26   Type: Sample        STD50PPM;;;;;8a
     Vial: 25            ;;;;;;ppbna.sub
     Method  : IXBN4.M
     Datafile: cal8a.D
     Bar Code:                        Samp Amt: 0          Multiplr: 1
     Area% Report      :per Method       Lib. Search Rep :per Method
     Quant Report      :per Method       Post-Quant Macro:per Method
     CR Database       :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
27   Type: Sample        STD60PPM;;;;;9a
     Vial: 26            ;;;;;;ppbna.sub
     Method  : IXBN4.M
     Datafile: cal9a.D
     Bar Code:                        Samp Amt: 0          Multiplr: 1
     Area% Report      :per Method       Lib. Search Rep :per Method
     Quant Report      :per Method       Post-Quant Macro:per Method
     CR Database       :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
28   Type: Sample        STD80PPM;;;;;10a
     Vial: 27            ;;;;;;ppbna.sub
     Method  : IXBN4.M
     Datafile: cal10a.D
     Bar Code:                        Samp Amt: 0          Multiplr: 1
     Area% Report      :per Method       Lib. Search Rep :per Method
     Quant Report      :per Method       Post-Quant Macro:per Method
     CR Database       :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
29   Type: Sample        STD100PPM;;;;;11a
     Vial: 28            ;;;;;;ppbna.sub
     Method  : IXBN4.M
     Datafile: cal11a.D
     Bar Code:                        Samp Amt: 0          Multiplr: 1
     Area% Report      :per Method       Lib. Search Rep :per Method
     Quant Report      :per Method       Post-Quant Macro:per Method
```

```
    CR Database      :per Method       CR Spreadsheet  :per Method
--------------------------------------------------------------------
30  Type: Sample       STD50PPM;;;;; (lcs1)
    Vial: 29           ;;;;;;ppbna.sub
    Method  : IXBN4.M
    Datafile: ICV50A.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
--------------------------------------------------------------------
31  Type: Sample       STD50PPM;;;;;  (lcs2)
    Vial: 30           ;;;;;;ppbna.sub
    Method  : IXBN4.M
    Datafile: ICV50B.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
--------------------------------------------------------------------
32  Type: Sample       STD50PPM;;;;;  (benzidines)
    Vial: 31           ;;;;;;ppbna.sub
    Method  : IXBN4.M
    Datafile: benzicv.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
--------------------------------------------------------------------
```

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Sequence Name: C:\msdchem\1\sequence\071609b4.S
Comment: SIM EPA8270
Operator: ADM
Data Path: D:\DATA\071609b4\
Instrument Control Pre-Seq Cmd:
Data Analysis Pre-Seq Cmd:

Instrument Control Post-Seq Cmd:
Data Analysis Post-Seq Cmd:

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M 7/16/09

Method Sections To Run
(X) Full Method
( ) Reprocessing Only

On A Barcode Mismatch
(X) Inject Anyway
( ) Don't Inject

Line		Sample Name/Misc Info			
1) Sample	1	DF0716B1	DFTPPBN4	DF0716B1;;;;;	
2) Sample	2	ICV50	IXBN4	STD50PPM;;;;;	
3) Sample	4	ICV50B	IXBN4	STD50PPM;;;;;	(lcs2)

```
   Sequence Name: C:\msdchem\1\sequence\071609b4.S
         Comment: SIM EPA8270
        Operator: ADM
       Data Path: D:\DATA\071609b4\
nstrument Control  Pre-Seq Cmd:
ata Analysis       Pre-Seq Cmd:

nstrument Control Post-Seq Cmd:
ata Analysis      Post-Seq Cmd:

  Method Sections To Run      On A Barcode Mismatch
    (X) Full Method             (X) Inject Anyway
    ( ) Reprocessing Only       ( ) Don't Inject

-------------------------------------------------------------------------
Line                    Sample Name/Misc Info
-------------------------------------------------------------------------
1    Type: Sample       DF0716B1;;;;;
     Vial: 1            ;3;DFTPP;;;;all.sub
     Method  : DFTPPBN4.M
     Datafile: DF0716B1.D
     Bar Code:                    Samp Amt: 0          Multiplr: 1
     Area% Report     :per Method       Lib. Search Rep :per Method
     Quant Report     :per Method       Post-Quant Macro:per Method
     CR Database      :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
2    Type: Sample       STD50PPM;;;;;
     Vial: 2            ;;;;;;ppbna.sub
     Method  : IXBN4.M
     Datafile: ICV50.D
     Bar Code:                    Samp Amt: 0          Multiplr: 1
     Area% Report     :per Method       Lib. Search Rep :per Method
     Quant Report     :per Method       Post-Quant Macro:per Method
     CR Database      :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
3    Type: Sample       STD50PPM;;;;;  (lcs2)
     Vial: 4            ;;;;;;ppbna.sub
     Method  : IXBN4.M
     Datafile: ICV50B.D
     Bar Code:                    Samp Amt: 0          Multiplr: 1
     Area% Report     :per Method       Lib. Search Rep :per Method
     Quant Report     :per Method       Post-Quant Macro:per Method
     CR Database      :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
```

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Sequence Name: C:\msdchem\1\sequence\072109b4.S
Comment: EPA8270
Operator: ADM
Data Path: D:\DATA\072109b4\
nstrument Control Pre-Seq Cmd:
ata Analysis Pre-Seq Cmd:

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nstrument Control Post-Seq Cmd:
ata Analysis Post-Seq Cmd:

Method Sections To Run
(X) Full Method
( ) Reprocessing Only

On A Barcode Mismatch
(X) Inject Anyway
( ) Don't Inject

SIM / Scan

Line		Sample Name/Misc Info		
1) Sample	2	TEST1	IXBN4	STD50PPM;;;;;9G0291
2) Sample	1	DF0721B1	DFTPPBN4	DF0721B1;;;;;9F0096 8:35, 7/21
3) Sample	2	CCV1	IXBN4	STD5PPM;;;;;9G0183
4) Sample	3	CCV2	IXBN4	STD50PPM;;;;;9G0291
5) Sample	4	S1BW0713	IXBN4	SBLK0713BW1;1;1000;1000;1;UG/
6) Sample	5	S1LW0713	IXBN4	SBLK0713BW1LCS;1;1000;1000;1;
7) Sample	6	0706619	IXBN4	0907066-19;1;1060;1000;1;UG/L
8) Sample	7	0706620	IXBN4	0907066-20;1;1070;1000;1;UG/L
9) Sample	8	0708721	IXBN4	0907087-21;1;1070;1000;1;UG/L
0) Sample	9	0708722	IXBN4	0907087-22;1;1070;1000;1;UG/L
1) Sample	10	0708724	IXBN4	0907087-24;1;1065;1000;1;UG/L
2) Sample	11	0708725	IXBN4	0907087-25;1;1040;1000;1;UG/L
3) Sample	12	0709814	IXBN4	0907098-14;1;1000;1000;1;UG/L
4) Sample	13	0709815	IXBN4	0907098-15;1;1020;1000;1;UG/L
5) Sample	14	0707202	IXBN4	0907072-02;1;1020;1000;1;UG/L
6) Sample	15	0707203	IXBN4	0907072-03;1;1000;1000;1;UG/L
7) Sample	16	0707204	IXBN4	0907072-04;1;1020;1000;1;UG/L
8) Sample	17	0707205	IXBN4	0907072-05;1;1070;1000;1;UG/L
9) Sample	18	0707206	IXBN4	0907072-06;1;1080;1000;1;UG/L
0) Sample	19	0707207	IXBN4	0907072-07;1;1020;1000;1;UG/L
1) Sample	20	0707202M	IXBN4	0907072-02;1;1000;1000;1;UG/L
2) Sample	21	0707202S	IXBN4	0907072-02;1;1080;1000;1;UG/L
3) Sample	1	DF0721B2	DFTPPBN4	DF0721B1;;;;;9F009620:53,7/21
4) Sample	2	CCV1E	IXBN4	STD5PPM;;;;;9G0183
5) Sample	3	CCV2E	IXBN4	STD50PPM;;;;;9G0291
6) Sample	22	0707208	IXBN4	0907072-08;1;1080;1000;1;UG/L
7) Sample	23	0707209	IXBN4	0907072-09;1;1080;1000;1;UG/L
8) Sample	24	S1BS0720	IXBN4	SBLK0720BS1;1;15;1000;1;UG/KG
9) Sample	25	S1LS0720	IXBN4	SBLK0720BS1LCS;1;15;1000;1;UG
0) Sample	26	0715101	IXBN4	0907151-01;1;15;1000;1;UG/KG;
1) Sample	27	0715102	IXBN4	0907151-02;1;15;1000;1;UG/KG;
2) Sample	28	0715103	IXBN4	0907151-03;1;15;1000;1;UG/KG;
3) Sample	29	0715104	IXBN4	0907151-04;1;15;1000;1;UG/KG;
4) Sample	30	0715105	IXBN4	0907151-05;1;15;1000;1;UG/KG;
5) Sample	31	0715106	IXBN4	0907151-06;1;15;1000;1;UG/KG;
6) Sample	32	0715107	IXBN4	0907151-07;1;15;1000;1;UG/KG;
7) Sample	33	0715108	IXBN4	0907151-08;1;15;1000;1;UG/KG;
8) Sample	34	0715109	IXBN4	0907151-09;1;15;1000;1;UG/KG;
9) Sample	35	0715110	IXBN4	0907151-10;1;15;1000;1;UG/KG;
0) Sample	36	0715102D	IXBN4	0907151-02;1;15;1000;1;UG/KG;-NK
1) Sample	37	0715109D	IXBN4	0907151-09;1;15;1000;1;UG/KG;-NK
2) Sample	38	0715103M	IXBN4	0907151-03;1;15;1000;1;UG/KG;
3) Sample	39	0715103S	IXBN4	0907151-03;1;15;1000;1;UG/KG; 8:32, 7/22

E

Sequence Name: C:\msdchem\1\sequence\072109b4.S

	Line	Type	Vial	DataFile	Method	Sample Name
:4)		Sample	1	DF0721B3	DFTPPBN4	DF0721B3;;;;;9F0096
:5)		Sample	3	CCV1F	IXBN4	STD5PPM;;;;;9G0183

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```
  Sequence Name: C:\msdchem\1\sequence\072109b4.S
        Comment: EPA8270
       Operator: ADM
      Data Path: D:\DATA\072109b4\
nstrument Control  Pre-Seq Cmd:
ata Analysis       Pre-Seq Cmd:

nstrument Control Post-Seq Cmd:
ata Analysis      Post-Seq Cmd:

  Method Sections To Run      On A Barcode Mismatch
   (X) Full Method              (X) Inject Anyway
   ( ) Reprocessing Only        ( ) Don't Inject
```

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```
 ---------------------------------------------------------------------
 Line                    Sample Name/Misc Info
 ---------------------------------------------------------------------
 1   Type: Sample        STD50PPM;;;;;9G0291
     Vial: 2             ;;;;;;ppbna.sub
     Method  : IXBN4.M
     Datafile: TEST1.D
     Bar Code:                    Samp Amt: 0          Multiplr: 1
     Area% Report     :per Method       Lib. Search Rep :per Method
     Quant Report     :per Method       Post-Quant Macro:per Method
     CR Database      :per Method       CR Spreadsheet  :per Method
 ---------------------------------------------------------------------
 2   Type: Sample        DF0721B1;;;;;9F0096
     Vial: 1             ;3;DFTPP;;;;all.sub
     Method  : DFTPPBN4.M
     Datafile: DF0721B1.D
     Bar Code:                    Samp Amt: 0          Multiplr: 1
     Area% Report     :per Method       Lib. Search Rep :per Method
     Quant Report     :per Method       Post-Quant Macro:per Method
     CR Database      :per Method       CR Spreadsheet  :per Method
 ---------------------------------------------------------------------
 3   Type: Sample        STD5PPM;;;;;9G0183
     Vial: 2             ;;;;;;simbna.sub
     Method  : IXBN4.M
     Datafile: CCV1.D
     Bar Code:                    Samp Amt: 0          Multiplr: 1
     Area% Report     :per Method       Lib. Search Rep :per Method
     Quant Report     :per Method       Post-Quant Macro:per Method
     CR Database      :per Method       CR Spreadsheet  :per Method
 ---------------------------------------------------------------------
 4   Type: Sample        STD50PPM;;;;;9G0291
     Vial: 3             ;;;;;;ppbna.sub
     Method  : IXBN4.M
     Datafile: CCV2.D
     Bar Code:                    Samp Amt: 0          Multiplr: 1
     Area% Report     :per Method       Lib. Search Rep :per Method
     Quant Report     :per Method       Post-Quant Macro:per Method
     CR Database      :per Method       CR Spreadsheet  :per Method
 ---------------------------------------------------------------------
 5   Type: Sample        SBLK0713BW1;1;1000;1000;1;UG/L;14-JUL-2009
     Vial: 4             ;3;BLANK;;;9G13009;ppbna.sub;
     Method  : IXBN4.M
     Datafile: S1BW0713.D
     Bar Code:                    Samp Amt: 0          Multiplr: 1
     Area% Report     :per Method       Lib. Search Rep :per Method
     Quant Report     :per Method       Post-Quant Macro:per Method
     CR Database      :per Method       CR Spreadsheet  :per Method
 ---------------------------------------------------------------------
 6   Type: Sample        SBLK0713BW1LCS;1;1000;1000;1;UG/L;14-JUL-2009
     Vial: 5             ;3;LCS;;;9G13009;ppbna.sub;
     Method  : IXBN4.M
     Datafile: S1LW0713.D
     Bar Code:                    Samp Amt: 0          Multiplr: 1
     Area% Report     :per Method       Lib. Search Rep :per Method
     Quant Report     :per Method       Post-Quant Macro:per Method
```

```
    CR Database     :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------
7   Type: Sample        0907066-19;1;1060;1000;1;UG/L;13-JUL-2009
    Vial: 6             ch2.b07066;0;;;;9G13009;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0706619.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report    :per Method       Lib. Search Rep :per Method
    Quant Report    :per Method       Post-Quant Macro:per Method
    CR Database     :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------
8   Type: Sample        0907066-20;1;1070;1000;1;UG/L;13-JUL-2009
    Vial: 7             ch2.b07066;0;;;;9G13009;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0706620.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report    :per Method       Lib. Search Rep :per Method
    Quant Report    :per Method       Post-Quant Macro:per Method
    CR Database     :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------
9   Type: Sample        0907087-21;1;1070;1000;1;UG/L;13-JUL-2009
    Vial: 8             ch2.b07087;0;;;;9G13009;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0708721.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report    :per Method       Lib. Search Rep :per Method
    Quant Report    :per Method       Post-Quant Macro:per Method
    CR Database     :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------
10  Type: Sample        0907087-22;1;1070;1000;1;UG/L;13-JUL-2009
    Vial: 9             ch2.b07087;0;;;;9G13009;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0708722.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report    :per Method       Lib. Search Rep :per Method
    Quant Report    :per Method       Post-Quant Macro:per Method
    CR Database     :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------
11  Type: Sample        0907087-24;1;1065;1000;1;UG/L;13-JUL-2009
    Vial: 10            ch2.b07087;0;;;;9G13009;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0708724.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report    :per Method       Lib. Search Rep :per Method
    Quant Report    :per Method       Post-Quant Macro:per Method
    CR Database     :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------
12  Type: Sample        0907087-25;1;1040;1000;1;UG/L;13-JUL-2009
    Vial: 11            ch2.b07087;0;;;;9G13009;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0708725.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report    :per Method       Lib. Search Rep :per Method
    Quant Report    :per Method       Post-Quant Macro:per Method
    CR Database     :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------
13  Type: Sample        0907098-14;1;1000;1000;1;UG/L;13-JUL-2009
    Vial: 12            ch2.b07098;0;;;;9G13009;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0709814.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report    :per Method       Lib. Search Rep :per Method
    Quant Report    :per Method       Post-Quant Macro:per Method
    CR Database     :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------
14  Type: Sample        0907098-15;1;1020;1000;1;UG/L;13-JUL-2009
    Vial: 13            ch2.b07098;0;;;;9G13009;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0709815.D
```

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    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-----------------------------------------------------------------------
15  Type: Sample       0907072-02;1;1020;1000;1;UG/L;13-JUL-2009
    Vial: 14           agv.b07072;0;;;;9G13009;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0707202.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-----------------------------------------------------------------------
16  Type: Sample       0907072-03;1;1000;1000;1;UG/L;13-JUL-2010
    Vial: 15           agv.b07072;0;;;;9G13009;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0707203.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-----------------------------------------------------------------------
17  Type: Sample       0907072-04;1;1020;1000;1;UG/L;13-JUL-2011
    Vial: 16           agv.b07072;0;;;;9G13009;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0707204.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-----------------------------------------------------------------------
18  Type: Sample       0907072-05;1;1070;1000;1;UG/L;13-JUL-2012
    Vial: 17           agv.b07072;0;;;;9G13009;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0707205.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-----------------------------------------------------------------------
19  Type: Sample       0907072-06;1;1080;1000;1;UG/L;13-JUL-2013
    Vial: 18           agv.b07072;0;;;;9G13009;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0707206.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-----------------------------------------------------------------------
20  Type: Sample       0907072-07;1;1020;1000;1;UG/L;13-JUL-2014
    Vial: 19           agv.b07072;0;;;;9G13009;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0707207.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-----------------------------------------------------------------------
21  Type: Sample       0907072-02;1;1000;1000;1;UG/L;13-JUL-2014
    Vial: 20           agv.b07072;3;MS;;;9G13009;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0707202M.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-----------------------------------------------------------------------
22  Type: Sample       0907072-02;1;1080;1000;1;UG/L;13-JUL-2014
```

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```
     Vial: 21          agv.b07072;3;MSD;;;9G13009;ppbna.sub;
     Method  : IXBN4.M
     Datafile: 0707202S.D
     Bar Code:                    Samp Amt: 0          Multiplr: 1
     Area% Report     :per Method       Lib. Search Rep :per Method
     Quant Report     :per Method       Post-Quant Macro:per Method
     CR Database      :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------
 23  Type: Sample      DF0721B1;;;;;9F0096
     Vial: 1           ;3;DFTPP;;;;all.sub
     Method  : DFTPPBN4.M
     Datafile: DF0721B2.D
     Bar Code:                    Samp Amt: 0          Multiplr: 1
     Area% Report     :per Method       Lib. Search Rep :per Method
     Quant Report     :per Method       Post-Quant Macro:per Method
     CR Database      :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------
 24  Type: Sample      STD5PPM;;;;;9G0183
     Vial: 2           ;;;;;;simbna.sub
     Method  : IXBN4.M
     Datafile: CCV1E.D
     Bar Code:                    Samp Amt: 0          Multiplr: 1
     Area% Report     :per Method       Lib. Search Rep :per Method
     Quant Report     :per Method       Post-Quant Macro:per Method
     CR Database      :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------
 25  Type: Sample      STD50PPM;;;;;9G0291
     Vial: 3           ;;;;;;ppbna.sub
     Method  : IXBN4.M
     Datafile: CCV2E.D
     Bar Code:                    Samp Amt: 0          Multiplr: 1
     Area% Report     :per Method       Lib. Search Rep :per Method
     Quant Report     :per Method       Post-Quant Macro:per Method
     CR Database      :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------
 26  Type: Sample      0907072-08;1;1080;1000;1;UG/L;13-JUL-2015
     Vial: 22          agv.b07072;0;;;;9G13009;ppbna.sub;
     Method  : IXBN4.M
     Datafile: 0707208.D
     Bar Code:                    Samp Amt: 0          Multiplr: 1
     Area% Report     :per Method       Lib. Search Rep :per Method
     Quant Report     :per Method       Post-Quant Macro:per Method
     CR Database      :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------
 27  Type: Sample      0907072-09;1;1080;1000;1;UG/L;13-JUL-2016
     Vial: 23          agv.b07072;0;;;;9G13009;ppbna.sub;
     Method  : IXBN4.M
     Datafile: 0707209.D
     Bar Code:                    Samp Amt: 0          Multiplr: 1
     Area% Report     :per Method       Lib. Search Rep :per Method
     Quant Report     :per Method       Post-Quant Macro:per Method
     CR Database      :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------
 28  Type: Sample      SBLK0720BS1;1;15;1000;1;UG/KG;20-JUL-2009
     Vial: 24          ;3;BLANK;;;9G20005;ppbna.sub;
     Method  : IXBN4.M
     Datafile: S1BS0720.D
     Bar Code:                    Samp Amt: 0          Multiplr: 1
     Area% Report     :per Method       Lib. Search Rep :per Method
     Quant Report     :per Method       Post-Quant Macro:per Method
     CR Database      :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------
 29  Type: Sample      SBLK0720BS1LCS;1;15;1000;1;UG/L;20-JUL-2009
     Vial: 25          ;3;LCS;;;9G20005;ppbna.sub;
     Method  : IXBN4.M
     Datafile: S1LS0720.D
     Bar Code:                    Samp Amt: 0          Multiplr: 1
     Area% Report     :per Method       Lib. Search Rep :per Method
     Quant Report     :per Method       Post-Quant Macro:per Method
```

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```
    CR Database      :per Method       CR Spreadsheet  :per Method
-----------------------------------------------------------------------
30  Type: Sample       0907151-01;1;15;1000;1;UG/KG;20-JUL-2016
    Vial: 26           tri.b07151;0;;;;9G20005;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0715101.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-----------------------------------------------------------------------
31  Type: Sample       0907151-02;1;15;1000;1;UG/KG;20-JUL-2017
    Vial: 27           tri.b07151;0;;;;9G20005;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0715102.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-----------------------------------------------------------------------
32  Type: Sample       0907151-03;1;15;1000;1;UG/KG;20-JUL-2018
    Vial: 28           tri.b07151;0;;;;9G20005;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0715103.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-----------------------------------------------------------------------
33  Type: Sample       0907151-04;1;15;1000;1;UG/KG;20-JUL-2019
    Vial: 29           tri.b07151;0;;;;9G20005;ppbna.sub;
    Method  : IXBN4.M
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    Bar Code:                    Samp Amt: 0          Multiplr: 1
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    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-----------------------------------------------------------------------
34  Type: Sample       0907151-05;1;15;1000;1;UG/KG;20-JUL-2020
    Vial: 30           tri.b07151;0;;;;9G20005;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0715105.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-----------------------------------------------------------------------
35  Type: Sample       0907151-06;1;15;1000;1;UG/KG;20-JUL-2021
    Vial: 31           tri.b07151;0;;;;9G20005;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0715106.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-----------------------------------------------------------------------
36  Type: Sample       0907151-07;1;15;1000;1;UG/KG;20-JUL-2022
    Vial: 32           tri.b07151;0;;;;9G20005;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0715107.D
    Bar Code:                    Samp Amt: 0          Multiplr: 1
    Area% Report     :per Method       Lib. Search Rep :per Method
    Quant Report     :per Method       Post-Quant Macro:per Method
    CR Database      :per Method       CR Spreadsheet  :per Method
-----------------------------------------------------------------------
37  Type: Sample       0907151-08;1;15;1000;1;UG/KG;20-JUL-2023
    Vial: 33           tri.b07151;0;;;;9G20005;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0715108.D
```

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```
    Bar Code:                          Samp Amt: 0          Multiplr: 1
    Area% Report      :per Method       Lib. Search Rep :per Method
    Quant Report      :per Method       Post-Quant Macro:per Method
    CR Database       :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
38  Type: Sample       0907151-09;1;15;1000;1;UG/KG;20-JUL-2024
    Vial: 34           tri.b07151;0;;;;9G20005;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0715109.D
    Bar Code:                          Samp Amt: 0          Multiplr: 1
    Area% Report      :per Method       Lib. Search Rep :per Method
    Quant Report      :per Method       Post-Quant Macro:per Method
    CR Database       :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
39  Type: Sample       0907151-10;1;15;1000;1;UG/KG;20-JUL-2025
    Vial: 35           tri.b07151;0;;;;9G20005;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0715110.D
    Bar Code:                          Samp Amt: 0          Multiplr: 1
    Area% Report      :per Method       Lib. Search Rep :per Method
    Quant Report      :per Method       Post-Quant Macro:per Method
    CR Database       :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
40  Type: Sample       0907151-02;1;15;1000;1;UG/KG;20-JUL-2017
    Vial: 36           tri.b07151;0;;;;9G20005;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0715102D.D
    Bar Code:                          Samp Amt: 0          Multiplr: 1
    Area% Report      :per Method       Lib. Search Rep :per Method
    Quant Report      :per Method       Post-Quant Macro:per Method
    CR Database       :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
41  Type: Sample       0907151-09;1;15;1000;1;UG/KG;20-JUL-2017
    Vial: 37           tri.b07151;0;;;;9G20005;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0715109D.D
    Bar Code:                          Samp Amt: 0          Multiplr: 1
    Area% Report      :per Method       Lib. Search Rep :per Method
    Quant Report      :per Method       Post-Quant Macro:per Method
    CR Database       :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
42  Type: Sample       0907151-03;1;15;1000;1;UG/KG;20-JUL-2018
    Vial: 38           tri.b07151;3;MS;;;9G20005;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0715103M.D
    Bar Code:                          Samp Amt: 0          Multiplr: 1
    Area% Report      :per Method       Lib. Search Rep :per Method
    Quant Report      :per Method       Post-Quant Macro:per Method
    CR Database       :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
43  Type: Sample       0907151-03;1;15;1000;1;UG/KG;20-JUL-2018
    Vial: 39           tri.b07151;3;MSD;;;9G20005;ppbna.sub;
    Method  : IXBN4.M
    Datafile: 0715103S.D
    Bar Code:                          Samp Amt: 0          Multiplr: 1
    Area% Report      :per Method       Lib. Search Rep :per Method
    Quant Report      :per Method       Post-Quant Macro:per Method
    CR Database       :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
44  Type: Sample       DF0721B3;;;;;9F0096
    Vial: 1            ;3;DFTPP;;;;all.sub
    Method  : DFTPPBN4.M
    Datafile: DF0721B3.D
    Bar Code:                          Samp Amt: 0          Multiplr: 1
    Area% Report      :per Method       Lib. Search Rep :per Method
    Quant Report      :per Method       Post-Quant Macro:per Method
    CR Database       :per Method       CR Spreadsheet  :per Method
-------------------------------------------------------------------------
45  Type: Sample       STD5PPM;;;;;9G0183
```

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```
Vial: 3            ;;;;;;simbna.sub
Method   : IXBN4.M
Datafile: CCV1F.D
Bar Code:                    Samp Amt: 0          Multiplr: 1
Area% Report     :per Method       Lib. Search Rep :per Method
Quant Report     :per Method       Post-Quant Macro:per Method
CR Database      :per Method       CR Spreadsheet  :per Method
```

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Attachment 5

Data Validation

Validation Report

Soil Samples
St. John's Tank Motor Park
Excavation

Trieco, LLC
Louisville Kentucky

Prepared by DataChek

August 3, 2009

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ACRONYMS AND ABBREVIATIONS

%	Percent
%D	percent difference
BTEX	benzene, toluene, ethylbenzene, and xylenes
CB	calibration blank
CCAL	continuing calibration
CCV	continuing calibration verification
COC	chain of custody
DRO	diesel range organic
EPH	extractible petroleum hydrocarbons
ER	equipment rinsate
FD	field duplicate
GRO	gasoline range organic
ICAL	initial calibration
ICL	instrument calibration limit
IS	internal standard
J	estimated value
LCS	laboratory control sample
MB	method blank
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
MTBE	methyl tert butyl ether
PAH	polynuclear aromatic hydrocarbon
PARCC	precision, accuracy, representativeness, comparability, completeness
PRO	petroleum range organics
QC	quality control
R	Rejected
RL	reporting limit
RPD	relative percent difference
RRF	relative response factor
RSD	relative standard deviation
SDG	sample delivery group
TB	trip blank
TPH	total petroleum hydrocarbons
TCE	trichloroethene
U	not detected
UJ	not detected; associated value is an estimate
VOC	volatile organic compound

1. INTRODUCTION

The data validation of 10 soil samples from the pit excavations at the St. Johns Tank Motor Park (Trieco, LLC) project was completed in August 2009. Level III data validation was performed on all samples collected during the sampling activities. No data was rejected during the validation process and all the data is acceptable for use as qualified. All the samples from the soil sample delivery group (SDG), 0907151 have the following label: Stage_3_Validation_Manual (S3VM). Empirical Laboratories, Nashville, TN, produced all the analytical data. All samples were analyzed for polyaromatic hydrocarbons (PAHs).

2. PROCEDURES

The sample data were validated following the logic identified in *The CLP National Functional Guidelines for Organic Data Review (June 2008)*. The data validation qualifiers (Table 5-1) applied by the reviewer were recorded in a column adjacent and to the right of the laboratory results. A data validation reason code was also added to each of the reviewer's qualifiers to provide the user with a means to identify which results were qualified and the reason for the qualifiers (Table 5-2). The data were labeled according to *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (January, 2009)*.

3. SUMMARY OF DATA VALIDATION FINDINGS

This data validation report reflects the data validation findings for samples associated with the St John's project. The validated data set consisted of 10 soil samples and was validated at Level III. All sample information acquired in the field, sample number and desired analyses were listed on the appropriate chain-of-custody (COC) and the COC was satisfactory and complete. Overall the data was of excellent quality, and all measurements required to satisfy the project quality control (QC) objectives (precision, accuracy, representativeness, comparability, and completeness) were met. Each of these measures and specific data qualifications are discussed below.

Precision: Precision is a measure of the agreement between duplicate sample measurements of the same quantity and is reflected in the relative percent difference (RPD) between spikes and the RPD for the field duplicate analysis. Precision was measured at 100.0 percent.

Accuracy: Accuracy is measured by the results from the recovery of known amounts of compounds or elements from laboratory control samples (LCS), matrix spikes (MS), and surrogate recoveries. The overall measure of accuracy for The St John's project was calculated by comparing the number of spike

recoveries that exceeded the laboratory limits by the total number of LCS, MS and surrogate spikes. As all recoveries were within the QC limits, accuracy was measured at 100.0 percent.

Representativeness: The measures of representativeness – sample handling, analytical blank analysis, field blanks – were met for all sites. Designated analytical protocols were followed. Holding times were met for all analyses. Overall, no major problems were identified resulting from analytical failure.

Comparability: All data were analyzed using appropriate approved methods of analysis. All data results were reported correctly and in standard units

Completeness: Completeness is the amount of valid data compared to the planned amount and is expressed as a percent of the usable data points divided by the total number of analytes for each parameter analyzed. Out of a total of 160 data points, no data points were rejected, resulting in a completeness of 100.0 percent.

Several sample results for both the organic compounds and inorganic elements were assigned "J" qualifiers by the laboratory, which is standard practice, because the concentrations were quantified between the method detection limit and the reporting limit. Due to the uncertainty associated with this region of quantification, the validation reviewer retained the "J" qualifiers assigned by the laboratory to indicate an estimated quantity.

A data validation summary, which functions as a worksheet for the validation task, is included. The following section highlights the key findings of the data validation.

4. ANALYSIS-SPECIFIC DATA VALIDATION SUMMARIES

4.1 POLYAROMATIC HYDROCARBONS (PAH) BY SW846 8270C

Overall, the data are of good quality and are usable as qualified. Ten soil samples were analyzed for PAHs. Data were reviewed for the following:

Holding Times/Sample Condition. All samples were received in acceptable condition and were extracted and analyzed within the acceptable QC holding time.

Initial and Continuing Calibration. The ICAL analysis was within the QC limits. The CCAL for acenaphthylene exceeded the 25% QC criteria and the result in all 10 samples was qualified as "UJ".

Blanks. No contamination was noted in the associated method or field blanks.

Surrogate Recoveries. All the surrogate recoveries were within the QC limits.

Internal Standards. The internal standards area count recoveries and the retention times were within the QC criteria, so no qualifiers were needed.

Matrix Spike/Matrix Spike Duplicates. The MS/MSD recoveries for the PAH compounds were within the QC limits, so no qualifiers were required.

Laboratory Control Sample (LCS). All the LCS recoveries were within the QC limits.

Field Duplicates. No field duplicate sample was analyzed.

Quantification. All results were acceptable as qualified.

5. DATA QUALIFIER DEFINITIONS

5.1 DATA QUALIFIER DEFINITIONS

Table 5-1 Data Qualifier Definitions

Qualifier	Definition
R	Indicates that the analyte result was rejected. The data was not reliable. Additional supporting analyses required.
U	The analyte was analyzed for, but was not detected above the reported sample quantification limit or the reported analyte value was not detected above 5x or 10x the level reported in laboratory or field blanks.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ	The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

5.2 DATA VALIDATION REASON CODES

During the review process, a data validation reason code was added to each of the reviewer's qualifiers to allow the user to identify which results were qualified and the reason(s) for the qualifiers. Reason codes are listed and defined in Table 5-2.

Table 5-2 Data Validation Reason Codes

Reason Code	Definition
01	Sample received outside of 4+/-2 degrees Celsius
01A	Improper sample preservation
02	Holding time exceeded
02A	Extraction
02B	Analysis
03	Instrument performance – outside criteria
03A	BFB
03B	DFTPP
03C	DDT and/or Endrin % breakdown exceeds criteria
03D	Retention time windows
03E	Resolution
04	Initial calibration results outside specified criteria
04A	Compound mean RRF QC criteria not met
04B	Individual % RSD criteria not met
04C	Correlation coefficient >0.995
05	Continuing calibration results outside specified criteria
05A	Compound mean RRF QC criteria not met
05B	Compound % D QC criteria not met
06	Result qualified as a result of the 5x/10x blank correction
06A	Method or preparation blank
06B	ICB or CCB
06C	ER
06D	TB
06E	FB
07	Surrogate recoveries outside control limits
07A	Sample
07B	Associated method blank or LCS
08	MS/MSD/Duplicate results outside criteria
08A	MS and/or MSD recovery not within control limits (accuracy)
08B	% RPD outside acceptance criteria (precision)
09	Post digestion spike outside criteria (GFAA)
10	Internal standards outside specified control limits

10A	Recovery
10B	Retention time
11	Laboratory control sample recoveries outside specified limits
11A	Recovery
11B	% RPD (if run in duplicate)
12	Interference check standard
13	Serial dilution
14	Tentatively identified compounds
15	Quantification
16	Multiple results available; alternate analysis preferred
17	Field duplicate RPD criteria is exceeded
18	Percent difference between original and second column exceeds QC criteria
19	Professional judgment was used to qualify the data
20	Pesticide clean-up checks
21	Target compound identification
22	Radiological calibration
23	Radiological quantification
24	Reported result and/or lab qualifier revised to reflect validation findings

% = percent
%D = percent difference
BFB = bromofluorobenzene
CCB = continuing calibration blank
DFTPP = decafluorotriphenylphosphine
ER = equipment rinseate
FB = field blank
GFAA = graphite furnace atomic absorption
ICB = initial calibration blank
LCS = laboratory control sample
MS = matrix spike
MSD = matrix spike duplicate
QC = quality control
RPD = relative percent difference
RRF = relative response factor
RSD = relative standard deviation
TB = trip blank

6. REFERENCES

EPA (U.S. Environmental Protection Agency), June 2008. OWSER 9240.1-48 *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (USEPA-540-R-08-01).*

EPA (U.S. Environmental Protection Agency), January 2009. OSWER 9200-1-85. *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use. (EPA-540/R-08-005).*

Attachment 6

Special Waste Tracking Documents and Associated Weight Receipts

1

Waste Management of Kentucky, LLC

☒ LANDFILL ☐ BIOREACTOR
☐ SOLIDIFICATION ☐ BIOREMEDIATION

SPECIAL WASTE TRACKING DOCUMENT

GENERATOR U.S. ARMY FT. KNOX GARRISON PROFILE # 103735 KY

FACILITY STREET ADDRESS ST. JOHNS TANK MOTOR PARK

CITY, COUNTY, STATE FT. KNOX, KY

TECHNICAL CONTACT CHRIS WARD PHONE (502) 609-2630

QUANTITY SHIPPED 20T (APPROX) DATE SHIPPED

WASTE DESCRIPTION PETROLEUM IMPACTED SOIL

I CERTIFY THAT WHILE THE WASTE WAS IN MY CUSTODY OR CONTROL, NO WASTE REGULATED BY THE CABINET AS HAZARDOUS WASTE OR INFECTIOUS WASTE WAS KNOWINGLY INTRODUCED INTO THE WASTE.

AUTHORIZED SIGNATURE

TRANSPORTER SKAGGS TRUCK # 96

I CERTIFY THAT WHILE THE WASTE WAS IN MY CUSTODY OR CONTROL, NO WASTE REGULATED BY THE CABINET AS HAZARDOUS WASTE OR INFECTIOUS WASTE WAS KNOWINGLY INTRODUCED INTO THE WASTE.

DRIVER'S SIGNATURE X James Reed

BILL TO TRIECO LLC

CONTACT CHRIS WARD PHONE (502) 609-2630

☒ LANDFILL ☐ BIOREACTOR ☐ SOLIDIFICATION ☐ BIOREMEDIATION

GROSS 50900

OUTER LOOP RDF
2673 OUTER LOOP
LOUISVILLE, KY 40219

QUANTITY REC'D 18 NET WEIGHT 29440

DATE RECEIVED 7-15-09 COMMENTS

SIGNATURE J. Warden

WASTE MANAGEMENT

Outer Loop RDF
2673 Outer Loop
Louisville, KY, 40219
Ph: (502) 966-0272

Original 5685923
Ticket# 378304

Customer Name TRIECOLLC_2015 TRIECO LLC_201
Ticket Date 07/15/2009
Payment Type Credit Account
Manual Ticket#
Hauling Ticket#
Route
State Waste Code
Manifest 1
Destination
PO
Profile 103736KY (PETROLEUM CONTAMINATED SOIL)
Generator 181-USAARCFKNOX USAARMC FT KNOX

Carrier SKAGGSINCJIM SKAGGS INC. / JIM
Vehicle# SKAGGS96 Volume 18.0
Container
Driver
Check#
Billing # 0000201
Gen EPA ID
Grid

	Time	Scale	Operator
In	07/15/2009 09:47:13	Scale1	CHARLIE
Out	07/15/2009 10:16:56	Scale1	CHARLIE

Inbound

Gross	56960 lb
Tare	27520 lb
Net	29440 lb
Tons	14.72

Comments

	Product	LD%	Qty	UOM	Rate	Fee	Amount	Origin
1	Cont Soil Pet-Tons	100	14.72	Tons				HARD
2	FUEL-Fuel Surcharg	100		%				HARD
3	Evf8-Env Fee $8 Lg	100	1	Load				HARD

Total Fees
Total Ticket

Driver's Signature

403WM-N

2

Waste Management of Kentucky, LLC

☒ LANDFILL ☐ BIOREACTOR

☐ SOLIDIFICATION ☐ BIOREMEDIATION

SPECIAL WASTE TRACKING DOCUMENT

GENERATOR U.S. ARMY FT. KNOX GARRISON PROFILE # 103735 KY

FACILITY STREET ADDRESS ST. JOHNS TANK MOTOR PARK

CITY, COUNTY, STATE FT. KNOX KY

TECHNICAL CONTACT CHRIS WARD PHONE (502) 609-2630

QUANTITY SHIPPED 20T DATE SHIPPED

WASTE DESCRIPTION PETROLEUM IMPACTED SOIL

I CERTIFY THAT WHILE THE WASTE WAS IN MY CUSTODY OR CONTROL, NO WASTE REGULATED BY THE CABINET AS HAZARDOUS WASTE OR INFECTIOUS WASTE WAS KNOWINGLY INTRODUCED INTO THE WASTE.

AUTHORIZED SIGNATURE

TRANSPORTER SKAGGS TRUCK # 96

I CERTIFY THAT WHILE THE WASTE WAS IN MY CUSTODY OR CONTROL, NO WASTE REGULATED BY THE CABINET AS HAZARDOUS WASTE OR INFECTIOUS WASTE WAS KNOWINGLY INTRODUCED INTO THE WASTE.

DRIVER'S SIGNATURE

BILL TO TRIECO LLC

CONTACT CHRIS WARD PHONE (502) 609-2630

☐ LANDFILL ☐ BIOREACTOR ☐ SOLIDIFICATION ☐ BIOREMEDIATION

OUTER LOOP RDF
2673 OUTER LOOP
LOUISVILLE, KY 40219

QUANTITY REC'D 18 NET WEIGHT 47000

DATE RECEIVED 7-15-09 COMMENTS

SIGNATURE

WASTE MANAGEMENT

Outer Loop RDF
2673 Outer Loop
Louisville, KY, 40219
Ph: (502) 966-0272

Origin 5685949
Ticket# 378430

Customer Name TRIECOLLC_2015 TRIECO LLC_201 Carrier SKAGGSINCJIM SKAGGS INC. / JIM
Ticket Date 07/15/2009 Vehicle# SKAGGS96 Volume 18.0
Payment Type Credit Acoount Container
Manual Ticket# Driver
Hauling Ticket# Check#
Route Billing # 0000201
State Waste Code Gen EPA ID
Manifest 1 Grid
Destination
PO
Profile 103736KY (PETROLEUM CONTAMINATED SOIL)
Generator 181-USAARCFKNOX USAARMC FT KNOX

	Time	Scale	Operator	Inbound		
In	07/15/2009 12:26:47	Scale1	CHARLIE		Gross	74580 lb
Out	07/15/2009 12:26:47		CHARLIE		Tare	27520 lb
					Net	47060 lb
					Tons	23.53

Comments

	Product	LD%	Qty	UOM	Rate	Fee	Amount	Origin
1	Cont Soil Pet-Tons	100	23.53	Tons				HARD
2	FUEL-Fuel Surcharg	100		%				HARD
3	Evf8-Env Fee $8 Lg	100	1	Load				HARD

Total Fees
Total Ticket

Driver's Signature

403WM-N

3

Waste Management of Kentucky, LLC

☒ LANDFILL ☐ BIOREACTOR
☐ SOLIDIFICATION ☐ BIOREMEDIATION

SPECIAL WASTE TRACKING DOCUMENT

GENERATOR US ARMY FT. KNOX GARRISON PROFILE # 103735 KY

FACILITY STREET ADDRESS ST. JOHNS TANK MOTOR PARK

CITY, COUNTY, STATE FT. KNOX, KY

TECHNICAL CONTACT CHRIS WARD PHONE (502)609-2630

QUANTITY SHIPPED 20T (APPROX) DATE SHIPPED

WASTE DESCRIPTION PETROLEUM IMPACTED SOIL

I CERTIFY THAT WHILE THE WASTE WAS IN MY CUSTODY OR CONTROL, NO WASTE REGULATED BY THE CABINET AS HAZARDOUS WASTE OR INFECTIOUS WASTE WAS KNOWINGLY INTRODUCED INTO THE WASTE.

AUTHORIZED SIGNATURE

TRANSPORTER SKAGGS TRUCK # 96

I CERTIFY THAT WHILE THE WASTE WAS IN MY CUSTODY OR CONTROL, NO WASTE REGULATED BY THE CABINET AS HAZARDOUS WASTE OR INFECTIOUS WASTE WAS KNOWINGLY INTRODUCED INTO THE WASTE.

DRIVER'S SIGNATURE James Reed

BILL TO TRIECO LLC

CONTACT CHRIS WARD PHONE (502)609-2630

☒ LANDFILL ☐ BIOREACTOR ☐ SOLIDIFICATION ☐ BIOREMEDIATION

OUTER LOOP RDF
2673 OUTER LOOP
LOUISVILLE, KY 40219

QUANTITY REC'D 18 NET WEIGHT 55 260

DATE RECEIVED 7-15 09 COMMENTS

SIGNATURE ARS James

5662984

WASTE MANAGEMENT

Outer Loop RDF
2673 Outer Loop
Louisville, KY, 40219
Ph: (502) 966-0272

Original
Ticket# 378588

Customer Name TRIECOLLC_2015 TRIECO LLC_201 Carrier SKAGGSINCJIM SKAGGS INC. / JIM
Ticket Date 07/15/2009 Vehicle# SKAG0596 Volume 18.0
Payment Type Credit Account Container
Manual Ticket# Driver
Hauling Ticket# Check#
Route Billing # 0000201
State Waste Code Gen EPA ID
Manifest 1
Destination Grid
PO
Profile 103735KY (PETROLEUM CONTAMINATED SOIL)
Generator 181-USAARCFKNOX USAARMC FT KNOX

	Time	Scale	Operator	Inbound		
=> In	07/15/2009 14:50:41	Scale2	RICH		Gross	82780 lb
Out	07/15/2009 14:50:41		RICH		Tare	27520 lb
					Net	55260 lb
					Tons	27.63

Comments

	Product	LDX	Qty	UOM	Rate	Tax	Amount	Origin
1	Cont Soil Pet-Tons	100	27.63	Tons				MARD
2	FUEL-Fuel Surcharg	100		%				MARD
3	EvTA-Env Fee $0 Lg	100	1	Load				MARD

Total Tax
Total Ticket

403WM/N

4

Waste Management of Kentucky, LLC

☒ LANDFILL ☐ BIOREACTOR
☐ SOLIDIFICATION **SPECIAL WASTE TRACKING DOCUMENT** ☐ BIOREMEDIATION

GENERATOR USARMY FT KNOX GARRISON PROFILE # 103735 KY

FACILITY STREET ADDRESS ST. JOHNS TANK MOTOR PARK

CITY, COUNTY, STATE FT. KNOX, KY

TECHNICAL CONTACT CHRIS WARD PHONE (502)609-2630

QUANTITY SHIPPED 4 ~~[illegible]~~ T (APPROX) DATE SHIPPED

WASTE DESCRIPTION PETROLEUM IMPACTED SOIL

I CERTIFY THAT WHILE THE WASTE WAS IN MY CUSTODY OR CONTROL, NO WASTE REGULATED BY THE CABINET AS HAZARDOUS WASTE OR INFECTIOUS WASTE WAS KNOWINGLY INTRODUCED INTO THE WASTE.

AUTHORIZED SIGNATURE [signature]

TRANSPORTER ~~[illegible]~~ CHASE ENV. TRUCK # T-12

I CERTIFY THAT WHILE THE WASTE WAS IN MY CUSTODY OR CONTROL, NO WASTE REGULATED BY THE CABINET AS HAZARDOUS WASTE OR INFECTIOUS WASTE WAS KNOWINGLY INTRODUCED INTO THE WASTE.

DRIVER'S SIGNATURE Jarrell Truman

BILL TO TRIECO LLC

CONTACT CHRIS WARD PHONE (502)609-2630

☐ LANDFILL ☐ BIOREACTOR ☐ SOLIDIFICATION ☐ BIOREMEDIATION

OUTER LOOP RDF
2673 OUTER LOOP
LOUISVILLE, KY 40219

QUANTITY REC'D (4 Loads) NET WEIGHT 5380

DATE RECEIVED 07-16-09 COMMENTS

SIGNATURE [signature]

WASTE MANAGEMENT

Outer Loop RDF
2673 Outer Loop
Louisville, KY, 40219
Ph: (502) 966-0272

5690330
Original
Ticket# 378762

Customer Name TRIECOLLC_2015 TRIECO LLC_201
Ticket Date 07/16/2009
Payment Type Credit Account
Manual Ticket#
Hauling Ticket#
Route
State Waste Code
Manifest 1
Destination
PO
Profile 103735KY (PETROLEUM CONTAMINATED SOIL)
Generator 181-USAARCFKNOX USAARMC FT KNOX

Carrier CHABEENVIRONMEN CHABE ENVIRONMENTAL
Vehicle# CHASET12 Volume 8.0
Container
Driver
Check#
Billing # 0000201
Gen EPA ID
Grid

	Time	Scale	Operator	Inbound		
In	07/16/2009 09:00:55	Scale3	MARY		Gross	18500 lb
Out	07/16/2009 09:01:21	Scale3	MARY		Tare	13120 lb*
			* Manual Weight		Net	5380 lb
					Tons	2.69

Comments

Product	LD%	Qty	UOM	Rate	Fee	Amount	Origin
1 Cont Soil Pet-Tons	100	2.69	Tons				HARD
2 FUEL-Fuel Surcharg	100		%				HARD
3 Evf8-Env Fee $8 Lg	100	1	Load				HARD

Total Fees
Total Ticket

Driver's Signature

403WM-N

Attachment 7

Backfill Receipts

Vulcan
Materials Company
Midsouth Division
Vulcan Construction Materials, LP

SHIPPING LOCATION:
Fort Knox Quarry
Hwy 434, Battletraini
Elizabethtown, KY 427

WARNING
Read: Important health information on reverse.

PRECAUCIÓN
Léase la información importante para la salud en el reverso.

RECEIVED BY	WEIGHER
X	J. YOUNG

DATE	TIME	PLANT	TICKET NO.
08/07/00	08:28	FORT KNOX	117002

STATE OF KENTUCKY: THIS IS TO CERTIFY THAT I HAVE PERSONALLY RECEIVED MATERIAL DESCRIBED HEREON AS AGENT OF THE OWNER AND QUANTITY APPEARS TO BE AS STATED ON THIS TICKET.

SIGNATURE:

LIMITED WARRANTY AND WARRANTY DISCLAIMER: Seller warrants for a period of one (1) year from date of delivery only that the material sold hereunder substantially complies with Seller's specifications for said material or the specifications set forth in Seller's quotation. **SELLER HEREBY EXCLUDES ALL WARRANTIES OF MERCHANTABILITY AND FITNESS FOR ANY PURPOSE, AND ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, OF THE MATERIAL SOLD HEREUNDER, OTHER THAN THE EXPRESS WARRANTY STATED ABOVE.** In addition, except to the extent otherwise set forth in the specifications described above, Seller makes no warranty whatsoever with respect to specific gravity, absorption, whether the material is innocuous, non-deleterious, or non-reactive, or whether the material is in conformance with any plans, other specifications, regulations, ordinances, statutes, or other standards applicable to customer's job or to said material as used by customer. SELLER SHALL IN NO EVENT BE RESPONSIBLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGE CAUSED BY NON-COMPLIANCE OF THE MATERIAL WITH SPECIFICATIONS, OR FOR ANY DEFECTS IN THE MATERIAL SOLD HEREUNDER.

ALL SALES AND DELIVERIES MADE SUBJECT TO SELLER'S GENERAL TERMS AND CONDITIONS.

AS EVIDENCED BY SIGNATURE, OR DEPARTURE FROM SELLER'S FACILITY, CARRIER ACKNOWLEDGES THAT CARRIER IS SOLELY RESPONSIBLE FOR THE ACCURACY OF THIS VEHICLE'S TARE WEIGHT, AXLE WEIGHTS AND GROSS WEIGHT. CARRIER SHALL BE RESPONSIBLE FOR NOTIFYING SELLER WHEN ANY TRUCK OR TRAILER HAS BEEN OVERLOADED SO AS TO RENDER IT OUT OF COMPLIANCE WITH ANY APPLICABLE WEIGHT LIMITS. TO THE MAXIMUM EXTENT ALLOWED BY LAW, CARRIER SHALL INDEMNIFY SELLER FOR ANY LOSS CAUSED BY OVERLOADING.

TRUCK TARE AND GROSS WEIGHTS ARE DETERMINED WITH THE DRIVER ON THE VEHICLE.

CUSTOMER: 491710
SHIP TO: SKAGGS TRUCKING CO
CHASE ENTERPRISES CRIS WARD
FT KNOX

PURCHASE ORDER NO.		GROSS KG	GROSS LBS. 70,120
JOB NO. 200010 SKAGGS CONTR/VARIOU		TARE KG	TARE LBS. 20,160
PRODUCT 02M - SDR-10		NET KG	NET LBS. 49,960
STATE ITEM NO. Y	LOAD COUNT 1	NET METRIC TONS	NET TONS 24.98
TRUCK NO. 598	HAULER NO. 100	CUMULATIVE METRIC TONS	CUMULATIVE TONS 24.98
TRUCK I.D. NO.	[redacted]	X	
GROSS LEGAL WT.	LICENSE NO.		AXLES

CASH SALES	PROD	HAUL	TAX	TOTAL
PER TON				
AMOUNT				

DELIVERY RECEIPT 117002

Vulcan
Materials Company.
Midsouth Division
Vulcan Construction Materials, LP

SHIPPING LOCATION:
Fort Knox Quarry
Hwy 434, Battletraining
Elizabethtown, KY 4270

WARNING
Read: Important health information on reverse.

PRECAUCIÓN
Léase la Información Importante para la salud en el reverso.

RECEIVED BY
X

WEIGHER
J. YOUNG

DATE	TIME	PLANT	TICKET NO.
09/07/09	12:25	FORT KNOX	117084

STATE OF KENTUCKY: THIS IS TO CERTIFY THAT I HAVE PERSONALLY RECEIVED MATERIAL DESCRIBED HEREON AS AGENT OF THE OWNER AND QUANTITY APPEARS TO BE AS STATED ON THIS TICKET.

SIGNATURE:

LIMITED WARRANTY AND WARRANTY DISCLAIMER: Seller warrants for a period of one (1) year from date of delivery only that the material sold hereunder substantially complies with Seller's specifications for said material or the specifications set forth in Seller's quotation. **SELLER HEREBY EXCLUDES ALL WARRANTIES OF MERCHANTABILITY AND FITNESS FOR ANY PURPOSE, AND ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, OF THE MATERIAL SOLD HEREUNDER, OTHER THAN THE EXPRESS WARRANTY STATED ABOVE.** In addition, except to the extent otherwise set forth in the specifications described above, Seller makes no warranty whatsoever with respect to specific gravity, absorption, whether the material is innocuous, non-deleterious, or non-reactive, or whether the material is in conformance with any plans, other specifications, regulations, ordinances, statutes, or other standards applicable to customer's job or to said material as used by customer. SELLER SHALL IN NO EVENT BE RESPONSIBLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGE CAUSED BY NONCOMPLIANCE OF THE MATERIAL WITH SPECIFICATIONS, OR FOR ANY DEFECTS IN THE MATERIAL SOLD HEREUNDER.

ALL SALES AND DELIVERIES MADE SUBJECT TO SELLER'S GENERAL TERMS AND CONDITIONS.

AS EVIDENCED BY SIGNATURE, OR DEPARTURE FROM SELLER'S FACILITY, CARRIER ACKNOWLEDGES THAT CARRIER IS SOLELY RESPONSIBLE FOR THE ACCURACY OF THIS VEHICLE'S TARE WEIGHT, AXLE WEIGHTS AND GROSS WEIGHT. CARRIER SHALL BE RESPONSIBLE FOR NOTIFYING SELLER WHEN ANY TRUCK OR TRAILER HAS BEEN OVERLOADED SO AS TO RENDER IT OUT OF COMPLIANCE WITH ANY APPLICABLE WEIGHT LIMITS. TO THE MAXIMUM EXTENT ALLOWED BY LAW, CARRIER SHALL INDEMNIFY SELLER FOR ANY LOSS CAUSED BY OVERLOADING.

TRUCK TARE AND GROSS WEIGHTS ARE DETERMINED WITH THE DRIVER ON THE VEHICLE.

CUSTOMER: SKAGGS TRUCKING CO 491710
SHIP TO: CHASE ENTERPRISES
FT KNOX

PURCHASE ORDER NO.		GROSS KG	GROSS LBS. 77,460
JOB NO. 380010 SKAGGS CONTR/VARIOU		TARE KG	TARE LBS. 28,160
PRODUCT 031		NET KG	NET LBS. 49,300
STATE ITEM NO. Y	LOAD COUNT 2	NET METRIC TONS	NET TONS 24.65
TRUCK NO. 538	HAULER NO. 100	CUMULATIVE METRIC TONS	CUMULATIVE TONS 47.36
TRUCK I.D. NO.			
GROSS LEGAL WT.	LICENSE NO.		AXLES

CASH SALES	PROD	HAUL	TAX	TOTAL
PER TON				
AMOUNT				

DELIVERY RECEIPT 117084

Vulcan
Materials Company
Midsouth Division
Vulcan Construction Materials, LP

SHIPPING LOCATION:
Fort Knox Quarry
Hwy 434, Battletraining R
Elizabethtown, KY 427

WARNING
Read: Important health information on reverse.

PRECAUCIÓN
Léase la información importante para la salud en el reverso.

RECEIVED BY	WEIGHER
X	J. YOUNG

DATE	TIME	PLANT	TICKET NO.
08/07/09	10:56	FORT KNOX	117051

STATE OF KENTUCKY: THIS IS TO CERTIFY THAT I HAVE PERSONALLY RECEIVED MATERIAL DESCRIBED HEREON AS AGENT OF THE OWNER AND QUANTITY APPEARS TO BE AS STATED ON THIS TICKET.

SIGNATURE:

LIMITED WARRANTY AND WARRANTY DISCLAIMER: Seller warrants for a period of one (1) year from date of delivery, only that the material sold hereunder substantially complies with Seller's specifications for said material or the specifications set forth in Seller's quotation. **SELLER HEREBY EXCLUDES ALL WARRANTIES OF MERCHANTABILITY AND FITNESS FOR ANY PURPOSE, AND ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, OF THE MATERIAL SOLD HEREUNDER, OTHER THAN THE EXPRESS WARRANTY STATED ABOVE.** In addition, except to the extent otherwise set forth in the specifications described above, Seller makes no warranty whatsoever with respect to specific gravity, absorption, whether the material is innocuous, non-deleterious, or non-reactive, or whether the material is in conformance with any plans, other specifications, regulations, ordinances, statutes, or other standards applicable to customer's job or to said material as used by customer. SELLER SHALL IN NO EVENT BE RESPONSIBLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGE CAUSED BY NON-COMPLIANCE OF THE MATERIAL WITH SPECIFICATIONS, OR FOR ANY DEFECTS IN THE MATERIAL SOLD HEREUNDER.

ALL SALES AND DELIVERIES MADE SUBJECT TO SELLER'S GENERAL TERMS AND CONDITIONS.

AS EVIDENCED BY SIGNATURE, OR DEPARTURE FROM SELLER'S FACILITY, CARRIER ACKNOWLEDGES THAT CARRIER IS SOLELY RESPONSIBLE FOR THE ACCURACY OF THIS VEHICLE'S TARE WEIGHT, AXLE WEIGHTS AND GROSS WEIGHT. CARRIER SHALL BE RESPONSIBLE FOR NOTIFYING SELLER WHEN ANY TRUCK OR TRAILER HAS BEEN OVERLOADED SO AS TO RENDER IT OUT OF COMPLIANCE WITH ANY APPLICABLE WEIGHT LIMITS. TO THE MAXIMUM EXTENT ALLOWED BY LAW, CARRIER SHALL INDEMNIFY SELLER FOR ANY LOSS CAUSED BY OVERLOADING.

TRUCK TARE AND GROSS WEIGHTS ARE DETERMINED WITH THE DRIVER ON THE VEHICLE.

CUSTOMER: SKAGGS TRUCKING CO 491710
SHIP TO: CHASE ENTERPRISES
FT KNOX

PURCHASE ORDER NO.		GROSS KG	GROSS LBS. 73,580
JOB NO. 380010 SKAGGS CONTR/VARIOU		TARE KG	TARE LBS. 28,160
PRODUCT 031 - DGA		NET KG	NET LBS. 45,420
STATE ITEM NO. V	LOAD COUNT 1	NET METRIC TONS	NET TONS 22.71
TRUCK NO. 838	HAULER NO. 100	CUMULATIVE METRIC TONS	CUMULATIVE TONS 22.71
TRUCK I.D. NO.			
GROSS LEGAL WT.	LICENSE NO.		AXLES

CASH SALES	PROD	HAUL	TAX	TOTAL
PER TON				
AMOUNT				

DELIVERY RECEIPT 117051

ROLLING ACRES FARM

4252

896 BATES LN
SHEPHERDSVILLE, KY 40165
502-957-3844 fax 502-543-6372

INVOICE

Customer

Name TRI ECO
Address 11450 waterson trail
City louisville State KY ZIP 40299
Phone 502-609-2630

Date 8/7/2009
Order No.
Rep fort knox
FOB

Qty	Description	Unit Price	TOTAL
16	cubic yards of topsoil delivered to fort knox		

Payment Details

- (•) Cash
- ( ) Check
- ( ) Credit Card

Name
CC #
Expires

	SubTotal	$0.00
Shipping & Handling		
Taxes	State	
	TOTAL	$0.00

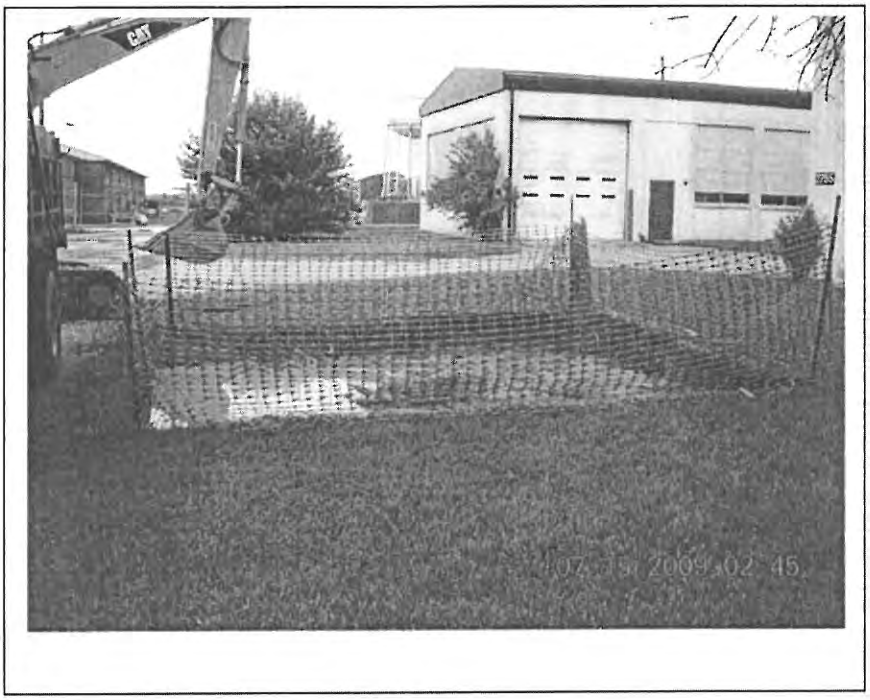
Office Use Only

PLEASE PAY FROM INVOICE

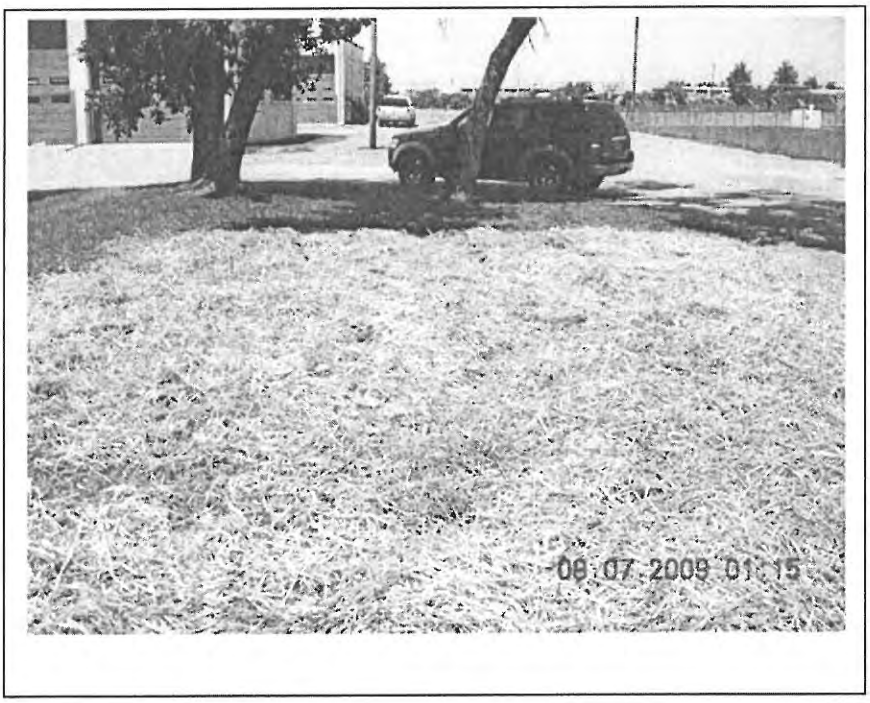
HAVE A GREAT NEW YEAR

Attachment 8

Photographs

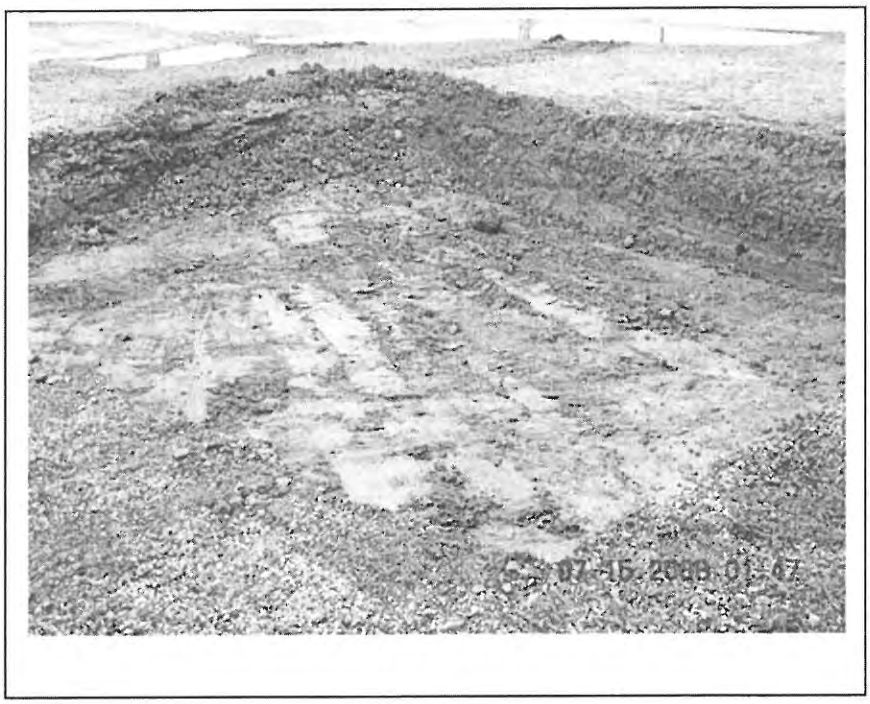


Gas can Storage Area Secured

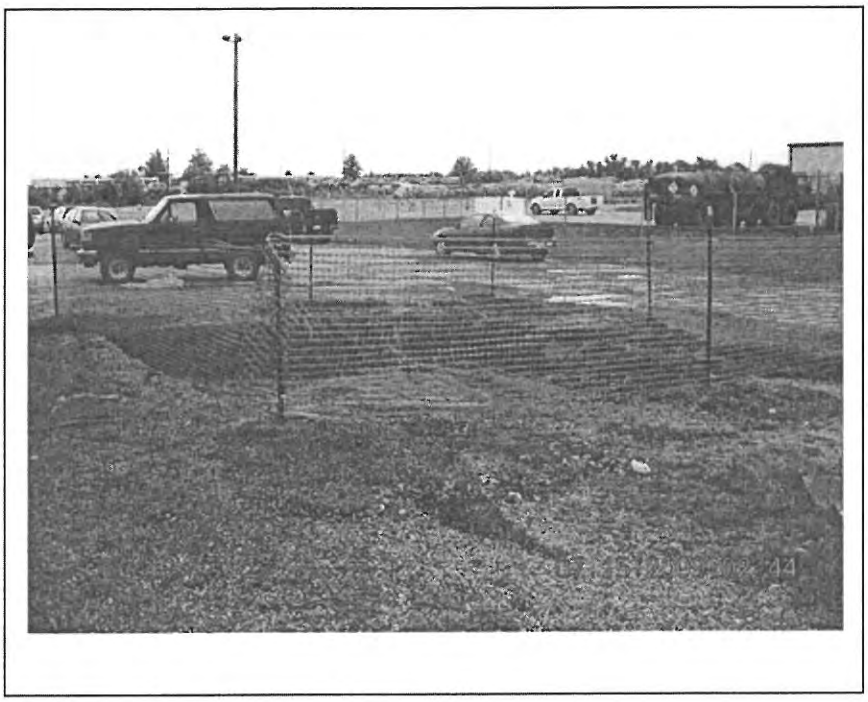


Gas can Storage Area Backfill Seed and Straw

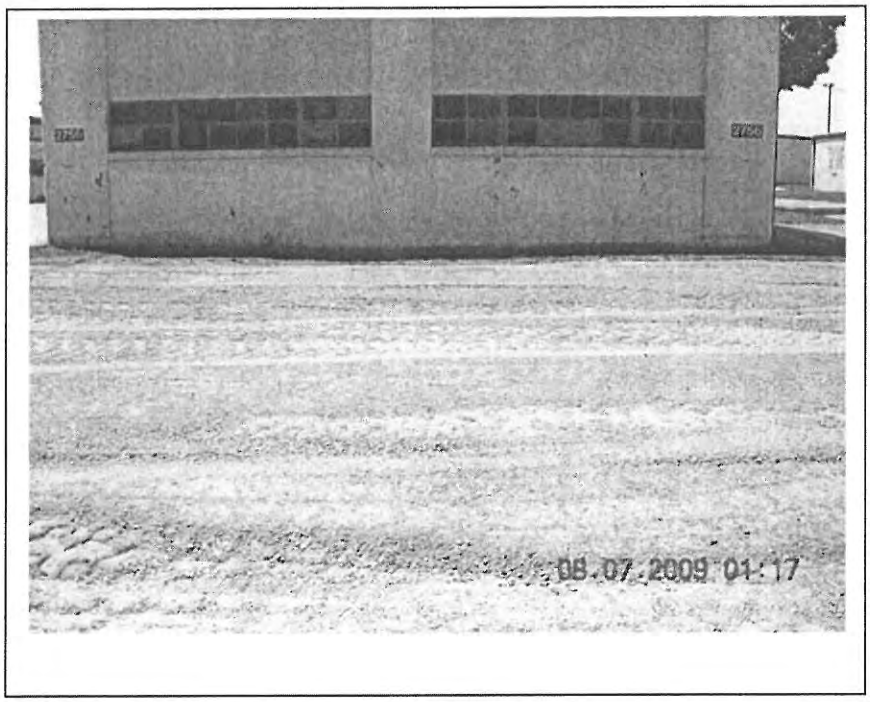
Area Of Stressed Vegetation Showing
Final Excavation



Area Of Stressed Vegetation Showing
Confirmatory Sampling Locations



Area Of Stressed Vegetation Secured



Area Of Stressed Vegetation Backfilled

APPENDIX F
Conceptual Aesthetic Considerations

Conceptual Aesthetic Considerations

Primary Consideration: Building 2835 - South Elevation

Primary Consideration: Building 2835 - South Elevation

Primary Consideration: Building 2835 - South Elevation

Primary Consideration: Building 2835 - South Elevation

Primary Consideration: Building 2835 - South Elevation

Secondary Consideration: Building 2841 - Northwest Elevation

Secondary Consideration: Building 2841 - North Elevation

Secondary Consideration: Building 2841 - North Elevation

APPENDIX G
GIS Data

(Not Used)

APPENDIX H
Exterior Signage

Figure 11-24. Static display at Fort Knox.

- Memorial and Display Design. Memorials will conform to the guidance set forth in Army Regulation (AR) 1-33, Memorial Programs.

11.4 SIGNS

Signs are used to visually communicate information. They are highly visible features that should be attractive and compatible with their surroundings. Careful consideration must be given to what a sign says, how it is said, its visual appearance and organization, its location, structural support system, and relation to other signs within the installation. Standardized signage systems facilitate movement, provide a sense of orientation, and reinforce standards of excellence. Signage creates a unifying element throughout the installation that visually ties the installation themes together and builds a reference and continuity that translates into confidence and reassurance when traveling throughout the installation. The standards to apply for sign color, type, sizing, etc. are found in Technical Manual (TM) 5-807-10, Signage.

Sign System Characteristics. There are several basic design characteristics that, by serving to convey necessary information clearly and attractively, are an integral part of any successful signage system.

- Simplicity. An effective strategy provides only needed information, avoids redundancy, and eliminates over-signing with resultant clutter and visual confusion. Sign messages must be clear, simple, and easy for motorists to process quickly.
- Continuity. It is essential that the system be applied uniformly and consistently throughout the entire Fort Knox installation. The importance of consistent implementation extends from the larger issues of sign type and size down to accurate color continuity and matching typestyles.
- Visibility. Sign location is a very important ingredient within the system. Signs must be located at significant decision points and oriented to provide clear sight lines for the intended user. Close coordination of locations with respect to landscaping, utilities, adjacent signage, and various other street design elements is important to ensure long-term maximum visibility.
- Legibility. Sign typestyle, line spacing, color, and size all combine to create the crucial design characteristics of legibility. This aspect of sign design should take into consideration users such as motorist, pedestrians, or bicyclists and the relative travel speed at which each type of user will be traveling when viewing the signs.

Vocabulary-Communications.

A common language has been created for establishing a signing system. The different components that create the sign package have been named and referred to within the total signing system.

The creation of a "signing language" helps generate a unified bond within sign types that make up a signing family.

- Reference
- Information/Message
- Presentation
- Architectural Influence
- Graphic Architecture

Visual Hierarchy.

- The entire signing system must communicate, through a range of sign and typestyle sizes, the relative importance of the individual activity that the sign identifies. The system should follow a logical progression from a point of origin to the desired destination.
- A stated ranking method supports the visual standard of hierarchy within the signing system. Signs can be organized within assigned classes with emphasis on the function and image of the installation.
- Within each class, the level of architectural influence evokes the importance of the sign to the installation. This is also critical to the idea of progression. The importance of a sign must be presented in its size and level of detail.

- As individuals move closer to their destination on the installation, the scale of the sign becomes progressively smaller and the level of the message more detailed.

Exterior Signage.

- Building Signage: Post, 3” x 3”, Black, Sign Panel, 48” L x 36” W, Dark Bronze, Letters, White, 3” Upper Case, 2” Lower Case, 3” Numerals
- Building Number Signage: Aluminum, Panel, 20” L x 8” W, Black, Numerals, 6”, Raised Brushed Aluminum
- Street Signage: Panel, 24” L x 8” W, Dark Bronze, Letters, White, 4”, Panel Border, ¼”, White (Note: Backside of Stop Signs, No Parking Signs, etc to be Dark Bronze / Signage posts to be 2” x 2”, Dark Bronze)
- Small Directional Signage: Post, 2” x 2”, Black, Panel, 48” L x 8” W, Dark Bronze, Letters, 4” Upper Case, 3” Lower Case, 4” Numerals, White
- Large Directional Signage: Post 3” x 3”, Black, Panel, 72” L x 12” W, Dark Bronze, Letters, 4” Upper Case, 3” Lower Case, 4” Numerals, White

Information / Identification Signs. These are signs that identify entrances to the installation, areas within the installation, major tenants, buildings, and organizational or functional components. They identify a location and greet the visitor at that location. They should be compatible in scale and character with the architecture and also blend with the natural surroundings. These signs are designed to include the following:

- Typeface: Lettering is self-adhesive backing material.
  - Building Title: Helvetica Medium, upper and lower case.
  - Building Numbers: Helvetica regular.
  - Building Addresses: Helvetica Medium, upper and lower case.
- Color:
  - Panel: Dark Brown
  - Lettering: White
  - Post: Dark Brown
  - Exposed panel backs and edges: Dark Brown
  - All paint: Semi-gloss
- Materials:
  - Panel: Double-face 1/8” thick aluminum
  - Post: Pre-treated square wood posts
  - Foundation: Concrete pier or direct burial

Figure 11-25.Typical identification sign for new construction at Fort Knox.

Building Identification. These are signs that identify buildings either by street address or building number.

- Street Addresses. The addressing procedures prescribed in DoD 4525.8-M, DoD Official Mail Manual are mandatory for use by all DoD components. DoD 4525.8-M, Chapter 3 prescribes the following:
  - All DoD addresses shall be assigned so they are compatible with the United States Postal Services automated delivery point sequencing.
  - The DoD installation is responsible for assigning city-style, street addresses on the installation.
  - Street addresses shall be assigned and used even though a DoD activity may deliver the mail to the addressee.
  - Only geographically locatable civilian-style street addresses (such as 4102 Cindy Avenue) shall be used.
  - Installations shall not use one street address for the entire installation and then use secondary unit designators such as "Building 123" to designate the delivery addresses on the installation.
  - Addresses such as "Building 123 Roberts Street" are not a valid address format and shall not be used.
- Address Placement.

- Place addresses by the front entrance of the building so they can be seen.
- Place both the street name and address number on the building if both the building number and street address are visible from the street.
- Building identification signs will use street addresses.
- Buildings without identification signs shall have the address number and street name centered above the main entrance or located to the right side.

- Housing Areas.
  - The sign should be complimentary to the architectural setting of the housing area and approved by the installation Real Property Planning Board.
  - Housing numbers should be placed on the curb in front of the respective house and on the house where street lighting will effectively light the numbering.

Installation Identification Signs. Installation identification signs name the installation and display the official US Army plaque. The designation "United States Army" must appear at the top of the sign in accordance with AR 420-70, para. 2-7h. Every installation entrance shall have an installation identification sign displaying only the US Army plaque, with the words "United States Army, Fort (Name of Fort), and gate name. The placement of Senior Mission Commander logo, unit crest, and other installation identification signs, monuments, or displays shall be located inside the installation beyond the cleared area of the Access Control Point (ACP) of entry. When used service-wide, these signs convey a uniform image of strength and stability to the public. Emblems, branch colors, unit mottos, names, and titles of individuals are not to be displayed. Installation identification signs consist of three types:

- Sign Type A1, main entrance sign, identifies the principal visitor entrance.
- Sign Type A2, secondary entrance sign, identifies entry points with relatively high volumes of visitor traffic.
- Sign Type A3, limited access entry gate signs, identifies entry points with limited public access.
- See Technical Manual (TM) 5-807-10, Signage, paragraph 3-3, for sign specifications and paragraph 3-11 for sign placement guidelines.

Figure 11-26. Electronic signage at Fort Knox should be installed on brick veneered structure.

Street Signs. Street name identification signs should be designed with the same lettering, color, and materials as other information signs. All street name identification signs shall be dark brown per TM 5-807-10.

Figure 11-27.Identification sign at Disney barracks in dark brown color.

Wheeled Electrical Signs. Wheeled electrical signs should have an attractive presentation. Temporary landscape elements should be used whenever possible. The siting of this type of sign will be approved by the RPPB. No sign of this type will be left in place for longer than six months, after which time the sign will be removed or turned into a permanent sign.

Directional Signs. These signs guide the motorist or pedestrian in, around, and out of the installation. The legibility and placement of these signs, as well as the ordering of information, is critical to their effectiveness. These signs should be placed in central locations and at major decision points along circulation routes. These signs are designed to include the following:

- Typeface: Lettering is self-adhesive backing material.
  - Helvetica Medium upper and lower case
- Arrow:
  - Place at end indicating direction
  - Stoke width: Helvetica Medium cap
- Color:
  - Panel: Dark Brown
  - Lettering: White
  - Post: Dark Brown
  - Exposed panel backs and edges: Dark Brown
  - All paint: Semi-gloss
- Materials:
  - Panel: Double-face 1/8” thick aluminum
  - Post: Pre-treated square wood posts
  - Foundation: Concrete pier or direct burial

Figure 11-28. Typical informational signage at Fort Knox.

Regulatory Signs. These signs provide the rules for travel and parking on the installation. They include speed signs, turning and lane use signs, warning signs, parking control signs, etc. Related to these signs are pavement markings and traffic signals. These signs are designed to include the following:

- Typeface: Lettering is self-adhesive backing material.
  - Helvetica Medium upper and lower case
- Color:

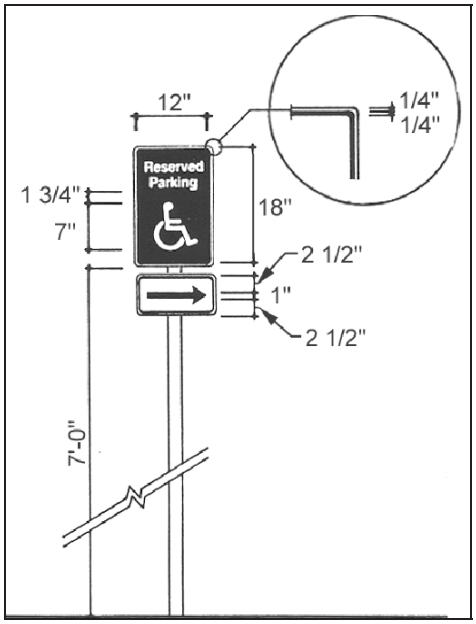


Figure 11-29.Regulatory Sign.

  - Panel: Dark Brown
  - Lettering: White
  - Post: Dark Brown
  - Exposed panel backs and edges: Dark Brown
  - All paint: Semi-gloss
- Materials:
  - Panel: Double-face 1/8” thick aluminum
  - Post: Steel pipe or pre-treated wood post
  - Foundation: Concrete pier or direct burial

Traffic Control Signs. National highway standards will be used for signs to regulate vehicular traffic on Fort Knox installation (AR 420-72, Transportation Infrastructure and Dams, Para 2-15f). These standards are described in the Manual of Uniform Traffic Control Devices (MUTCD). Also see MTMC Pamphlet 55-14, Traffic Engineering for Better Signs and Markings. This pamphlet clarifies existing standards and provides definite guidelines for installation officials to conform to the MUTCD. These standards shall be used installation wide to include installation Access Control Points.

Prohibitory (Warning) Signs. This category of signage is intended to maintain security and safety on the installation perimeter and at other specific secure areas. These signs notify visitors of restrictions, as well as other security procedures. The guidelines for design, fabrication, and placement

of warning signs are found in Technical Manual (TM) 5-807-10, Signage, para 3-9.

Electronic Exterior Signs. All exterior flashing signs, traveling lights, or signs animated by lights of changing degrees of intensity or color are prohibited.

Sign Placement. Placement of signs differs according to the type of sign and the specific site constraints. The following guidelines apply to placement of the majority of signs.

- Do not place more than one sign at any location. Traffic rules are the exception to this rule.

Figure 11-30. Clutter creates confusion and ineffectiveness. Often motorists and pedestrians are confused by the bombardment of messages.

- Place signs in areas free of visual clutter and landscape materials.
- Place signs in locations that allow enough time for the user to read and react to the message.
- Signs should not be placed to block sight lines at intersections.
- Place signs approximately four feet above ground level to be within 10 degrees of the driver's line of vision.
- Over-signing detracts from a uniform sign system and if left uncontrolled will eventually destroy the integrity of the system.
- Clutter creates confusion and ineffectiveness. Often motorist and pedestrians are confused by the bombardment of messages that have no relationship to each other, or the communication is on such a minimal level that the sign serves no purpose.

Sign System Typography.

- **Military Emblems.** The Army has a rich tradition of military heraldry. Military emblems are an important part of the soldiers' identity and the emblems have been carefully crafted over the years to express unit pride and unique history and function of the unit. The care and use of organizational emblems in a signage system can add visual interest as well as build pride and a sense of history. However, the overuse of miscellaneous emblems can lead to clutter and a dilution of their importance. Colors for military emblems must be in accordance with the Institute of Heraldry.
- **Department of the Army Plaque.** The plaque should be displayed on installation identification signage to emphasize the heritage and professionalism of the United States Army. The design of the plaque must be in accordance with Army Regulation (AR) 840-1, Department of the Army Seal, and Department of the Army Emblem and Branch of Service Plaques, and must be reproduced in full color.
- **Insignias.** The use of branch insignia, shoulder sleeve insignia, coat of arms and/or distinctive insignia on headquarters signs is permitted. All military emblems must appear in full color. Motivational symbols or motifs will not be used.

11.5 LIGHTING

Lighting is a functional requirement of installations that also impacts the visual environment. The installation lighting system conveys a sense of order and organization. There are five primary types of lighting on military installations. They are:

- roadway lighting
- pedestrian lighting
- parking lot lighting
- outdoor architectural lighting
- security lighting

The primary visual problem that exists with exterior lighting on most military installations has been the lack of overall coordination of a lighting system.

A lighting system provides the proper type of lighting for different lighting requirements and locations. A system is composed of six primary com-

APPENDIX I
Acceptable Plant List

O PLANT PALETTE

O.1 HOW TO USE THE PLANT MATRIX

Table O-1, Plant Material Suitability Matrix, should be used in conjunction with a thorough investigation of the micro-climate of the specific planting project. Emphasis should be placed on selection of native or acceptable hybrid plant species and avoidance of invasive exotic species. The matrix should then be used as a guideline to developing a plant list for the specific project subject to review by the Environmental Division, Natural Resources Branch staff. The staff or design professionals should use this list as an initial guide and apply other design criteria as required to prepare the planting plan. The listed plants are recommended species and their listing does not preclude selection of other species based on availability, cost or other factors.

The plant material suitability matrix is organized by plant category:

- tall deciduous trees (over 50' high);
- tall evergreen trees (over 50' high);
- medium deciduous trees (25'-50' high);
- medium evergreen tree (25'-50' high);
- small deciduous trees/large shrubs (10'-25' high);
- small evergreen trees/large shrubs (10'-25' high);
- medium deciduous shrubs (6'-10' high);
- medium evergreen shrubs (6'-10' high);
- small deciduous shrubs (4'-5' high);
- small evergreen shrubs (4'-5' high);
- low deciduous shrubs (2'-3' high);
- low evergreen shrubs (2'-3' high);
- deciduous ground covers (up to 18" high);
- evergreen ground covers (up to 18" high);
- vines;
- large grasses (3' tall and more);
- medium grasses (1'-3' tall);
- small grasses (under 1' tall); and
- grasses for lawn / turf

The applicable criteria checklist to the right of the species provides the following information:

Growth (slow, medium, or fast);
Landscape Interest (form, spread, flower color, and fall color)
Light (shade-tolerant, partial shade-tolerant, and sun-tolerant);
Soil pH (alkaline-tolerant, adaptable, and acid-tolerant);
Disease Resistant (medium and high);
Soil Moisture (moist, well-drained, and dry); and
Application/Use (street tree; shade tree; screen; massing/grouping; lawn edging/border; hedge; bank cover/hill slope; and specimen planting).

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PLANT SELECTION LIST

Plant Material Suitability Matrix

Botanical Name	Common Name	Growth/ Type: Slow	Growth/ Type: Medium	Growth/ Type: Fast	Landscape Interest: Form	Landscape Interest: Spread	Landscape Interest: Flower Color	Landscape Interest: Fall Color	Light: Shade	Light: Sun/Shade	Light: Sun	Soil pH: Alkaline	Soil pH: Adaptable	Soil pH: Acidic	Disease Resistant: Medium	Disease Resistant: High	Soil Moisture: Moist	Soil Moisture: Well Drained	Soil Moisture: Dry	Function: Street Tree	Function: Shade Tree	Function: Screen	Function: Massing/ Grouping	Function: Lawn Edging / Border	Function: Hedge	Function: Bank Cover	Function: Specimen	Function: Park Open Space	Comments
		Characteristics							Culture											Use									
TALL DECIDUOUS TREES (OVER 50 FT HIGH)																												
Acer rubrum	Red Maple		●	●	Pyramidal	40’-60’	Red	Yellow-red		●				●		●	●				●						●	●	
Acer saccharum	Sugar Maple	●			Oval	60’-75’	Greenish-yellow	Yellow-red		●				●		●	●	●			●						●	●	
Fraxinus Americana	White Ash		●		Pyramidal	60’-80’	Purple	Yellow			●				●		●	●		●	●								
Fraxinus pennsylvanica	Green Ash			●	Pyramidal-upright	25’-30’	Green to purple	Yellow			●		●		●		●			●	●							●	
Ginkgo biloba	Ginkgo	●	●		Pyramidal	30’-40’	Green	Excellent yellow			●		●			●	●	●			●	●							●	Use male tree
Gymnocladus dioica	Kentucky Coffee Tree	●	●		Obovate crown	40’-50’	Greenish-white	Some yellow			●	●				●	●				●							●	
Liriodendron tulipifera	Tulip Tree, Tulip Poplar			●	Pyramidal	35’-50’	Greenish-yellow	Golden yellow			●		●	●		●	●	●			●						●		
Magnolia acuminate	Cucumbertree Magnolia		●	●	Pyramidal	50’-80’	Greenish-yellow	Brown		●	●			●		●		●									●	●	
Quercus acutissima	Sawtooth Oak		●	●	Broad pyramidal	30’-40’	Golden catkins	Golden brown			●			●		●		●			●		●					●	
Quercus alba	White Oak	●	●		Pyramidal	50’-80’		Brown to red			●			●	●		●	●			●							●	
Quercus bicolor	Swamp White Oak	●	●		Pyramidal	50’-60’	Yellow-green	Copper to red			●			●	●		●	●			●							●	
Quercus imbricaria	Shingle Oak	●	●		Pyramidal	50’-60’					●			●	●		●	●		●								●	
Quercus macrocarpa	Bur Oak	●			Pyramidal to Oval	70’-80’		Dull yellow			●			●	●		●			●	●						●	●	
Quercus muehlenbergii	Chinkapin Oak		●		Rounded crown	70’-80’		Yellow to brown			●			●		●	●	●		●	●							●	
Quercus palustris	Pin Oak			●	Pyramidal	25’-40’		Brown or red			●			●			●	●		●				●			●	●	
Quercus phellos	Willow Oak		●		Pyramidal	30’-40’		Bronze orange to russet-red			●			●		●	●	●		●	●							●	
Quercus rubra	Red Oak			●	Round	60’-75’		Russet-red to red			●			●		●	●	●			●			●				●	
Taxodium distichum	Bald Cypress		●		Pyramidal conifer	30’-30’		Orange-brown			●			●	●		●	●			●	●	●	●						
TALL EVERGREEN TREES (OVER 50 FT HIGH)																												
Picea abies	Norway Spruce			●	Conical	30’-35’					●			●			●	●									●		
Pinus strobes	White Pine			●	Conical	30’-35’				●	●	●	●	●	●		●	●					●		●		●		
Pseudotsuga menziesii	Douglas Fir		●		Conical	30’-35’					●			●	●		●	●					●	●			●	●	

PLANT SELECTION LIST

Plant Material Suitability Matrix

Botanical Name	Common Name	Growth/ Type: Slow	Growth/ Type: Medium	Growth/ Type: Fast	Landscape Interest: Form	Landscape Interest: Spread	Landscape Interest: Flower Color	Landscape Interest: Fall Color	Light: Shade	Light: Sun/Shade	Light: Sun	Soil pH: Alkaline	Soil pH: Adaptable	Soil pH: Acidic	Disease Resistant: Medium	Disease Resistant: High	Soil Moisture: Moist	Soil Moisture: Well Drained	Soil Moisture: Dry	Function: Street Tree	Function: Shade Tree	Function: Screen	Function: Massing/ Grouping	Function: Lawn Edging / Border	Function: Hedge	Function: Bank Cover	Function: Specimen	Function: Park Open Space	Comments
		Characteristics							Culture											Use									
Tsuga canadensis	Canadian Hemlock		●		Pyramidal	30’-35’			●	●				●	●		●	●				●		●	●					Can be used as small evergreen
MEDIUM DECIDUOUS TREE (25’-50’ HIGH)																													
Acer griseum	Paperbark Maple	●			Upright-oval	20’-30’	Greenish	Russet-red to red		●	●		●			●	●	●					●				●	●	Unrivaled Aesthetic quality
Aesculus x carnea	Red Horse Chestnut		●		Rounded	30’-40’	Rose red	Brown		●	●		●				●	●				●					●		
Amelanchier arborea	Downy Serviceberry				Rounded crown			Yellow-orange to red		●	●			●			●	●								●				
Amelanchier canadensis	Shadlow Serviceberry		●		Obovate	15’-25’	White	Gold		●	●			●			●						●			●				
Amelanchier grandiflora	Apple Serviceberry		●		Obovate	15’-25’	Tinged pink	Gold		●	●			●		●	●						●		●	●	●			
Amelanchier laevis	Allegheny Serviceberry		●			15’-40’	White			●	●			●		●	●	●					●		●	●	●			
Betula alleghaniensis	Yellow Birch		●		Pyramidal	35’-45’		Golden yellow		●				●			●	●			●		●				●	●		
Betula nigra	River Birch		●	●	Pyramidal	40’-60’	Dark brown	Yellow		●				●		●	●									●		●		
Cladrastis kentukea	American Yellowwood		●			30’-50’	White	Yellow			●		●			●	●	●			●						●			
Franklinia alatamaha	Franklin Tree		●		Upright	6’-15’	White	Red		●	●			●			●	●									●	●		
Fraxinus pennsylvanica	Green Ash		●		Pyramidal-upright	25’-30’	Green to purple	Yellow			●		●				●	●			●						●	●		
Halesia caroliniana	Carolina Silverbell		●		Rounded Crown	20’-35’	White	Yellow-green		●				●		●	●	●		●	●							●		
Halesia diptera magniflora	Two-winged silverbell		●		Obovate	20’-35’	White	Yellow-green		●				●		●	●	●							●		●			
Koelreuteria paniculata	Golden Raintree		●	●	Rounded	30’-40’	Yellow	Orange-yellow			●	●					●	●	●				●				●	●		
Magnolia virginiana	Sweet Bay		●	●	Upright	10’-20’	Creamy white	Yellow-brown			●			●		●	●	●									●	●		
Ostrya virginiana	Hop Hornbeam	●			Rounded	20’-30’		Yellow		●	●			●		●	●	●		●			●					●		
MEDIUM EVERGREEN TREE (25’-50’ HIGH)																														
Abies concolor	White Fir	●	●		Pyramidal	20’-30’					●				●		●	●									●			
Chamaecyparis obtusa	Hinoki Cypress		●		Slender Pyramidal	10’-20’					●			●			●	●					●				●			
Ilex attenuate	Foster No. 2 Holly			●	Upright	18’-40’				●	●			●	●		●	●				●		●	●		●		Tall screen, tolerant of pollution
Ilex opaca	American Holly	●	●							●	●			●	●		●	●				●	●		●		●		
Pinus bungeana	Lacebark Pine	●			Open broad	30’-40’				●	●		●		●			●									●		Good for bonsai, too

PLANT SELECTION LIST

Plant Material Suitability Matrix

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		Characteristics							Culture											Use									
Taxus cuspidata	Upright Japanese Yew	●			Spreading to pyramidal	10’-40’				●	●			●				●					●	●		●				Foundation planting as bonsai
SMALL DECIDUOUS TREES/LARGE SHRUBS(10’-25’ HIGH)																													
Acer ginnala	Amur Maple			●	Rounded	15’-25’	Yellowish-white	Red		●	●		●			●		●	●				●		●		●			
Acer japonicum	Japanese Maple or Fullmoon Maple	●	●			20’-30’	Red to purple	Crimson		●	●			●		●		●	●				●		●		●			
Aesculus parviflora	Bottlebrush Buckeye			●	Upright	8’-15’	White	Yellow-green		●	●			●				●	●				●		●	●	●		Rejuvenate by heavy pruning
Betula nigra	Dwarf River Birch		●	●	Pyramidal	’	Dark brown	Yellow		●				●		●		●								●		●	
Buddleia alternifolia	Fountain Buddleia			●		5’-10’	Lavender				●		●			●		●	●				●						Attract butterflies
Cornus alternifolia	Pagoda Dogwood	●	●		Horizontal	20’-25’	Yellowish-white	Reddish purple		●	●			●				●	●								●		Best in naturalistic area
Cornus florida	Flowering Dogwood	●	●		Horizontal	30’	Greenish-yellow	Red to red-purple			●			●	●			●	●				●	●			●		
Cornus kousa	Kousa Dogwood	●	●		Vase Shape	20’-30’		Scarlet		●	●			●		●		●	●				●	●			●		
Forsythia intermedia	Border Forsythia			●	Upright	10’-12’	Yellow	Yellow-green		●	●		●					●	●				●		●				
Hydrangea paniculata	Panicle Hydrangea			●	Upright spreading	10’-20’	White	Green		●	●		●		●			●	●				●		●		●		Good flowers
Ilex decidua	Possum Haw	●			Multi branch	5’-15’	White	Yellow		●	●			●		●	●					●	●			●			Good foundation plant
Ilex serrata	Finetooth Holly	●	●		Upright spreading	6’-10’				●	●			●		●	●						●	●		●			
Magnolia soulangiana	Saucer Magnolia		●		Rounded	20’-30’	White to Pink	Yellow-brown		●	●			●		●	●						●				●		
Magnolia stellata	Star Magnolia	●			Oval to Rounded	10’-15’	White	Yellow to orange		●	●			●		●	●										●		
Rhododendron arborescens	Sweet or Smooth Deciduous Azalea	●			Rounded	8’-20’	White	Red			●			●		●	●										●		
Rhus glabra	Smooth Sumac		●		Upright	10’-15’	Greenish-yellow	Red or orange		●	●		●			●		●				●	●			●			Highway buffer, excellent tolerance of salt
Syringa vulgaris	Common Lilac		●		Upright	6’-12’	Lilac				●			●				●					●				●		Use for fragrance
Viburnum burkwoodii	Burkwood Viburnum	●	●		Upright	2/3rd of height	White	Wine-red					●	●		●	●	●						●					
Viburnum carlcephalum	Fragrant Viburnum	●			Rounded	6’-10’	White			●	●			●	●			●											Foundation planting
Viburnum dentatum	Arrowwood Viburnum		●		Rounded	6’-15’	Creamy-white	Yellow to glossy red		●	●		●					●				●	●	●					Extremely durable, attract birds

PLANT SELECTION LIST

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		Characteristics							Culture											Use									
Viburnum lentago	Nannyberry Viburnum		●		Rounded	10’-15’	White			●	●		●			●	●	●	●					●	●				Attract birds
Viburnum opulus	Cranberry Bush Viburnum		●		Upright	10’-15’	White	Reddish-purple		●	●		●		●		●						●	●					
Viburnum plicatum	Doublefile Viburnum		●		Broad rounded	9’-12’	White	Reddish-purple		●	●		●			●	●	●						●	●		●		Good fall color
Viburnum prunifolium	Black Haw	●	●		Rounded	8’-12’	Creamy-white	Reddish-purple		●	●		●			●			●			●	●				●		Attract birds
Viburnum rufidulum	Southern Blackhaw	●	●		Rounded	8’-12’	Creamy-white	Reddish-purple		●	●		●			●			●			●	●				●		
SMALL EVERGREEN TREE/LARGE SHRUBS(10’-25’ HIGH)																													
Buxus sempervirens	Common Boxwood	●			Rounded	15’-20’	Creamy yellow			●	●		●		●		●						●		●				Foundation planting, deer resistant
Ilex crenata	Japanese Holly	●				6’-10’	Dull white			●	●			●	●		●	●					●	●	●	●			Foundation planting
Kalmia latifolia	Mountain Laurel	●			Rounded	5’-12’	Pink to white			●	●			●			●						●						Foundation planting
Picea glauca	Dwarf Albert Spruce		●		Conical	10’20’					●			●	●			●					●		●		●		Use as Christmas tree
Rhododendron	Azalea	●			Upright rounded		Pink to Rose pink			●	●			●	●		●	●					●	●			●		Showy blooms
Taxus cuspidata	Japanese Yew	●			Spreading to pyramidal					●	●			●				●				●	●		●				Foundation planting as bonsai
Tsuga canadensis	Canadian Hemlock		●		Pyramidal				●	●				●	●		●	●				●		●	●				Can be used as small evergreen
MEDIUM DECIDUOUS SHRUB(6’-10’ HIGH)																													
Acer palmatum	Japanese Maple	●			Rounded	15’-20’	Red or purple	Orange or red		●	●			●			●	●					●				●		Accent plant for foliage and fall color
Berberis thunbergii	Japanese Barberry		●		Rounded	Wider than height	Yellow	Reddish purple		●	●		●			●		●					●	●	●				Good foliage
Buddleia davidii	Orange-Eye Butterfly Bush			●		5’-10’	Showy, many colors				●		●		●		●	●					●						Showy flowers
Cornus florida	Flowering Dogwood	●	●		Horizontal	30’	Greenish-yellow	Red to red-purple			●			●	●		●	●					●	●			●		
Cornus sericea	Yellow Twig Dogwood			●	Broad spreading	6’-10’	Dull white	Purple to reddish		●	●		●		●		●	●				●	●	●		●			Excellent red stem color for winter interest
Euonymus alatus	Burning Bush	●			Rounded	15’-20’		Bright red		●	●		●			●	●	●	●				●	●					Attractive fall foliage
Forsythia intermedia	Border Forsythia			●	Upright	10’-12’	Brilliant yellow	Yellow-green			●		●				●	●	●			●	●	●					Showy early spring bloom
Hydrangea quercifolia	Oakleaf Hydrangea			●	Rounded	Wider than height	White	Red or red-purple		●	●						●						●	●			●		Showy foliage, foundation plant

PLANT SELECTION LIST

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		Characteristics							Culture											Use									
Ilex verticillata	Winterberry	●	●		Oval-rounded	6’-10’	White	Yellow-green		●	●			●		●	●	●					●	●					Good foundation plant
Salix gracilistyla	Rosegold Pussy Willow			●	Open rounded top	6’-10’					●		●				●										●		Use in small landscape
Spiraea nipponica	Spirea		●		Vase shaped	3’-5’	White			●	●						●	●					●	●					Good foundation plant
Viburnum acerifolium	Mapleleaf Viburnum		●		Upright	4’6’	Yellowish white	Reddish purple		●	●			●				●					●	●					
Viburnum carlesii	Koreanspice	●			Rounded	4’-6’	Pinkish purple	Reddish		●	●			●	●			●					●	●					Fragrant flowers
Viburnum juddii	Judd Viburnum	●			Rounded	6’-8’	Pinkish white			●	●			●		●		●					●	●					Fragrant flowers
Weigela florida	Weigela		●		Spreading	9’-12’	Rose pink				●		●					●					●	●					Fragrant flowers
MEDIUM EVERGREEN SHRUB (6’-10’)																													
Ilex x meserveae	Blue Holly	●			Pyramidal	Same as height	White			●	●			●	●		●	●					●	●	●				Attractive wild flowers
Mahonia aquifolium	Oregon Grape Holly	●			Upright	3’-5’	Yellow	Purple-bronze		●				●	●		●	●					●	●					Good foundation plant
Mahonia bealei	Leatherleaf Mahonia	●			Upright	3’-5’	Yellow	Purple-bronze		●				●	●		●	●					●	●					Good foundation plant
Pinus strobus ‘Nana’	Dwarf White Pine	●				14’				●	●			●	●			●						●			●		Good foundation plant
Taxus cuspidate var. nana	Japanese Yew	●			Horizontal spreading	6’				●	●			●		●	●	●					●		●				Good foundation plant
Taxus x media	Anglojap Yew	●			Rounded	Same as height				●	●			●	●		●	●				●	●		●				Good foundation plant
Tsuga Canadensis ‘Monler’	Canadian Hemlock	●				2’-3’			●	●							●	●					●				●		Good foundation plant
SMALL DECIDUOUS SHRUBS (4’-5’ HIGH)																													
Abelia grandiflora	Glossy Abelia		●	●		3’-6’	Pinkish white	bronze		●	●		●	●		●	●	●					●		●				
Berberis thunbergii	Golden Japanese Barberry		●		Rounded	Wider than height	Yellow	Reddish purple															●	●	●				Good foliage
Cotoneaster horizontalis	Rock Cotoneaster		●	●	Spreading	6’-8’	Light pink	Purple		●	●		●				●	●					●			●			
Hydrangea arborescens	Hills-of-Snow			●	Rounded	3’-5’				●	●					●	●	●					●						
Ilex verticillata	Winterberry	●	●		Oval-rounded	6’-10’	White	Yellow-green		●	●			●		●	●	●					●	●					Good foundation plant
Potentilla fruticosa	Bush Cinquefoil	●			Rounded	Same as height					●		●			●							●	●					Good foundation plant

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		Characteristics							Culture											Use									
Pyracantha coccinea	Pyracantha				Upright arching		White	Brown		●	●							●	●										Good foundation plant
Rhododendron	Azalea			●	Upright rounded		Pink to Rose pink		●	●	●			●		●	●	●						●	●					
Syringa microphylla	Littleleaf Lilac	●			Broad rounded	1-1/2 times of height	Violet																●	●			●		
Viburnum opulus	Dwarf Cranberrybush Viburnum		●			2'-3'				●	●		●			●	●	●						●	●				Foundation plant
Viburnum trilobum	Compact American Cranberry Bush		●		Rounded	Equal spread	White	Red-purple		●	●					●	●	●						●	●				Showy flowers
SMALL EVERGREEN SHRUBS (4'-5' HIGH)																													
Buxus microphylla	Boxwood	●			Rounded	3'-4'				●	●						●						●		●				Foundation plant and deer resistant
Buxus sempervirens x B. microphylla	Boxwood	●								●	●	●	●				●						●		●				
Ilex crenata	Japanese Holly	●								●				●			●	●					●		●				
Ilex glabra	Inkberry	●			Rounded					●	●			●			●						●	●					Foundation plant
Ilex opaca	Maryland Dwarf American Holly	●			Horizontal spreading	3'-10'	White			●	●				●		●						●		●		●		Fruit color in winter, foundation plant
Juniperus chinensis var. sargentii	Chinese Juniper																												
Picea abies 'Sherwood Compacta'	*Dwarf forms of spruce*	●			Pyramidal	5'-7'					●		●				●	●						●	●		●		Foundation plant
Picea pungens 'Walnut Glen'	*Dwarf forms of Colorado Spruce*	●			Pyramidal					●	●			●		●	●	●					●				●		Foundation plant, rose garden
Pinus mugo 'Valley Cushion'	Mugo Pine	●				2'-3'										●													
Rhododendron	Starry Night Rhododendron																												
Taxus baccata 'Stove Pipe'	Spreading English Yew	●			Columnar					●	●		●			●	●	●											
Taxus cuspidata	Japanese Yew	●			Horizontal spreading	6'				●	●			●		●	●	●					●		●				Good foundation plant
Tsuga canadensis	Gentsch White Canadian Hemlock	●				2'-3'			●	●							●	●					●				●		Good foundation plant

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		Characteristics							Culture											Use									
LOW DECIDUOUS SHRUBS (2'-3' HIGH)																													
Berberis thunbergii	Japanese Barberry		●		Rounded	Wider than height	Yellow	Reddish purple															●	●	●				Good foliage
Cotoneaster adpressus	Creeping Cotoneaster	●			Creeping, dense	4'-6'	White tinged with pink	Purple		●			●					●				●	●		●	●			
Rhododendron	Azalea	●	●		Upright rounded	Same as height	Shades of pink, orange, white, and purple		●	●	●			●	●		●	●						●	●		●		Showy and fragrant flowers
Rhododendron atlanticum	Coast or Dwarf Deciduous Azalea	●	●		Upright rounded	3'-5'	Pinkish white			●	●			●		●	●	●						●	●		●		
Spirea x bumalda	Spirea			●		5'	White pink	Bronz		●	●			●		●	●	●					●	●					Showy flowers and good foundation plant
Spirea japonica	Japanese Spirea			●		4'-6'	Pink	Orange-red		●	●		●				●					●							Foundation plant
LOW EVERGREEN SHRUBS (2'-3' HIGH)																													
Abies balsamea 'Nana'	Dwarf Balsam Fir	●			Globe					●	●			●			●	●						●			●		
Chamaecyparis obtusa	Hinoki False Cypress	●	●		Slender Pyramidal						●			●			●	●					●				●		Groundcovers
Juniperus horizontalis	Compact Juniper		●		Dense rounded	4'-8'					●		●			●	●	●	●					●					
Juniperus sabina	Savin Juniper	●			Wide spreading	Wider than height					●		●			●	●	●	●			●	●		●				Foundation plant
Juniperus squamata	Juniper	●	●		Upright						●		●			●	●	●	●			●	●		●		●		Foundation plant
Picea abies	Dwarf Norway Spruce	●			Conical						●			●			●	●									●		
DECIDUOUS GROUND COVERS (UPTO 18 " HIGH)																													
Liriope muscari	Big Blue Lilyturf			●						●	●						●	●	●					●		●			Ideal for pathways
Spiraea japonica	Alpine Spirea			●		4'-6'	Pink	Orange-red		●	●		●				●					●							Foundation plant

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		Characteristics							Culture											Use									
EVERGREEN GROUND COVERS (UPTO 18” HIGH)																													
Euonymus fortunei	Purple Wintercreeper			●						●			●					●				●	●		●				
Juniperus conferta	Shore Juniper			●							●		●				●	●	●										Rock garden and pathways
Juniperus horizontalis	Creeping Juniper		●		Dense rounded	4’-8’					●		●			●	●	●	●					●					
Juniperus sabina	Blue Forest Savin Juniper	●			Wide spreading	Wider than height					●		●			●	●	●	●			●	●		●				Foundation plant
Rhododendron	Groundcover Azalea	●	●		Upright rounded	Same as height	Shades of pink, orange, white, and purple		●	●	●			●	●		●	●						●	●		●		Showy and fragrant flowers
VINES																													
Bigonia capreolata	Cross vine			●			Brownish red to orange			●	●		●			●	●	●											Covering a fence or trellis and can act as a good screen
Campsis radicans	Trumpet Creeper			●		5’-10’	Scarlet	Yellow-green		●	●		●			●		●											Grows well in woodland areas; not recommended to planting near structures
Clematis paniculata	Sweet Autumn Clematis																												
Clematis virginiana	Virgin’s bower			●		3’-6’	White			●	●		●				●	●											Grow on trellises, arbors, or posts; has showy flowers
Iris cristata	Dwarf Crested Iris			●		6”-12”	Purple			●	●			●		●	●	●											Fragrant flowers
Lonicera sempervirens	Coral Honeysuckle		●			3’-6’	Scarlet orange			●	●			●		●	●	●											Perennial border
Pachysandra procumbens	Allegheny Spurge	●				6”	Pinkish white			●	●			●		●	●	●											Grow on trellises, arbors, or posts; has showy flowers
Phlox amoena	Chalice Phlox		●				Lavender blue			●	●		●			●	●	●											Showy flowers and attracts butterflies
Vitis labrusca	Grape		●			15’-20’					●		●				●	●											Grow on fences, walls, trellises, arbors or other structures; edible fruit production
LARGE GRASSES (3’ TALL AND MORE)																													
Calamagrostis acutiflora ‘Stricta’	Feather Reed Grass	Perennial, Cool-season			Upright-narrow		Pinkish turning red	Orange-yellow	●	●	●		●										●				●		
Erianthus ravennae	Plume Grass, Ravennae Grass	Perennial, Warm-season			Upright-open, clump-type		Silver to gray	Brown; tinged with orange or purple			●						●	●				●			●				Fresh and dried cut flowers

PLANT SELECTION LIST

Plant Material Suitability Matrix

Botanical Name	Common Name	Growth/Type: Slow	Growth/Type: Medium	Growth/Type: Fast	Landscape Interest: Form	Landscape Interest: Spread	Landscape Interest: Flower Color	Landscape Interest: Fall Color	Light: Shade	Light: Sun/Shade	Light: Sun	Soil pH: Alkaline	Soil pH: Adaptable	Soil pH: Acidic	Disease Resistant: Medium	Disease Resistant: High	Soil Moisture: Moist	Soil Moisture: Well Drained	Soil Moisture: Dry	Function: Street Tree	Function: Shade Tree	Function: Screen	Function: Massing/Grouping	Function: Lawn Edging / Border	Function: Hedge	Function: Bank Cover	Function: Specimen	Function: Park Open Space	Comments
		Characteristics							Culture											Use									
Miscanthus giganteus	Giant Japanese Silver Grass	Perennial, Warm-season			Upright clumps with arching foliage		White	Reddish-purple		●	●						●	●				●			●		●		Grown for fall and winter effects
Miscanthus sinensis	Maiden Grass, Eulalia Grass	Perennial, Warm-season			Upright clumps with arching foliage		White or reddish	Beige			●		●				●	●				●					●		Fresh and dried cut flowers
Panicum virgatum	Switch Grass	Perennial, Warm-season			Upright-open, clumping		Slightly reddish	Golden-yellow or bronze		●	●		●				●	●	●				●				●		Planting along highways
Phalaris arundinacea	Ribbon Grass	Perennial, Cool-season			Upright-narrow, tufted		Greenish sometimes purplish	Beige		●				●			●	●									●		Bedding plant. Ground cover
Spartina pectinata	Prairie Cord Grass	Perennial			Upright-open, rhizomatous		Light yellow, beige	Yellow		●	●						●					●	●			●			Good for marshes
Spodiopogon sibiricus	Frost Grass, Graybeard Grass	Perennial, Cool-season			Clump, bamboo-like		Purple	Purple, white tints	●	●	●											●					●		Cut flowers
MEDIUM GRASSES (1'-3' TALL)																													
Bouteloua curtipendula	Sideoats Gramma	Perennial, Warm-season			Upright-narrow to upright-arching		White, light brown	Beige			●	●							●				●				●		Naturalized areas, cut flowers
Calamagrostis arundinacea 'Karl Foerster'	Foerster's Feather Reed Grass	Perennial, Warm-season			Upright-narrow to upright-open		Rose-purple	Yellow			●	●	●				●					●	●						Naturalized areas in bogs
Deschampsia caespitosa	Tufted Hair Grass	Perennial, Cool-season			Upright-open, densely tufted, mound		White, light green	Light brown	●	●	●	●	●											●			●		Rock and water garden areas
Hakonechloa macra	Hakone Grass	Perennial, Cool-season			Upright-open, rhizomatous		Light green	Buff		●							●	●					●	●					Grown for foliage; naturalized areas
Helictotrichon sempervirens	Blue Oat Grass	Perennial, Cool-season			Upright-open, mound-forming		Whitish, light beige	Blue-green		●	●						●										●		Grown for bluish-green foliage
Koeleria glauca	Blue Hair Grass	Perennial, Cool-season			Upright-open, tufted clump		Spring flower				●	●						●									●		Ground cover, rock garden
Molinia caerulea	Purple Moor Grass	Perennial, Warm-season			Upright to arching		Light to dark purple	Tan			●			●			●						●				●		Intolerant of alkaline soil
Pennisetum alopecuroides	Fountain Grass	Perennial, Warm-season			Upright-open, mound forming		Brown or bronze	Yellow and golden fading		●	●			●			●	●				●	●				●		
Pennisetum setaceum	Crimson Fountain Grass	Annual			Mound to upright arching		Dark purple red	Beige		●	●													●			●		Water garden

PLANT SELECTION LIST

Plant Material Suitability Matrix

Botanical Name	Common Name	Growth/ Type: Slow	Growth/ Type: Medium	Growth/ Type: Fast	Landscape Interest: Form	Landscape Interest: Spread	Landscape Interest: Flower Color	Landscape Interest: Fall Color	Light: Shade	Light: Sun/Shade	Light: Sun	Soil pH: Alkaline	Soil pH: Adaptable	Soil pH: Acidic	Disease Resistant: Medium	Disease Resistant: High	Soil Moisture: Moist	Soil Moisture: Well Drained	Soil Moisture: Dry	Function: Street Tree	Function: Shade Tree	Function: Screen	Function: Massing/ Grouping	Function: Lawn Edging / Border	Function: Hedge	Function: Bank Cover	Function: Specimen	Function: Park Open Space	Comments
SMALL GRASSES (UNDER 1' TALL)																												
Arrhenatherum elatius var. *bulbosum* 'Variegatum'	Bulbous Oat Grass	Perennial, Cool-season			Clumping, low growing, open to spreading		Greenish white	Retains variegation into autumn		●				●	●		●	●						●			●		
GRASSES FOR LAWN / TURF																													
Festuca arundinacea	Tall Fescue	Cool Season			Clumped and upright					●	●	●					●	●											Mow height is 2.5"-3.5"
Poa pratensis	Kentucky Bluegrass	Cool Season			Smooth upright						●	●					●	●											Mow height is 3"-3.5"
Zoysia sp.	Zoysia Grass	Cool Season									●			●				●											Mow height is 1"-2", Excellent grass for turf

APPENDIX J

Note: See Volume II of the RFP for Drawings

APPENDIX K
Fuel Cost Information

The following utility rates for this installation are provided for design

Electrical:
Demand Charge - $xx.xx per kilowatt
Not Available or Not Applicable

Energy Charge - $ x.xx per kilowatt-hour
Not Available or Not Applicable

Blended Rate - $0.06809 per kilowatt-hour with current proposed LG&E rate increase (blended annual energy and demand charge)

Natural Gas:
Commodity Charge Rate - $7.4991 per thousand cubic feet (MCF)

Water:
Commodity Charge Rate - $1.576 per thousand gallons (KGAL)

Sewer:
Commodity Charge Rate - $4.54 per thousand gallons (KGAL)

Purchased/Central Steam:
Commodity Charge Rate - $x.xx per [unit of measure]
Not Available or Not Applicable

Purchased High Temperature Water:
Commodity Charge Rate - $x.xx per [unit of measure]
Not Available or Not Applicable

Purchased Chilled Water:
Commodity Charge Rate - $x.xx per [unit of measure]
Not Available or Not Applicable

APPENDIX L
LEED Project Credit Guidance

See Appendix O LEED Contractor Responsibilities Table

APPENDIX M
LEED Owner's Project Requirements

Owner's Project Requirements Document for LEED Fundamental Commissioning

Project: ***19th Engineering Battalion Complex - Ft. Knox, KY___***

Approved:

_____	_____	_____
Name	Owner's Representative	Date
_____	_____	_____
Name	Design Agent's Representative	Date

Overview and Instructions

The purpose of this document is to provide clear and concise documentation of the Owner's goals, expectations and requirements for commissioned systems, and shall be utilized throughout the project delivery and commissioning process to provide an informed baseline and focus for design development and for validating systems' energy and environmental performance.

The Owner's Project Requirements Document is a required document for LEED Version 2009 EA Prerequisite 1, Fundamental Commissioning of the Building Energy Systems. It shall be completed by the Corps District/Design Agent based on coordination with the Installation/User/Proponent and shall be approved by the Installation/User/Proponent representative.

Use of this template is not required, nor are there any restrictions on editing of it. It is provided simply as a tool to assist project teams in meeting the documentation requirements for LEED Fundamental Commissioning.

The intent of the Owner's Project Requirements Document, per the LEED v2009 Reference Guide, is to detail the functional requirements of a project and the expectations of the building's use and operation as it relates to commissioned systems. This template contains the basic recommended components indicated in the LEED v2009 Reference Guide. It should be adapted as needed to suit the project, remaining reflective of the LEED intent.

The Owner's Project Requirements Document should ideally be completed before the start of design and furnished to the design team. It must be completed prior to the approval of Contractor submittals of any commissioned equipment or systems to meet LEED requirements.

Updates to the Owner's Project Requirements Document throughout the course of project delivery shall be made by the Corps District/Design Agent based on decisions and agreements coordinated with and agreed to by the Installation/User/Proponent.

The Owner's Project Requirements Document shall be included in the project's LEED documentation file under EA PR1, Fundamental Commissioning of the Building Energy Systems.

Owner's Project Requirements Document for LEED Fundamental Commissioning

Table of Contents

1. Owner and User Requirements
   - Primary Purpose, Program and Use
   - Project History
   - Broad Goals
2. Environmental and Sustainability Goals
   - Energy Efficiency Goals
   - General
   - Siting
   - Building Façade
   - Building Fenestration
   - Building Envelope
   - Roof
   - Other
3. Indoor Environmental Quality Requirements
   - Intended Use
   - Occupancy Schedule
   - Accommodations for After-Hours Use
   - Lighting, Temperature, Humidity, Air Quality, Ventilation, Filtration
   - Acoustics
   - Occupant Ability to Adjust System Controls
   - Types of Lighting
4. Equipment and Systems Expectations
   - Space Heating
   - Ventilation
   - Air Conditioning
   - Refrigeration
   - HVAC Controls
   - Domestic Hot Water
   - Lighting Controls
   - Daylighting Controls
   - Emergency Power
   - Other
5. Building Occupant and O&M Personnel Requirements
   - Facility Operation
   - EMCS
   - Occupant Training and Orientation
   - O&M Staff Training and Orientation

TABLE 1

1. *Owner and User Requirements*

What is the primary purpose, program and use of this project? (example: office building with data center)

This project will provide a consolidated complex consisting of a Company Operations Facility, Barracks and Battalion HQ for the 19th Engineering Battalion.

Describe pertinent project history. (example: standard design development)

Design-build RFP

Broad Goals

What are the broad goals relative to program needs?

The 19th Engineering Battalion requires a consolidated location adjacent to their existing motor pools, in space designed for their needs. Currently the 19th Engineering Battalion is located in space adapted for their use.

What are the broad goals relative to future expansion?

See other sections of the RFP for requirements.

What are the broad goals relative to flexibility?

See other sections of the RFP for requirements.

What are the broad goals relative to quality of materials?

See other sections of the RFP for requirements.

What are the broad goals relative to construction costs?

Facility must meet budget.

What are the broad goals relative to operational costs?

Minimize operating costs as much as possible within first cost budget. _____

What are the broad goals relative to life cycle of the equipment?

See other sections of the RFP for requirements. _____

Other broad goals: *(Insert as applicable)*

2. Environmental and Sustainability Goals

What are the project goals relative to sustainability and environmental issues? (example: LEED Silver rating)

Meet LEED Silver Certified Rating and applicable Federal regulations. _____

What are the project goals relative to energy efficiency? (example: Meet EPACT)

Meet LEED energy prerequisites, Appendix O "LEED Strategy Table" required credits, EPACT 2005, EO 13423 and EO 13514, ECB 2011-1 and 40% improvement over ASHRAE 90.1-2007 requirements.

What are the project goals and requirements for building siting that will impact energy use?

Meet LEED energy prerequisites, Appendix O "LEED Strategy Table" required credits, EPACT 2005, EO 13423 and EO 13514, ECB 2011-1 and 40% improvement over ASHRAE 90.1-2007 requirements.

What are the project goals and requirements for building facade that will impact energy use?

Meet LEED energy prerequisites, Appendix O "LEED Strategy Table" required credits, EPACT 2005, EO 13423 and EO 13514, ECB 2011-1 and 40% improvement over ASHRAE 90.1-2007 requirements.

What are the project goals and requirements for building fenestration that will impact energy use?

Meet LEED energy prerequisites, Appendix O "LEED Strategy Table" required credits, EPACT 2005, EO 13423 and EO 13514, ECB 2011-1 and 40% improvement over ASHRAE 90.1-2007 requirements.

What are the project goals and requirements for building envelope that will impact energy use?

Meet LEED energy prerequisites, Appendix O "LEED Strategy Table" required credits, EPACT 2005, EO 13423 and EO 13514, ECB 2011-1 and 40% improvement over ASHRAE 90.1-2007 requirements.

What are the project goals and requirements for building roof that will impact energy use?

Meet LEED energy prerequisites, Appendix O "LEED Strategy Table" required credits, EPACT 2005, EO 13423 and EO 13514, ECB 2011-1 and 40% improvement over ASHRAE 90.1-2007 requirements.

Other: *(Insert as applicable)*

3. Indoor Environmental Quality Requirements

What is the intended use for all spaces? For all spaces that have an intended use that is not readily apparent from the space name, provide this information in Table 1.

The Admin project spaces will be used for administrative (business), purposes. The barracks will be used as residential space. The COF will be used for administrative and operational readiness purposes.

What is the anticipated occupancy schedule (numbers of occupants and time frames) for all occupied spaces? Indicate the default occupancy schedule below and for all spaces that have an occupancy schedule that differs from the default, provide this information in Table 1.

Typical occupancy schedule is normal business days for the Admin and COF projects. The Barracks will be used 24-hours per day.

What accommodations for after-hours use are required? (example: access control, lighting controls, HVAC controls) Indicate general accommodations required below and for all spaces that have special requirements, provide this information in Table 1.

What are the lighting, temperature, humidity, air quality, ventilation and filtration requirements for all spaces? Indicate the default requirements below and for all spaces that have a requirement that differs from the default, provide this information in Table 1.

Lighting: ***ASHRAE 90.1 and IESNA*** _____
Temperature: ***UFC 3-410-01FA***_____

Humidity: ***UFC 3-410-01FA*** _____
Air Quality: ***ASHRAE 62.1*** _____

Ventilation: ***ASHRAE 62.1*** _____

Filtration: _____

What are the acoustical requirements for all spaces? Indicate the default acoustical requirements below and for all spaces that have a requirement that differs from the default, provide this information in Table 1.

STC 42 at interior walls and floor/ceiling assemblies. Interior solid wood doors with STC 25 rating. Video conferencing areas shall meet Noise Criteria (NC) 30 rating.

_____
_____

What is the desired level of occupant ability to adjust systems controls? Indicate the default desired levels below and for all spaces that have a desired level that differs from the default, provide this information in Table 1.

Lighting: ***ASHRAE 90.1***_____

Temperature:_____
Humidity: _____
Air Quality:_____

Ventilation:_____

What, if any, specific types of lighting are desired? (example: fluorescent in 2x2 grid, accent lighting, particular lamps)

Lighting shall be in compliance with ASHRAE 90.1 and IESNA_____
_____
_____

4. Equipment and System Expectations

(Complete for each category as applicable or indicate "none identified" or "N/A". Add desired features information for other anticipated commissioned systems as applicable)

Indicate desired features for the following commissioned system: Space Heating

Desired Type: ***Ground Coupled Heat Pump*** _____

Quality: ***High efficiency***_____

Preferred Manufacturer: _____
Reliability: _____
Automation: ***Connected to base-wide DDC***_____

Flexibility:_____
Maintenance Requirements: _____
Efficiency Target: ***Minimum 92%*** _____

Desired Technologies: ***Condensing with infinite burner modulation*** _____

Indicate desired features for the following commissioned system: Ventilation

Desired Type: _____

Quality: _____

Preferred Manufacturer: _____
Reliability: _____
Automation: ***Connected to base-wide DDC*** _____

Flexibility:_____
Maintenance Requirements: _____
Efficiency Target: _____

Desired Technologies: ***Variable air flow, high efficiency motors*** _____

Indicate desired features for the following commissioned system: Air Conditioning

Desired Type: ***Ground Coupled Heat Pump*** _____

Quality: _____

Preferred Manufacturer: _____
Reliability: _____
Automation: ***Connected to base-wide DDC*** _____

Flexibility:_____
Maintenance Requirements: _____
Efficiency Target: _____

Desired Technologies: ***High efficiency motors*** _____

Indicate desired features for the following commissioned system: Refrigeration

Desired Type: _____

Quality: _____

Preferred Manufacturer: _____
Reliability: _____
Automation: ***Manufacturer's standard packaged controls connected to base-wide DDC*** _____

Flexibility:_____
Maintenance Requirements: _____
Efficiency Target: ***High efficiency motors, consider variable frequency drives (VFD)*** _____

Desired Technologies:

Indicate desired features for the following commissioned system: HVAC Controls

Desired Type: ***Direct Digital Controls (DDC)***

Quality: _____

Preferred Manufacturer: ***Open LonWorks®*** _____
Reliability: _____
Automation: _____

Flexibility:_____
Maintenance Requirements: _____
Efficiency Target: _____

Desired Technologies: _____

Indicate desired features for the following commissioned system: Domestic Hot Water

Desired Type: ***Ground Coupled Heat Pump*** _____

Quality: _____

Preferred Manufacturer: _____
Reliability: _____
Automation: ***Connected to base-wide DDC***_____

Flexibility:_____
Maintenance Requirements: _____
Efficiency Target: _____

Desired Technologies: ***Water- to-water heat pump***_____

Indicate desired features for the following commissioned system: Lighting Controls

Desired Type: ***ASHRAE 90.1 and IESNA*** _____

Quality: _____

Preferred Manufacturer: _____
Reliability: _____
Automation: ***Automatic controls with manual overrides*** _____

Flexibility:_____
Maintenance Requirements: _____
Efficiency Target: _____

Desired Technologies: _____

Indicate desired features for the following commissioned system: Daylighting Controls

Desired Type: ***Passive systems, maximize daylighting*** _____

Quality: _____

Preferred Manufacturer: _____
Reliability: _____
Automation: _____

Flexibility:_____
Maintenance Requirements: _____
Efficiency Target: _____

Desired Technologies: _____

Indicate desired features for the following commissioned system: Emergency Power

Desired Type: ***Battery backup emergency lighting*** _____

Quality: _____

Preferred Manufacturer: _____
Reliability: _____
Automation: _____

Flexibility:_____
Maintenance Requirements: _____
Efficiency Target: _____

Desired Technologies: _____

Indicate desired features for the following commissioned system: Other

Desired Type: _____

Quality: _____

Preferred Manufacturer: _____
Reliability: _____
Automation: _____

Flexibility:_____
Maintenance Requirements: _____
Efficiency Target: _____

Desired Technologies: _____

5. Building Occupant and O&M Personnel Requirements

How will the facility be operated? Who will operate the facility?

The facility will be used by the 19th Engineering Battalion and Maintained by the Ft. Knox Garrison and DPW.

Will the facility be connected to an EMCS? If so, what are the interface requirements? (example: monitoring points, control points, scheduling)

Yes. See other sections of the RFP for requirements.

What is the desired level of training and orientation for building occupants to understand and use the building systems?

Occupants will require training for the daily operation of any non-standard systems.

What is the desired level of training and orientation for O&M staff to understand and maintain the building systems?

Maintenance staff will require training to operate and maintain all building system.

Table 1

Space	Use / Activity	Num of Occs	Special Occupancy Schedule	After Hours Use Reqmt.	Special Cooling Reqmt.	Special Heating Reqmt.	Special Humidity Reqmt.	Special Ventil./Filtration Reqmt.	Special Acoustic Reqmt.	Special Lighting Reqmt.	Special Occup Adjustability Reqmt.

APPENDIX N
LEED Requirements for Multiple Contractor Combined Projects

(Not Used)

APPENDIX O
LEED Strategy Tables

LEED Credit Paragraph

LEED Multiple Contractor Responsibilities Table

CTR Substitution Permitted

Required Points Strategy

* = Additional points are allowed to be pursued for this credit.

PROJECT: Ft. Knox 19th Engineering Battalion Complex

PAR	FEATURE			REMARKS
CATEGORY 1 – SUSTAINABLE SITES				
SSPR1	Construction Activity Pollution Prevention (PREREQUISITE)	NO	R	Required. Design documentation provided by others if no changes to Appendix J Drawings or Appendix AA Technical Specification are made.
SS1	Site Selection	NIC	1	Documentation provided by others if no changes to Appendix J Drawings or Appendix AA Technical Specification are made.
SS2	Development Density & Community Connectivity	NIC	0	Project site does not comply with requirements.
SS3	Brownfield Redevelopment	NIC	0	Not Applicable to the scope of the project.
SS4.1	Alternative Transportation: Public Transportation Access	NIC	0	Project site does not comply with requirements.
SS4.2	Alternative Transportation: Bicycle Storage & Changing Rooms	NIC	0	Not Allowed.
SS4.3	Alternative Transportation: Low Emitting & Fuel Efficient Vehicles - OPTION 1	NIC	0	Not Allowed.
SS4.3	Alternative Transportation: Low Emitting & Fuel Efficient Vehicles - OPTION 2	NIC	0	Not Allowed.
SS4.3	Alternative Transportation: Low Emitting & Fuel Efficient Vehicles - OPTION 3	NIC	0	Not Allowed.
SS4.4	Alternative Transportation: Parking Capacity	NIC	?	Documentation provided by others if no changes to Appendix J Drawings or Appendix AA Technical Specification are made.Do not include credit points in required LEED points total.
SS5.1	Site Development: Protect or Restore Habitat	NIC	0	Not Applicable to the scope of the project.
SS5.2	Site Development: Maximize Open Space	NIC	0	
SS6.1	Stormwater Design: Quantity Control	NIC	1	Required. Documentation provided by others if no changes to Appendix J Drawings or Appendix AA Technical Specification are made.
SS6.2	Stormwater Design: Quality Control	NIC	1	Required. Documentation provided by others if no changes to Appendix J Drawings or Appendix AA Technical Specification are made.
SS7.1	Heat Island Effect: Non-Roof	NIC	0	Not Applicable to the scope of the project.
SS7.2	Heat Island Effect: Roof	NIC	1	Required
SS8	Light Pollution Reduction	NIC	0	Not Applicable to the scope of the project.
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	2	Required. Documentation provided by others if no changes to Appendix J Drawings or Appendix AA Technical Specification are made.

LEED Credit Paragraph	**LEED Multiple Contractor Responsibilities Table**	CTR Substitution Permitted	**Required Points Strategy**	* = Additional points are allowed to be pursued for this credit.

PROJECT: Ft. Knox 19th Engineering Battalion Complex

PAR	FEATURE			REMARKS
WE1	Water Efficient Landscaping: No Potable Water Use or No Irrigation OPTION 2	NO	2	Required. Documentation provided by others if no changes to Appendix J Drawings or Appendix AA Technical Specification are made.
WE2	Innovative Wastewater Technologies - OPTION 1	YES		Compliance is allowed through reduction in potable water for sewage conveyance or other measures applicable to the project.
WE2	Innovative Wastewater Technologies - OPTION 2	NO	0	Option 2 is not allowed to be pursued.
WE3	Water Use Reduction	NO*	2	Waterless urinals are not permitted. Min. of 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)	NO	R	Required.
EAPR3	Fundamental Refrigerant Management (PREREQUISITE)	NO	R	Required.
EA1	Optimize Energy Performance	NO*	15	Minimum of 15 points required by ECB 2011-1.
EA2	On-Site Renewable Energy	YES		
EA3	Enhanced Commissioning	NO	2	Required by ECB 2011-1. CxA will be provided by Government. See section 01 10 00, para. 6.14.8 for more information.
EA4	Enhanced Refrigerant Management	YES		
EA5	Measurement & Verification	NO	3	Required by ECB 2011-1.
EA6	Green Power	NIC	0	Not allowed.
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	1	
MR3.1	Materials Reuse: 5%	N/A	0	Not Applicable to the scope of the project.

LEED Credit Paragraph	**LEED Multiple Contractor Responsibilities Table**	CTR Substitution Permitted	**Required Points Strategy**	* = Additional points are allowed to be pursued for this credit.

PROJECT: Ft. Knox 19th Engineering Battalion Complex

PAR	FEATURE			REMARKS
MR3.2	Materials Reuse: 10%	N/A	0	Not Applicable to the scope of the project.
MR4.1	Recycled Content: 10% (post-consumer + 1/2 pre-consumer)	NO	1	Required by ECB 2011-1.
MR4.2	Recycled Content: 20% (post-consumer + 1/2 pre-consumer)	YES	1	
MR5.1	Regional Materials:10% Extracted, Processed & Manufactured Regionally	YES	1	
MR5.2	Regional Materials:20% Extracted, Processed & Manufactured Regionally	YES	1	
MR6	Rapidly Renewable Materials	YES	1	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	NO	1	
EQ2	Increased Ventilation	YES		
EQ3.1	Construction IAQ Management Plan: During Construction	NO	1	Required by ECB 2011-1.
EQ3.2	Construction IAQ Management Plan: Before Occupancy	NO	1	Required by ECB 2011-1.
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	1	
EQ6.1	Controllability of Systems: Lighting	YES	1	
EQ6.2	Controllability of Systems: Thermal Comfort	YES		
EQ7.1	Thermal Comfort: Design	NO	1	Required by ECB 2011-1 and HPSB.

LEED Credit Paragraph

LEED Multiple Contractor Responsibilities Table

CTR Substitution Permitted

Required Points Strategy

* = Additional points are allowed to be pursued for this credit.

PROJECT: Ft. Knox 19th Engineering Battalion Complex

PAR	FEATURE			REMARKS
EQ7.2	Thermal Comfort: Verification	NO	0	Not allowed.
EQ8.1	Daylight & Views: Daylight 75% of Spaces	YES		
EQ8.2	Daylight & Views: Views for 90% of Spaces	YES	1	
CATEGORY 6 – INNOVATION IN DESIGN				
IDc1.1	Innovation in Design	YES	1	TBD by building CTR. Only building specific credits are allowed.
IDc1.2	Innovation in Design	YES	1	TBD by building CTR. Only building specific credits are allowed.
IDc1.3	Innovation in Design	YES	1	TBD by building CTR. Only building specific credits are allowed.
IDc1.4	Innovation in Design	YES		TBD by building CTR. Only building specific credits are allowed.
IDc2	LEED Accredited Professional	NO	1	Required.
CATEGORY 7 – REGIONAL PRIORITY CREDITS (v3 only)				
EQc7.1	Regional Priority Credit	YES	1	TBD by building CTR. Only building specific credits are allowed.
SSc6.1	Regional Priority Credit	YES	1	TBD by building CTR. Only building specific credits are allowed.
TBD	Regional Priority Credit	YES		TBD by building CTR. Only building specific credits are allowed.
TBD	Regional Priority Credit	YES		TBD by building CTR. Only building specific credits are allowed.
	TOTAL		55	

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 ≥6'-11" (as measured to the underside of the structural system) and having perimeter walls which are ≥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.

TITLE AND LOCATION
Ft. Knox 19th Batt

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG# RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 33 00	SD-01 Preconstruction Submittals															
			Submittal Register	1.10	G													
		01 33 29.00 06	SD-01 Preconstruction Submittals															
			LEED Implementation Plan	1.3	G													
			LEED AP BD+C	1.2.1	G													
			LEED Final Design		G													
			Documentation															
			SD-05 Design Data															
			LEED Correction Plan	1.2	G													
			SD-11 Closeout Submittals															
			LEED Documentation Notebook		G													
			LEED Plaque		G													
		01 35 26	SD-01 Preconstruction Submittals															
			Accident Prevention Plan (APP)	1.6	G	A												
			Activity Hazard Analysis (AHA)	1.7	G	A												
			Crane Critical Lift Plan	1.6.1	G	A												
			Crane Operators	1.5.1.2	G	A												
			SD-06 Test Reports															
			Reports	1.11														
			Accident Reports	1.11.1														
			Crane Reports	1.11.3														
			SD-07 Certificates															
			Confined Space Entry Permit	1.8														
			Hot work permit	1.8														
			License Certificates															
		01 74 19	SD-01 Preconstruction Submittals															

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
Ft. Knox 19th Batt

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	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 74 19	Waste Management Plan	1.6	G													
			SD-11 Closeout Submittals															
			Records	1.7														

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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01 33 29.00 06

LEED™ CERTIFICATION
03/10

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

Six copies submitted to the Government on compact disk within 30 days after the accepted design submittal and before the start of any construction activity.

LEED AP BD+C; G

Statement of qualifications of the LEED AP BD+C submitted to the Government with the QC Plan. Includes name and date of expiration of the current credential.

LEED Final Design Documentation; G

copies submitted to the Government on compact disk concurrent with the Final Design submittal

SD-05 Design Data

LEED Correction Plan; G

SD-11 Closeout Submittals

LEED Documentation Notebook; G,

Six copies submitted to the Government on compact disk within 14 days of the issue of the LEED Rating for the project by the Green Building Certification Institute.

LEED Plaque; G,

Submitted to the Government within 14 days of receipt by the Contractor.

1.2 CONTRACTOR RESPONSIBILITIES

This project shall be designed and constructed to achieve a rating of

silver in accordance with LEED2009. The Contractor shall be responsible for certifying the project at the required LEED rating through the Green Building Certification Institute and shall bear all costs associated with the certification process. The Contractor shall use the Split Design & Construction Review path. The Final Design Review by the Green Building Certification Institute shall be completed prior to the Final Design submittal to the Government. The results of the Final Design Review shall be submitted with the Final Design to the Government. The Final Construction Review shall be completed and the final LEED rating shall be issued by the Green Building Certification Institute prior to Contract Completion.

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, associated documentation required by LEED certification requirements, and including a LEED Implementation Plan in accordance with paragraph LEED IMPLEMENTATION PLAN, shall be submitted with the LEED Correction Plan.

LEED credit and prerequisite requirement compliance for projects registered in LEED version 2009 shall be in accordance with the LEED-NC Application Guide for Multiple Buildings and On-Campus Building Projects. LEED Documentation shall be modified as necessary to conform to any additional or modified submittal requirements identified in the LEED-NC Application Guide for Multiple Buildings and On-Campus Building Projects.

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.

1.2.1 LEED Accredited Professional (LEED AP BD+C)

A LEED Accredited Professional with specialty in Building Design + Construction (LEED AP BD+C), accredited by the Green Building Certification Institute, on the Contractor's staff shall be responsible for assembling documentation and ensuring that LEED credits and prerequisites are earned and/or documented as required by this specification section and also in accordance with LEED certification requirements. 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 Documentation

The project has been registered with the Green Building Certification Institute in LEED Online by others. The Contractor shall coordinate with the Government to obtain the Project Administrator role for LEED Online. The Contractor shall coordinate with the Government to identify and grant access to representatives of the Government that will monitor documentation in LEED Online. The Contractor shall provide documentation using LEED Online. Documentation shall be completed in LEED Online in accordance with the schedule in the LEED Implementation Plan.

The LEED Final Design Documentation shall be submitted to the Government on compact disk with the Final Design submittal. The LEED Final Design Documentation shall include the results of the Final Design Review performed by the Green Building Certification Institute along with all completed documentation in LEED Online.

A LEED Documentation Notebook shall be provided to the Government on compact disk within 14 days of the issue of the LEED Rating for the project by the Green Building Certification Institute and shall include a copy of all completed documentation in LEED Online inlcuding both Design Phase and Construction Phase documentation. All correspondence with the Green Building Certification Institute shall be included. A copy of each LEED Correction Plan shall be included in the LEED Documentation Notebook. Modifications required by LEED-NC Application Guide for Multiple Buildings and On-Campus Building Projects shall be identified and documented for each credit and prerequisite.

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.

1.2.3 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 the Green Building Certification Institute for LEED certification. Innovation in Design credits shall conform to exemplary performance requirements or to the requirements of Credit Interpretation Rulings issued by the US Green Building Council or the Green Building Certification Institute. Applicable Credit Interpretation Rulings are those that apply to the LEED version under which the project has been registered. Innovation in Design credits not covered by exemplary performance requirements or Credit Interpretation Rulings will be evaluated by the Government and accepted based on their merit. Innovation in Design credits that are not accepted by the Government shall not be submitted for LEED certification except when failure to achieve the points for the credit will not result in failure of the project to achieve the required LEED rating. The Government will not be obligated to accept credits that do not conform to exemplary performance requirements 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.

1.2.4 Credit Interpretation Rulings

The Contractor shall apply existing US Green Building Council or Green Building Certification Institute Credit Interpretation Rulings when pursuing credits using non-standard compliance paths, or when there are special circumstances making compliance difficult. Applicable Credit Interpretation Rulings are those that apply to the LEED version under which the project has been registered. The Contractor may apply for a Credit Interpretation Request from the Green Building Certification Institute for any new proposed strategy, non-standard compliance path, or special circumstances. 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 addressed by existing or new Credit Interpretation Rulings shall not be submitted for LEED certification.

1.2.5 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 on LEED Online 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 acceptance of the design 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 plans shall also include:

a. The name of the LEED Accredited Professional Building Design + Construction (LEED AP BD+C).

b. A copy of the contract with the Commissioning Agent. The contract shall indicate all requirements for LEED Energy & Atmosphere (EA)

Prerequisite 1, Fundamental Commissioning of Building Energy Systems, for which the Commissioning Agent is responsible. If LEED EA Credit 3 is to be attempted, the contract shall indicate all additional requirements of the Commissioning Agent.

c. Copies of the LEED Letter Templates to be used for tracking and documenting LEED credits and prerequisites. Include proposed materials, estimated costs, and other calculation details to demonstrate that the requirements of the specified LEED credits and prerequisites can be attained.

d. The schedule for completion of the requirements and documentation for each credit and prerequisite.

e. 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.

f. 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.

g. For each credit or prerequisite requirement for which the Government has agreed to provide assistance or resources, provide a copy of written confirmation and any other associated supporting documentation.

h. 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.

i. For fast-track design build projects with multiple stages of design, the specific information as indicated above shall be submitted for each stage of design within the time indicated in this paragraph.

j. Modifications to credit and prerequisite compliance or documentation requirements identified by the LEED-NC Application Guide for Multiple Buildings and On-Campus Building Projects shall be listed independently for each credit or prerequisite.

1.4 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.

1.4.1 Materials and Resources Credit 2, Construction Waste Management

The Contractor shall comply with the requirements of Materials and Resources Credit 2, Construction Waste Management. Not withstanding 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 commingled. 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.

1.4.2 Materials and Resources Credit 4, Recycled Content

The Contractor shall comply with the requirements of Materials and Resources Credit 4, Recycled Content. Not withstanding 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.

1.4.2.1 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.

1.4.3 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.

1.4.4 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 the Forest Stewardship Council's (FSC) Principles and Criteria.

1.4.5 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.

1.4.6 Indoor Environmental Quality Credit 3.2, Construction IAQ Management Plan: Before Occupancy

The Contractor shall comply with the requirements of Indoor Environmental Quality Credit 3.2. 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.

1.4.6.1 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.

1.4.6.2 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.

1.4.6.3 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. All interior finishes including, but not limited to, millwork, doors, paint, carpet, and acoustic tile must be installed. 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 or for each contiguous floor area, whichever is larger. 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	27 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 - NOT USED

-- End of Section --

SECTION 01 35 26.00 06

GOVERNMENT SAFETY REQUIREMENTS
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 SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.32	(2004) Fall Protection
ASSE/SAFE Z359.1	(2007) Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components

ASME INTERNATIONAL (ASME)

ASME B30.22	(2005) Articulating Boom Cranes
ASME B30.3	(2004) Construction Tower Cranes
ASME B30.5	(2007) Mobile and Locomotive Cranes
ASME B30.8	(2004) Floating Cranes and Floating Derricks

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(2007; Errata 2007; AMD 1 2007)Standard for Portable Fire Extinguishers
NFPA 241	(2009) Safeguarding Construction, Alteration, and Demolition Operations
NFPA 51B	(2003) Fire Prevention During Welding, Cutting, and Other Hot Work
NFPA 70	(2008; AMD 1 2008) National Electrical Code-2008 Edition
NFPA 70E	(2009; Errata 2009)Standards for Electrical Safety in the Workplace

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008)Safety -- Safety and Health Requirements Manual

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 is required for submittals with a "G" designation; Government acceptance is required for submittals with a "GA" designation; Submittals not having a "G" designation are for Contractor Quality Control approval/acceptance, or for information only. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Accident Prevention Plan (APP); G, RO

Activity Hazard Analysis (AHA); G, RO

Site Safety & Health Officer Qualifications(SSHO); G, RO

Proof of qualification for Crane Operators; G, RO

Crane Critical Lift Plan; G, RO

SD-06 Test Reports

Reports; G

Submit reports as their incidence occurs, in accordance with the requirements of the paragraph entitled, "Reports."

Accident Reports; G

Monthly Exposure Reports; G

Crane Reports; G

Regulatory Citations and Violations; G

SD-07 Certificates

Confined Space Entry Permit; G

Hot work permit; G

License Certification; G

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 who has extensive knowledge, training and experience in the field of fall protection; this person 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 applicable 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 report to a senior corporate official and 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 04.00 10.

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 3 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 4 areas of competency: Excavation; Scaffolding; Health hazard recognition, evaluation and control of chemical, physical and biological agents; Personal protective equipment and clothing to include selection, use and maintenance.

c.) The superintendent and the CQC system manager 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 be either a college graduate with 5 years of previous heavy construction safety experience or be an individual having 10 years of similar previous heavy, 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:

(1) Prepare the Contractor's Safety Plan, and Activity Hazard Analysis for each definable feature of work;

(2) Provide safety indoctrination to all construction site visitors;

(3) Ensure the Contractor's accepted Accident Prevention Plan is carried out;

(4) Ensure that all Contractor/subcontractor employees have all HTRW, asbestos, and lead paint training, and their personnel protection equipment meets applicable OSHA/EPA requirements;

(5) Conducts daily walkthrough of the site ensuring work is being accomplished safely and occupational health is not compromised;

(6) Attend and participate in all preparatory and initial quality control phase meetings;

(7) Conduct weekly safety meetings for all workers;

(8) Conduct monthly supervisory safety meetings;

(9) Provide accident reports;

(10) Produce a Daily Safety Report of activities performed and attach this report to the Contractor's Quality Control Report.

(11) Provide minutes for weekly and monthly safety meetings, minutes to be attached wit 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 Certified Safety Professional (CSP) and/or Certified Industrial hygienist (CIH)

Not Used

1.6.1.3 Associate Safety professional (ASP), Certified Safety Trained Supervisor (STS) and/or Construction Health and Safety Technician (CHST)

Not Used

1.6.1.4 Competent Person for Confined Space Entry

Not Used

1.6.1.5 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 capacitates 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 and 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 04.00 10.

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.

1.6.2.2 Not Used

1.6.3 Meetings

1.6.3.1 Prework 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. Work cannot proceed without an accepted APP.

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 Construction Quality Control System 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 Resident Engineer'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, Section 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)six 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 Demolition Plan. The safety and health aspects prepared in accordance with referenced sources. Include engineering survey as applicable.

g. Excavation Plan.

h. 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. In addition, AHA's are needed using the project schedule as the basis for the activities performed. Any activities listed on the project schedule will require an AHA. The AHA's will either be developed by the contractor, supplier or subcontractor and provided to the prime contractor for submittal to the Contracting Officer. 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 I. 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 Installation's Fire Division. 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 Installation's Fire Division phone number. ANY FIRE, NO MATTER HOW SMALL, SHALL BE REPORTED TO THE RESPONSIBLE INSTALLATION'S FIRE DIVISION IMMEDIATELY.

1.15 SEVERE STORM PLAN

In the event of a severe storm warning, the Contractor must:

a. Secure outside equipment and materials and place materials that could be damaged in protected areas.

b. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.

c. Ensure that temporary erosion controls are adequate.

1.16 FACILITY OCCUPANCY CLOSURE

Streets, walks, and other facilities occupied and used by the Government/ installation shall not be closed or obstructed without written permission from the Contracting Officer.

1.17 GAS PROTECTION

Contractor shall have one or more employees properly trained and experienced in operation and calibration of gas testing equipment and formally qualified as gas inspectors who shall be on duty during times workers are in confined spaces. Their primary functions shall be to test for gas and operate testing equipment. Unless equipment of constant supervisory type with automatic alarm is employed, gas tests shall be made at least every 2 hours or more often when character of ground or experience indicates gas may be encountered. A gas test shall be made before workmen are permitted to enter the excavation after an idle period exceeding one-half hour.

Readings shall be permanently recorded daily, indicating the concentration of gas, point of test, and time of test. Submit copies of the gas test readings to the Contracting Officer at the end of each work day.

Special requirements, coordination, and precautions will apply to areas that contain a hazardous atmosphere or, by virtue of their use or physical character, may be oxygen deficient. A check by Government is required prior to entering confined space. Surveillance and monitoring shall be required in these types of work spaces by both Contractor and Government personnel.

1.18 HIGH NOISE LEVEL PROTECTION

Operations performed by the Contractor that involve the use of equipment with output of high noise levels (jackhammers, air compressors, and explosive-actuated devices) shall be scheduled for during the hours [_____] and [_____]. Use of any such equipment shall be approved in writing by the Contracting Officer prior to commencement of work.

PART 2 PRODUCTS

2.1 FALL PROTECTION ANCHORAGE

Fall protection anchorage, conforming to ASSE/SAFE Z359, 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 installation/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-isocynates, 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 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 Public Utilities 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 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

Contractor shall ensure that each employee is familiar with and complies with these procedures and USACE EM 385-1-1, Section 12, Control of Hazardous Energy

Contracting Officer will, at the Contractor's request, apply lockout/tagout tags and take other actions that, because of experience and knowledge are known to be necessary to make the particular equipment safe to work on for government owned and operated systems.

No person, regardless of position or authority, shall operate any switch, valve, or equipment that has an official lockout/tagout tag attached to it, nor shall such tag be removed except as provided in this section. No person shall work on any energized equipment including, but not limited to activities such as erecting, installing, constructing, repairing, adjusting, inspecting, un-jamming, setting up, trouble shooting, testing, cleaning, dismantling, servicing and maintaining machines equipment of processes until an evaluation has been conducted identifying the energy source and the procedures which will be taken to ensure the safety of personnel.

When work is to be performed on electrical circuits, only qualified personnel shall perform work on electrical circuits.

A supervisor who is required to enter an area protected by a lockout/tagout tag will be considered a member of the protected group provided he notifies the holder of the tag stub each time he enters and departs from the protected area.

Identification markings on building light and power distribution circuits shall not be relied on for established safe work conditions.

Before clearance will be given on any equipment other than electrical (generally referred to as mechanical apparatus), the apparatus, valves, or systems shall be secured in a passive condition with the appropriate vents, pins, and locks.

Pressurized or vacuum systems shall be vented to relieve differential pressure completely.

Vent valves shall be tagged open during the course of the work.

Where dangerous gas or fluid systems are involved, or in areas where the environment may be oxygen deficient, system or areas shall be purged, ventilated, or otherwise made safe prior to entry.

3.3.1 Tag Placement

Lockout/tagout tags shall be completed in accordance with the regulations printed on the back thereof and attached to any device which, if operated, could cause an unsafe condition to exist.

If more than one group is to work on any circuit or equipment, the employee in charge of each group shall have a separate set of lockout/tagout tags completed and properly attached.

When it is required that certain equipment be tagged, the Government will review the characteristics of the various systems involved that affect the

safety of the operations and the work to be done; take the necessary actions, including voltage and pressure checks, grounding, and venting, to make the system and equipment safe to work on; and apply such lockout/tagout tags to those switches, valves, vents, or other mechanical devices needed to preserve the safety provided. This operation is referred to as "Providing Safety Clearance."

3.3.2 Tag Removal

When any individual or group has completed its part of the work and is clear of the circuits or equipment, the supervisor, project leader, or individual for whom the equipment was tagged shall turn in his signed lockout/tagout tag stub to the Contracting Officer. That group's or individual's lockout/tagout tags on equipment may then be removed on authorization by the Contracting Officer.

3.4 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.

3.4.1 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.B.

3.4.2 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. 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 21N through 21N.04. 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 ASSE/SAFE A10.32.

3.4.2.1 Personal Fall Arrest Equipment

Personal fall arrest equipment, systems, subsystems, and components shall meet ASSE/SAFE 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.

3.4.3 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.

3.4.4 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 ASSE/SAFE Z359.1. Exiting horizontal lifeline anchorages shall be certified (or re-certified) by a registered professional engineer with experience in designing horizontal lifeline systems.

3.4.5 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).

3.4.6 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.

3.4.7 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).

3.5 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 SCAFFOLDING.

3.5.1 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 EM 385-1-1 for types of scaffolds where this requirement applies.

3.6 EQUIPMENT

3.6.1 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.

3.7 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. 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.

q. 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.

3.8 EXCAVATIONS

The competent person shall perform soil classification in accordance with 29 CFR 1926.

3.8.1 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.

3.8.2 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.

3.8.3 Shoring Systems

Trench and shoring systems must be identified in the accepted safety plan and AHA. Manufacture 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.

3.8.4 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.

3.9 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.

3.10 ELECTRICAL

3.10.1 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.

3.10.2 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.

3.11 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 34 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 --

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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 B564 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.

AMERICAN CONCRETE INSTITUTE 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-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@aashto.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 GAS ASSOCIATION (AGA)
400 North Capitol Street N.W.
Suite 450
Washington, D.C. 20001
Ph: 202-824-7000
Fax: 202-824-7115
E-mail: website@aga.org
Internet: http://www.aga.org

AMERICAN HARDBOARD ASSOCIATION (AHA)
1210 West Northwest Highway
Palatine, IL 60067
Ph: 847-934-8800
Fax: 847-934-8803
E-mail: aha@hardboard.org
Internet: http://www.hardboard.org

AMERICAN NURSERY & LANDSCAPE ASSOCIATION (ANLA)
1000 Vermont Ave NW
Suite 300
Washington, DC 20005
Ph: 202-789-2900
Fax: 202-789-1893
E-mail: aflynn@anla.org
Internet: http://www.anla.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 CIVIL ENGINEERS (ASCE)
1801 Alexander Bell Drive
Reston, VA 20191-4400
Ph: 703-295-6300 - 800-548-2723
Fax: 703-295-6333
E-mail: member@asce.org

Internet: http://www.asce.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

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)
933 North Plum Grove Road
Schaumburg, IL 60173-4758
Ph: 847-517-1200 or 800-328-6306
Fax: 847-517-1206
Internet: http://www.crsi.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

FOREST STEWARDSHIP COUNCIL (FSC)
212 Third Avenue North
Suite 280
Minneapolis, MN 55401
Ph: 612-353-4511
Fax: 612-208-1565
E-mail: info@fscus.org
Internet: http://www.fscus.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 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

L.H. BAILEY HORTORIUM (LHBH)
Dept of Plant Biology
c/o Cornell University
412 Mann Library Building
Ithaca, NY 14853
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Fax: 617-770-0700
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Internet: http://www.nfpa.org

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Internet: http://www.nicet.org

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Internet: http://www.nist.gov

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PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not used

-- 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

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).

1.3 EROSION AND SEDIMENT CONTROLS

The controls and measures required of the Contractor are described below.

The stormwater pollution control devices shall be in accordance with the Kentucky Department of Environmental Protection and Ft. Knox's standards and regulations.

1.3.1 Stabilization Practices

The stabilization practices to be implemented include temporary seeding, mulching, geotextiles, sod stabilization, vegetative buffer strips, erosion control matts, protection of trees, preservation of mature vegetation, 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

Not Used

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; Location and details of installation and construction are shown on the drawings.

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 as shown on the drawings.

e. Perpendicular to the flow in the bottom of new drainage ditches, channels, and swales. Space the rows as shown on the drawings.

f. At the entrance to culverts that receive runoff from disturbed areas.

1.3.4 Sediment Basins

Trap sediment in sediment basins. 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 Contractor Quality Control approval. 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; G
Erosion and Sediment Controls; G

SD-07 Certificates

Mill Certificate or Affidavit; G

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 Elongation (percent)	ASTM D 4632	100 lbs. min. 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 receive erosion control.

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.

3.4.4 Monthly Inspection Report and Certification Form

Not Used

-- End of Section --

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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.

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)

1.2 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. 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; G (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 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 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 included in the LEED Documentation Notebook.

Demolition accomplished by other parties on this project site count toward the project's total waste diversion cumulative score for LEED. Information on the quantity and disposition of these materials will be provided by the Contracting Officer. Include this data in records, annotated to indicate that it was accomplished by another party.

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. Coordinate reuse with the Contracting Officer. 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 02 41 00

DEMOLITION
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 ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 145	(1991; R 2008) Standard Specification for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
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

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; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011) 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 [Deconstruction Plan] and submit proposed [salvage,] [demolition,] [deconstruction,] 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. [Include statements affirming Contractor inspection of the existing roof deck and its suitability to perform as a safe working platform or if inspection reveals a safety hazard to workers, state provisions for securing the safety of the workers throughout the performance of the work.] Provide procedures for safe conduct of the work in accordance with EM 385-1-1. Plan shall be approved by [Structural PE] [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 [station daily] [project site]; do not allow accumulations [inside or outside the building[s]] [on airfield pavements].] [The work includes [demolition,] [deconstruction], 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 [structural elements] [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] [the Government will disconnect and seal utilities serving each area of alteration or removal upon written request from 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] [will be permitted in the area located [_____] and between the hours of [_____] and [_____]]. Where burning is permitted, adhere to federal, state, and local regulations.

1.5 AVAILABILITY OF WORK AREAS

Areas in which the work is to be accomplished will be available in accordance with the following schedule:

Area	Date
[_____]	[_____]

1.6 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-01 Preconstruction Submittals

Existing Conditions; G

SD-07 Certificates

Demolition Plan; G
Notification; G

SD-11 Closeout Submittals

Receipts

1.7 QUALITY ASSURANCE

Submit timely notification of [demolition] [deconstruction] [and] [renovation] projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61, Subpart M. Notify the [Regional Office of the United States Environmental Protection Agency (USEPA)] [State's environmental protection agency] [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] [will not] be permitted.

1.7.1 Dust [and Debris] Control

Prevent the spread of dust [and debris] [to occupied portions of the building] [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. [Vacuum and dust the work area [daily] [_____].] [Sweep pavements as often as necessary to control the spread of debris that may result in foreign object damage potential to aircraft.]

1.8 PROTECTION

1.8.1 Traffic Control Signs

a. Where [pedestrian and driver] [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.]

1.8.2 Protection of Personnel

Before, during and after the [demolition] [and] [deconstruction] work continuously evaluate the condition of the structure being [demolished] [and] [deconstructed] 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.

1.9 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.

1.10 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.

1.11 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.

b. [Fill material shall conform to the definition of satisfactory soil material as defined in AASHTO M 145, Soil Classification Groups A-1, A-2-4, A-2-5 and A-3. In addition, fill material shall be free from roots and other organic matter, trash, debris, frozen materials, and stones larger than 2 inches in any dimension.

c. Proposed fill material must be sampled and tested by an approved soil testing laboratory, as follows:

Soil classification	AASHTO M 145
Moisture-density relations	AASHTO T 180, Method B or D]

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. Remove existing structures indicated to be removed to [grade] [top of foundation walls] [[_____] feet below grade]. Interior walls, other than retaining walls and partitions, shall be removed to [_____] feet below grade or to top of concrete slab on ground. Break up basement slabs to permit drainage. Remove sidewalks, curbs, gutters and street light bases as indicated.

b. [Demolish] [Deconstruct] 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] [Deconstruct] 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.

c. Locate demolition and deconstruction equipment throughout the structure and remove materials so as to not impose excessive loads to supporting walls, floors, or framing.

d. [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 [on the station] 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 [ground] [scarified] [sawcut] concrete and asphaltic concrete paving and slabs [including aggregate base] [as indicated] to a depth of [_____] inches below [existing adjacent] [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 Roofing

[Remove existing roof system and associated components in their entirety down to existing roof deck.] [Remove [built-up] [single-ply] roofing to effect the connections with new flashing or roofing.] [Remove gravel surfacing from existing roofing felts for a minimum distance of 18 inches back from the cut. Remove gravel without damaging felts.] [Salvage asphalt roofing materials.] [Cut existing [felts] [membrane] [and insulation] along straight lines.] [Remove roofing system [and insulation] without damaging the roof deck.] Sequence work to minimize building

exposure between demolition or deconstruction and new roof materials installation.

3.1.5.1 Temporary Roofing

Install temporary roofing and flashing as necessary to maintain a watertight condition throughout the course of the work. Remove temporary work prior to installation of permanent roof system materials unless approved otherwise by the Contracting Officer. [The existing [deck] [and support structure] is deteriorated where indicated, such that ability to support foot traffic and construction loads is unknown. Make provisions for worker safety during demolition, deconstruction, and installation of new materials as described in paragraphs entitled "Statements" and "Regulatory and Safety Requirements."]

3.1.5.2 Reroofing

When removing the existing roofing system from the roof deck, remove only as much roofing as can be recovered by the end of the work day, unless approved otherwise by the Contracting Officer. Do not attempt to open the roof covering system in threatening weather. Reseal all openings prior to suspension of work the same day.

3.1.6 Masonry

Sawcut and remove masonry so as to prevent damage to surfaces to remain[, to removed materials being salvaged] [and to facilitate the installation of new work]. Where new masonry adjoins existing, the new work shall abut or tie into the existing construction as [indicated] [specified for the new work]. Provide square, straight edges and corners where existing masonry adjoins new work and other locations.[Masonry removed in whole blocks shall be salvaged and stored for reuse.] [Masonry removed in pieces shall be crushed[for use as aggregate]].

3.1.7 Concrete

Saw concrete along straight lines to a depth of a minimum 2 inch. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete. [Salvage removed concrete.]

3.1.8 Structural Steel

Dismantle structural steel at field connections and in a manner that will prevent bending or damage. Salvage for [reuse] [recycle] structural steel, steel joists, girders, angles, plates, columns and shapes. [Do not use flame-cutting torches] [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 [storage area] [recycling facility] [area as directed by the Contracting Officer], stacked according to size, type of member and length, and stored off the ground, protected from the weather.

3.1.9 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.

3.1.10 Carpentry

Salvage for [reuse] [recycle] 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.] [Salvage] [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.] [Salvage hardware attached to units for reuse.] Brace the open end of door frames to prevent damage.

3.1.11 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.

3.1.12 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.

3.1.13 Airfield Lighting

Remove existing airfield lighting as indicated and terminate in a manner satisfactory to the Contracting Officer. Remove [edge lights], [associated transformers] [and] [_____] as indicated and [deliver to a location on the station in accordance with instructions of the Contracting Officer] [dispose of off station] [_____].

3.1.14 Patching

Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces, using on-site materials when available. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall be flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish. Patching shall be as specified and indicated, and shall include:

a. Concrete and Masonry: Completely fill holes and depressions, [caused by previous physical damage or] left as a result of removals in existing masonry walls to remain, with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.

b. Where existing partitions have been removed leaving damaged or missing resilient tile flooring, patch to match the existing floor tile.

c. Patch acoustic lay-in ceiling where partitions have been removed. The transition between the different ceiling heights shall be effected by continuing the higher ceiling level over to the first runner on the lower ceiling and closing the vertical opening with a painted sheet metal strip.

3.1.15 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."]

3.1.16 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)."

3.1.17 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.

3.1.18 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 [on station] 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].

3.1.18.1 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.

3.1.18.2 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.

3.1.18.3 Ducts

Classify removed duct work as scrap metal.

3.1.18.4 Fixtures, Motors and Machines

Remove and salvage fixtures, motors and machines associated with plumbing, heating, air conditioning, refrigeration, and other mechanical system installations. Salvage, box and store auxiliary units and accessories with the main motor and machines. Tag salvaged items for identification, storage, and protection from damage. Classify [non-porcelain]broken, damaged, or otherwise unserviceable units and not caused to be broken, damaged, or otherwise unserviceable as debris to be disposed of by the Contractor. [Salvage and crush porcelain plumbing fixtures unsuitable for reuse.]

3.1.19 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.

3.1.19.1 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.

3.1.19.2 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.

3.1.19.3 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.

3.1.19.4 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.

3.1.20 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 Reuse of Materials and Equipment

Remove and store materials and equipment [listed [in the [Demolition] [Deconstruction] Plan] [_____]] [indicated [_____]] to be reused or relocated to prevent damage, and reinstall as the work progresses.

3.3.3 Salvaged Materials and Equipment

Remove materials and equipment that are [listed [in the [Demolition] [Deconstruction] Plan][_____]] [indicated [_____]] [and] [specified [_____]] 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 [_____] 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: [_____].

d. Remove the following items reserved as property of the using service prior to commencement of work under this contract: [_____].

e. 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.

f. [Remove and capture all Class I ODS refrigerants in accordance with the Clean Air Act Amendment of 1990, and turn in to the Navy [as directed by the Commanding Officer.] [by shipping the refrigerant container to the Defense Logistics Agency at the following address:

Defense Depot Richmond VA (DDRV)
SW0400
Cylinder Operations
8000 Jefferson Davis Highway
Richmond, VA 23297-5900]]

[The Government will remove and capture Class I ODS refrigerants. To view the web site for ODS, link to:
https://www.osd.mil/denix/Public/News/DLA/ODS/sect1.html]

3.3.4 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 [put back into the existing equipment] [turned over to the Contracting Officer] [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.

3.3.4.1 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).

3.3.4.2 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.

3.3.5 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.

3.3.6 Unsalvageable and Non-Recyclable Material

Dispose of unsalvageable and non-recyclable noncombustible material in the disposal area located [_____]. The fill in the disposal area shall remain below elevation [_____] and after disposal is completed, 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] [by burning].

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 [off the [_____] center] [in the Waste Management Plan] [_____]. [Storage of removed materials on the project site is prohibited.]

3.5.2 Burning on Government Property

[Burning of materials removed from demolished and deconstructed structures will not be permitted on Government property] [Transport combustible materials removed from demolished and deconstructed structures to the areas designated for burning. Control fires for protection of persons and property. Monitor fires continuously until the fires have burned out or have been extinguished. Comply with Federal, State and local laws regulating the building and maintaining of brush and trash fires].

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 --

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SECTION 03 30 00

CAST-IN-PLACE CONCRETE
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.

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
AASHTO M 322M/M 322	(2010) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI/MCP-1	(2011) Manual of Concrete Practice Part 1
ACI/MCP-2	(2011) Manual of Concrete Practice Part 2
ACI/MCP-3	(2011) Manual of Concrete Practice Part 3
ACI/MCP-4	(2011) Manual of Concrete Practice Part 4

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1995; R 2004) Basic Hardboard

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4/D1.4M	(2011) Structural Welding Code - Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

ASTM A185/A185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A496/A496M	(2007) Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement
ASTM A497/A497M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
ASTM A53/A53M	(2010) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated,

	Welded and Seamless
ASTM A615/A615M	(2009b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A706/A706M	(2009b) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A767/A767M	(2009) Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A775/A775M	(2007b) Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A82/A82M	(2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A934/A934M	(2007) Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A996/A996M	(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 1107/C 1107M	(2011) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 1116/C 1116M	(2010a) Standard Specification for Fiber-Reinforced Concrete
ASTM C 1260	(2007) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C 143/C 143M	(2010) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C 150/C 150M	(2011) Standard Specification for Portland Cement
ASTM C 156	(2009a) Standard Test Method for Water Retention by Concrete Curing Materials
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 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 192/C 192M	(2007) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 295	(2008) Petrographic Examination of Aggregates for Concrete
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 311	(2011) Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete
ASTM C 33/C 33M	(2011) Standard Specification for Concrete Aggregates
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 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 881/C 881M	(2010) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 920	(2011) Standard Specification for Elastomeric Joint Sealants
ASTM C 932	(2006) Standard Specification for Surface-Applied Bonding Compounds for Exterior Plastering
ASTM C 94/C 94M	(2011) 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 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 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 5759	(1995; R 2005) Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses
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 E 1155	(1996; R 2008) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers
ASTM E 1745	(2009) Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
ASTM E 329	(2011) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP	(2009; 28th Ed) Manual of Standard Practice

FOREST STEWARDSHIP COUNCIL (FSC)

FSC STD 01 001	(2000) Principles and Criteria for Forest Stewardship

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST PS 1	(2007) DOC Voluntary Product Standard PS 1-07, Structural Plywood

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstops

U.S. DEPARTMENT OF COMMERCE (DOC)

DOC/NIST PS1	(1995) Construction and Industrial Plywood with Typical APA Trademarks

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS LLL-B-810	(Rev B; Notice 1) Building Board, (Hardboard) Hard Pressed, Vegetable Fiber
FS MMM-A-001993	(1978) Adhesive, Epoxy, Flexible, Filled (For Binding, Sealing, and Grouting)
FS UU-B-790	(Rev A; Am 1; Notice 1) Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant)

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)

1.2 DEFINITIONS

a. "Cementitious material" as used herein must include all portland cement, pozzolan, fly ash, ground granulated blast-furnace slag

b. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.

c. "Chemical admixtures" are materials in the form of powder or fluids that are added to the concrete to give it certain characteristics not obtainable with plain concrete mixes.

d. "Workability (or consistence)" is the ability of a fresh (plastic) concrete mix to fill the form/mould properly with the desired work (vibration) and without reducing the concrete's quality. Workability depends on water content, chemical admixtures, aggregate (shape and size distribution), cementitious content and age (level of hydration).

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control .

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

Fabrication Drawings for concrete formwork must be submitted by the Contractor in accordance with paragraph entitled, "Shop Drawings," of this section, to include the following:

Reinforcing steel; G

Reproductions of contract drawings are unacceptable.

SD-03 Product Data

Materials for curing concrete; G
Joint sealants (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.]

Joint filler; G (LEED)

Recycled Aggregate Materials; G (LEED)
Cement; G (LEED)
Portland Cement; G
Ready-Mix Concrete; G
Vapor retarder
Bonding Materials

Concrete Curing Materials
Reinforcement (LEED)
Reinforcement Materials

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.

Vapor retarder

Wood Forms

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.

Biodegradable Form Release Agent; G

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-05 Design Data

Concrete mix design; G

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, fly ash, pozzolans, ground slag , and admixtures; and applicable reference specifications. Provide mix proportion data using at least three different water-cement ratios for each type of mixture, which produce a range of strength encompassing those required for each class and type of concrete required. If source material changes, resubmit mix proportion data using revised source material. Provide only materials that have been proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by the Contracting Officer. Indicate clearly in the submittal where each mix design is used when more than one mix design is submitted. Submit additional data regarding concrete aggregates if the source of aggregate changes. Submit copies of the fly ash, and pozzolan test results, in addition. The approval of fly ash, and pozzolan test results must be within 6 months of submittal date. Obtain acknowledgement of receipt prior to concrete placement.

SD-06 Test Reports

Concrete mix design; G

Fly ash

Pozzolan

Ground granulated blast-furnace slag

Aggregates

Compressive strength tests; G

Air Content

Slump

Air Entrainment

SD-08 Manufacturer's Instructions

Fly ash

Ground granulated blast-furnace slag

1.4 MODIFICATION OF REFERENCES

Accomplish work in accordance with ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the Contracting Officer.

1.5 DELIVERY, STORAGE, AND HANDLING

Do not deliver concrete until vapor retarder, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. ACI/MCP-2 for job site storage of materials. Protect materials from contaminants such as grease, oil, and dirt. Ensure materials can be accurately identified after bundles are broken and tags removed. Do not store concrete curing compounds or sealers with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions. Do not store concrete curing compounds or sealers in occupied spaces.

1.5.1 Reinforcement

Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid rusting. Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be accurately identified after bundles are broken and tags removed.

1.6 QUALITY ASSURANCE

1.6.1 Drawings

1.6.1.1 Reinforcing Steel

ACI/MCP-4. Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars.

1.6.2 Control Submittals

1.6.2.1 Material Safety Data Sheets

Submit Material Safety Data Sheets (MSDS) for all materials that are regulated for hazardous health effects. Prominently post the MSDS at the construction site.

1.6.3 Test Reports

1.6.3.1 Concrete Mix Design

Submit copies of laboratory test reports showing that the mix has been successfully tested to produce concrete with the properties specified and that mix must be suitable for the job conditions. Include mill test and all other test for cement, aggregates, and admixtures in the laboratory test reports. Provide maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Submit test reports along with the concrete mix design. Obtain approval before concrete placement.

1.6.3.2 Fly Ash and Pozzolan

Submit test results in accordance with ASTM C 618 for fly ash and pozzolan. Submit test results performed within 6 months of submittal date. Submit manufacturer's policy statement on fly ash use in concrete.

1.6.3.3 Ground Granulated Blast-Furnace Slag

Submit test results in accordance with ASTM C 989 for ground granulated

blast-furnace slag. Submit test results performed within 6 months of submittal date. Submit manufacturer's policy statement on slag use in concrete.

1.7 ENVIRONMENTAL REQUIREMENTS

Provide space ventilation according to manufacturer recommendations, at a minimum, during and following installation of concrete curing compound and sealer. Maintain one of the following ventilation conditions during the curing compound/sealer curing period or for 72 hours after installation:

a. Supply 100 percent outside air 24 hours a day.

b. Supply airflow at a rate of 6 air changes per hour, when outside temperatures are between 55 degrees F and 84 degrees F and humidity is between 30 percent and 60 percent.

c. Supply airflow at a rate of 1.5 air changes per hour, when outside air conditions are not within the range stipulated above.

1.7.1 Submittals for Environmental Performance

a. Provide data indication the percentage of post-industrial pozzolan (fly ash, blast furnace slag) cement substitution as a percentage of the full product composite by weight.

b. Provide data indicating the percentage of post-industrial and post-consumer recycled content aggregate.

c. Provide product data indicating the percentage of post-consumer recycled steel content in each type of steel reinforcement as a percentage of the full product composite by weight.

d. Provide product data stating the location where all products were manufactured

e. For projects using FSC certified formwork, provide chain-of-custody documentation for all certified wood products.

f. For projects using reusable formwork, provide data showing how formwork is reused.

g. Provide MSDS product information data showing that form release agents meet any environmental performance goals such as using vegetable and soy based products.

h. Provide MSDS product information data showing that concrete adhesives meet any environmental performance goals including low emitting, low volatile organic compound products.

1.8 SUSTAINABLE DESIGN REQUIREMENTS

1.8.1 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. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Concrete materials may be locally available.

1.8.2 Forest Stewardship Council (FSC) Certification

Use FSC-certified wood where specified. Provide letter of certification signed by lumber supplier. Indicate compliance with FSC STD 01 001 and identify certifying organization. Submit FSC certification numbers; identify each certified product on a line-item basis. Submit copies of invoices bearing the FSC certification numbers.

1.9 QUALIFICATIONS FOR CONCRETE TESTING SERVICE

Perform concrete testing by an approved laboratory and inspection service experienced in sampling and testing concrete. Testing agency must meet the requirements of ASTM E 329.

PART 2 PRODUCTS

2.1 MATERIALS FOR FORMS

Provide wood, plywood, plastic, carton, or steel. Use plywood or steel forms where a smooth form finish is required.

2.1.1 Wood Forms

Use lumber as specified in Section 06 10 00 ROUGH CARPENTRY and as follows. Provide lumber that is square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects. Provide plywood that complies with DOC/NIST PS1, B-B concrete form panels or better or AHA A135.4, hardboard for smooth form lining. Virgin wood used must be FSC-certified.]

2.1.1.1 Concrete Form Plywood (Standard Rough)

Provide plywood that conforms to NIST PS 1, B-B, concrete form, not less than 5/8-inch thick.

2.1.1.2 Overlaid Concrete Form Plywood (Standard Smooth)

Provide plywood that conforms to NIST PS 1, B-B, high density form overlay, not less than 5/8-inch thick.

2.1.2 Steel Forms

Provide steel form surfaces that do not contain irregularities, dents, or sags.

2.2 FORM TIES AND ACCESSORIES

The use of wire alone is prohibited. Provide form ties and accessories that do not reduce the effective cover of the reinforcement.

2.2.1 Polyvinylchloride Waterstops

COE CRD-C 572.

2.2.2 Dovetail Anchor Slot

Preformed metal slot approximately 1 by 1 inch of not less than 22 gage galvanized steel cast in concrete. Coordinate actual size and throat

opening with dovetail anchors and provide with removable filler material.

2.3 CONCRETE

2.3.1 Contractor-Furnished Mix Design

ACI/MCP-1, ACI/MCP-2, and ACI/MCP-3 except as otherwise specified. Indicate the compressive strength (f'c) of the concrete for each portion of the structure(s) and as specified below.

Location	f'c (Min. 28-Day Comp. Strength) (psi)	ASTM C 33/C 33M Maximum Nominal Aggregate (Size No.)	Range of Slump (inches)	Maximum Water-Cement Ratio] (by weight)	Air Entr. (percent)
Footings	4000	57	1-3	0.50	
Concrete exposed to weather	4000	57	1-3	0.50	6
Floor slabs	3000	See Combined Aggregate Gradation	1-3	0.50	(a)
All other areas	3000	57	1-3	0.50	0

Maximum slump shown above may be increased 1 inch for methods of consolidation other than vibration. Slump may be increased to 8 inches when superplasticizers are used. Provide air entrainment using air-entraining admixture. Provide air entrainment within plus or minus 1.5 percent of the value specified. Note (a): Entrapped air must be 3 percent or less.

2.3.1.1 Mix Proportions for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified are the responsibility of the Contractor. Base mixture proportions 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. Samples of all materials used in mixture proportioning studies must be representative of those proposed for use in the project and must be accompanied by the manufacturer's or producer's test report indicating compliance with these specifications. Base trial mixtures having proportions, consistencies, and air content suitable for the work on methodology described in ACI/MCP-1. In the trial mixture, use at least three different water-cement ratios for each type of mixture, which must produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cement ratio required must be based on equivalent water-cement ratio calculations as determined by the conversion from the weight ratio of water to cement plus pozzolan, silica fume, and ground granulated blast-furnace slag by weight equivalency method. Design laboratory trial mixture for maximum permitted slump and air content. Each combination of material proposed for use must have separate trial mixture, except for accelerator or retarder use can be provided without separate trial mixture. Report the temperature of concrete in each trial batch. For each water-cement ratio, at least three

test cylinders for each test age must be made and cured in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39/C 39M for 7 and 28 days. From these results, plot a curve showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition, plot a curve showing the relationship between 7 and 28 day strengths.

2.3.1.2 Lightweight Concrete Proportion

Not Used

2.3.1.3 Required Average Strength of Mix Design

The selected mixture must produce an average compressive strength exceeding the specified strength by the amount indicated in ACI/MCP-2. When a concrete production facility has a record of at least 15 consecutive tests, the standard deviation must be calculated and the required average compressive strength must be determined in accordance with ACI/MCP-2. When a concrete production facility does not have a suitable record of tests to establish a standard deviation, the required average strength must follow ACI/MCP-2 requirements.

2.3.2 Ready-Mix Concrete

Provide concrete that meets the requirements of ASTM C 94/C 94M.

Ready-mixed concrete manufacturer must provide duplicate delivery tickets with each load of concrete delivered. Provide delivery tickets with the following information in addition to that required by ASTM C 94/C 94M:

Type and brand cement

Cement content in 95-pound bags per cubic yard of concrete

Maximum size of aggregate

Amount and brand name of admixtures

Total water content expressed by water/cement ratio

2.3.3 Concrete Curing Materials

2.3.3.1 Absorptive Cover

Provide burlap cloth cover for curing concrete made from jute or kenaf, weighing 10 ounces plus or minus 5 percent per square yard when clean and dry, conforming to ASTM C 171, Class 3; or cover may be cotton mats as approved.

2.3.3.2 Moisture-Retaining Cover

Provide waterproof paper cover for curing concrete conforming to ASTM C 171, regular or white, or polyethylene sheeting conforming to ASTM C 171, or polyethylene-coated burlap consisting of a laminate of burlap and a white opaque polyethylene film permanently bonded to the burlap; burlap must conform to ASTM C 171, Class 3, and polyethylene film must conform to ASTM C 171. When tested for water retention in accordance with ASTM C 156, weight of water lost 72 hours after application of moisture retaining covering material must not exceed 0.039 gram per square centimeter of the

mortar specimen surface.

2.3.3.3 Membrane-Forming Curing Compound

Provide liquid type compound conforming to ASTM C 309, Type 1, clear, Type 1D with fugitive dye for interior work and Type 2, white, pigmented for exterior work.

2.4 MATERIALS

2.4.1 Cement

ASTM C 150/C 150M, Type I or II or ASTM C 595/C 595M blended cement except as modified herein. Provide blended cement that consists of a mixture of ASTM C 150/C 150M, Type II, cement and one of the following materials: ASTM C 618 pozzolan or fly ash, ASTM C 989 ground granulated blast-furnace slag. For portland cement manufactured in a kiln fueled by hazardous waste, maintain a record of source for each batch. Supplier must certify that no hazardous waste is used in the fuel mix or raw materials.

2.4.1.1 Fly Ash and Pozzolan

ASTM C 618, Type N, F, or C, except that the maximum allowable loss on ignition must be 6 percent for Types N and F. Add with cement. Fly ash content must be a minimum of 15 percent by weight of cementitious material, provided the fly ash does not reduce the amount of cement in the concrete mix below the minimum requirements of local building codes. Where the use of fly ash cannot meet the minimum level, provide the maximum amount of fly ash permittable that meets the code requirements for cement content. Report the chemical analysis of the fly ash in accordance with ASTM C 311. Evaluate and classify fly ash in accordance with ASTM D 5759.

High contents of supplementary cementitious materials can have some detrimental effects on the concrete properties, such as slowing excessively the strength gain rate, and delaying and increasing the difficulty of finishing. The recommended maximum content (by weight of the total cementitious material) for these materials are:

1. For GGBF slag: 50 percent

2. For fly ash or natural pozzolan: 40 percent (25 percent in cold climates)

3. For silica fume: 10 percent

2.4.1.2 Ground Granulated Blast-Furnace Slag

ASTM C 989, Grade 80. Slag content must be a minimum of 25 percent by weight of cementitious material.

2.4.1.3 Silica Fume
Not Used

2.4.1.4 Portland Cement

Provide cement that conforms to ASTM C 150/C 150M, Type I, IA, II, or IIA. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

2.4.2 Water

Minimize the amount of water in the mix. The amount of water must not exceed 45 percent by weight of cementitious materials (cement plus pozzolans), and in general, improve workability by adjusting the grading rather than by adding water. Water must be fresh, clean, and potable; free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete.

2.4.3 Aggregates

ASTM C 33/C 33M, except as modified herein. Furnish aggregates for exposed concrete surfaces from one source. Provide aggregates that do not contain any substance which may be deleteriously reactive with the alkalies in the cement.

Fine and coarse aggregates must show expansions less than 0.08 percent at 16 days after casting when testing in accordance with ASTM C 1260. Should the test data indicate an expansion of 0.08 percent or greater, reject the aggregate(s) or perform additional testing using ASTM C 1567 using the Contractor's proposed mix design. In this case, include the mix design low alkali portland cement and one of the following supplementary cementitious materials:

1. GGBF slag at a minimum of 40 percent of total cementitious

2. Fly ash or natural pozzolan at a minimum of total cementitious of
   a. 30 percent if (SiO_2 plus Al_2O_3 plus Fe_2O_3) is 65 percent or more,
   b. 25 percent if (SiO_2 plus Al_2O_3 plus Fe_2O_3) is 70 percent or more,
   c. 20 percent if (SiO_2 plus Al_2O_3 plus Fe_2O_3) is 80 percent or more,
   d. 15 percent if (SiO_2 plus Al_2O_3 plus Fe_2O_3) is 90 percent or more.

3. Silica fume at a minimum of 7 percent of total cementitious.

If a combination of these materials is chosen, the minimum amount must be a linear combination of the minimum amounts above. Include these materials in sufficient proportion to show less than 0.08 percent expansion at 16 days after casting when tested in accordance with ASTM C 1567.

Aggregates must not possess properties or constituents that are known to have specific unfavorable effects in concrete when tested in accordance with ASTM C 295.

2.4.3.1 Aggregates/Combined Aggregate Gradation (Floor Slabs Only)

ASTM C 33/C 33M, uniformly graded and as follows: Nominal maximum aggregate size of 1 inch. A combined sieve analysis must indicate a well graded aggregate from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on coarsest sieve and on No. 50 (0.3mm) sieve, and less than 8 percent may be retained on sieves finer than No. 50 (0.3mm). Provide sand that is at least 50 percent natural sand.

2.4.3.2 Aggregates for Lightweight Concrete

Not Used

2.4.3.3 Recycled Aggregate Materials

Not Used

2.4.4 Nonshrink Grout

ASTM C 1107/C 1107M.

2.4.5 Admixtures

ASTM C 494/C 494M: Type A, water reducing; Type B, retarding; Type C, accelerating; Type D, water-reducing and retarding; and Type E, water-reducing and accelerating admixture. Do not use calcium chloride admixtures.

2.4.5.1 Air-Entraining

ASTM C260/C260M.

2.4.5.2 High Range Water Reducer (HRWR) (Superplasticizers)

ASTM C 494/C 494M, Type F and Type G (HRWR retarding admixture)] and ASTM C 1017/C 1017M.

2.4.5.3 Pozzolan

Provide fly ash or other pozzolans used as admixtures that conform to ASTM C 618.

2.4.6 Vapor Retarder and Vapor Barrier

ASTM E 1745 polyethylene sheeting, minimum 10 mil thickness.

Waterproof Paper. Kraft paper, glass reinforcing fibers and layers of polyethylene laminated under heat and pressure to form a single layer meeting the requirements of FS UU-B-790, Type I, Grade A, Style 4; or waterproof paper, regular, conforming to ASTM C 171, consisting of two sheets of kraft paper cemented together with bituminous material in which are embedded cords or strands of fiber running in both directions not more than 1 1/4 inch apart.

Consider plastic vapor retarders and adhesives with a high recycled content, low toxicity low VOC (Volatile Organic Compounds) levels.

2.4.7 Materials for Curing Concrete

Use water-based curing compounds, sealers, and coatings with low (maximum 160 grams/liter, less water and less exempt compounds) VOC content.

Consider the use of water based or vegetable or soy based curing agents in lieu of petroleum based products. Consider agents that are not toxic and emit low or no Volatile Organic Compounds (VOC). Consider the use of admixtures that offer high performance to increase durability of the finish product but also have low toxicity and are made from bio-based materials such as soy, and emit low levels of Volatile Organic Compounds (VOC). Curing compounds must comply with USDA BioPreferred requirements.

2.4.7.1 Impervious Sheeting

ASTM C 171; waterproof paper, clear or white polyethylene sheeting, or polyethylene-coated burlap.

2.4.7.2 Pervious Sheeting

AASHTO M 182.

2.4.7.3 Liquid Membrane-Forming Compound

ASTM C 309, white-pigmented, Type 2, Class B.

2.4.8 Liquid Chemical Sealer-Hardener Compound

Provide surface treatments containing certain chemicals, including sodium silicate and the fluosilicates of magnesium and zinc. Provide compound that does not reduce the adhesion of resilient flooring, tile, paint, roofing, waterproofing, or other material applied to concrete.

2.4.9 Expansion/Contraction Joint Filler

ASTM D 1751, ASTM D 1752, cork or 100 percent post-consumer paper meeting ASTM D 1752 (subparagraphs 5.1 to 5.4). Material must be 1/2 inch thick, unless otherwise indicated.

2.4.9.1 Preformed Joint Filler Strips

Provide nonextruding and resilient bituminous type filler strips conforming to ASTM D 1751.

2.4.10 Joint Sealants

Use concrete penetrating sealers with a low (maximum 100 grams/liter, less water and less exempt compounds) VOC content.

2.4.10.1 Horizontal Surfaces, 3 Percent Slope, Maximum

ASTM D 6690 or ASTM C 920, Type M, Class 25, Use T. ASTM D 7116 for surfaces subjected to jet fuel.

2.4.10.2 Vertical Surfaces Greater Than 3 Percent Slope

ASTM C 920, Type M, Grade NS, Class 25, Use T.

2.4.10.3 Waterstops

Provide waterstops that are flat dumbbell type, not less than 3/16 inch for widths up to 5 inches, and not less than 3/8 inch for widths 5 inches and over.

Provide waterstops made of rubber and that conform to ASTM D 1752.

2.4.10.4 Joint Sealant Compound

Provide hot-poured, elastic type compound conforming to ASTM D 6690.

2.4.11 Epoxy Bonding Compound

ASTM C 881/C 881M. Provide Type I for bonding hardened concrete to hardened concrete; Type II for bonding freshly mixed concrete to hardened concrete; and Type III as a binder in epoxy mortar or concrete, or for use in bonding skid-resistant materials to hardened concrete. Provide Grade 1 or 2 for horizontal surfaces and Grade 3 for vertical surfaces. Provide Class A if placement temperature is below 40 degrees F; Class B if placement temperature is between 40 and 60 degrees F; or Class C if placement temperature is above 60 degrees F.

2.4.12 Biodegradable Form Release Agent

Provide form release agent that is colorless, biodegradable, and water-based, with a low (maximum of 55 grams/liter (g/l)) VOC content. A minimum of 85 percent of the total product must be biobased material. Provide product that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces. Provide form release agent that does not contain diesel fuel, petroleum-based lubricating oils, waxes, or kerosene.

2.5 REINFORCEMENT

Not Used

2.5.1 Reinforcing Bars

ACI/MCP-2 unless otherwise specified. Use deformed steel. ASTM A615/A615M and AASHTO M 322M/M 322 with the bars marked A, S, W, Grade 60; or ASTM A996/A996M with the bars marked R, Grade 60, or marked A, Grade 60. ASTM A706/A706M. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Reinforcing bars may contain post-consumer or post-industrial recycled content.

2.5.1.1 Galvanized Reinforcing Bars

Provide galvanized reinforcing bars that conform to ASTM A767/A767M, Class II with galvanizing before fabrication.

2.5.1.2 Weldable Reinforcing Bars

Provide weldable reinforcing bars that conform to ASTM A706/A706M and ASTM A615/A615M and Supplement S1, Grade 60, except that the maximum carbon content must be 0.55 percent.

2.5.1.3 Epoxy-Coated Reinforcing Bars

Provide epoxy-coated reinforcing bars that conform to ASTM A775/A775M, Grade 40 or Grade 60.

2.5.2 Mechanical Reinforcing Bar Connectors

ACI/MCP-2. Provide 125 percent minimum yield strength of the reinforcement bar.

2.5.3 Wire

ASTM A82/A82M or ASTM A496/A496M.

2.5.3.1 Welded Wire Fabric

ASTM A185/A185M or ASTM A497/A497M. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Wire fabric may contain post-consumer or post-industrial recycled content. Provide flat sheets of welded wire fabric for slabs and toppings.

2.5.3.2 Steel Wire

Wire must conform to ASTM A82/A82M.

2.5.4 Reinforcing Bar Supports

Provide bar ties and supports of coated or non corrodible material.

2.5.5 Fiber-Reinforced Concrete

In addition to the requirements specified above, provide fiber reinforced concrete in accordance with ASTM C 1116/C 1116M Type III, synthetic fiber reinforced concrete, and as follows. Synthetic reinforcing fibers must be monofilament polypropylene fibers. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Fibers may contain post-consumer or post-industrial recycled content. Provide fibers that have a specific gravity of 0.9, a minimum tensile strength of 70 ksi, graded per manufacturer, and specifically manufactured to an optimum gradation for use as concrete secondary reinforcement. Use a minimum of 1.5 pounds of fibers per cubic yard of concrete. Add fibers at the batch plant.

2.5.6 Chairs and Bolsters: Steel

See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Plastic and steel may contain post-consumer or post-industrial recycled content.

2.5.7 Dowels for Load Transfer in Floors

Provide dowels for load transfer in floors of the type, design, weight, and dimensions indicated. Provide dowel bars that are plain-billet steel conforming to ASTM A615/A615M, Grade 40. Provide dowel pipe that is steel conforming to ASTM A53/A53M.

2.5.8 Supports for Reinforcement

Supports include bolsters, chairs, spacers, and other devices necessary for proper spacing, supporting, and fastening reinforcing bars and wire fabric in place.

Provide wire bar type supports conforming to ACI/MCP-3, ACI/MCP-4 and CRSI 10MSP.

Legs of supports in contact with formwork must be hot-dip galvanized, or plastic coated after fabrication, or stainless-steel bar supports.

2.6 BONDING MATERIALS

2.6.1 Concrete Bonding Agent

Provide aqueous-phase, film-forming, nonoxidizing, freeze and

thaw-resistant compound agent suitable for brush or spray application conforming to ASTM C 932.

2.6.2 Epoxy-Resin Adhesive Binder

Provide two-component, epoxy-polysulfide polymer type binder with an amine-type curing-agent conforming to FS MMM-A-001993, Type I or ASTM C 881/C 881M.

2.7 FLOOR FINISH MATERIALS

Not Used

2.8 CLASSIFICATION AND QUALITY OF CONCRETE

2.8.1 Concrete Classes and Usage

Provide concrete classes, compressive strength, requirements for air entrainment, and usage as follows:

CONCRETE CLASS	MIN. 28-DAY COMPRESSIVE STRENGTH POUNDS PER SQ. IN.	REQUIREMENT FOR AIR ENTRAINMENT	USAGE
3A	3,000	Air-entrained	For foundation concrete work exposed to freezing and thawing or subjected to hydraulic pressure, such as foundation walls, grade beams, pits, tunnels. For exterior concrete slabs, such as steps, platforms, walks
3N	3,000	Nonair-entrained	For foundation concrete work not exposed to freezing and thawing or subjected to hydraulic pressure, such as footings, pile caps, foundation mats. For interior slabs on ground to be covered with resilient flooring
4A	4,000	Air-entrained	For structural concrete work exposed to freezing and thawing, unless otherwise indicated or specified, such as exterior columns and spandrels
4N	4,000	Nonair-entrained	For structural concrete work not exposed to freezing and thawing such as interior

CONCRETE CLASS	MIN. 28-DAY COMPRESSIVE STRENGTH POUNDS PER SQ. IN.	REQUIREMENT FOR AIR ENTRAINMENT	USAGE
			columns, beams, supported slabs and other structural members for interior slabs on ground subjected to foot traffic
2.5A	2,500	Air-entrained	For concrete not reinforced and not exposed to freezing and thawing
2.5N	2,500	Nonair-entrained	For concrete not reinforced and not exposed to freezing and thawing
5A	5,000	Air-entrained	For structural concrete work as indicated
5N	5,000	Nonair-entrained	For structural concrete work as indicated

2.8.2 Limits for Concrete Proportions

Provide limits for maximum water/cement ratio and minimum cement content for each concrete class as follows:

CONCRETE CLASS	MAX. WATER/CEMENT RATIO BY WEIGHT	MIN. CEMENT FOR 3- TO 4-INCH SLUMP, (NO. OF 94-POUND SACKS) PER CU. YD.
2.5A	0.58	4.75
2.5N	0.62	4.75
3A	0.50	5.25
3N	0.54	5.25
4A	0.46	6.0
4N	0.48	6.0
5A	0.41	6.5
5N	0.44	6.5

* Weight of water to weight of cement in pounds in one cubic yard of concrete

2.8.3 Maximum Size of Aggregate

Size of aggregate, designated by the sieve size on which maximum amount of retained coarse aggregate is 5 to 10 percent by weight, must be as follows:

MAXIMUM SIZE OF AGGREGATE	ASTM C 33/C 33M SIZE NUMBER	TYPE OF CONSTRUCTION
2 inches	357	Nonreinforced footings and other flat work having a depth of not less than 6 inches, and nonreinforced walls and other formed sections having a dimension between forms of not less than 10 inches
1-1/2 inches	467	Monolithic slabs on ground, concrete fill, and other flatwork having a depth of not less than 5 inches and a clear distance between reinforcing bars of not less than 2 inches
3/4 inch	67	Reinforced walls, columns, girders, beams, and other formed sections having a dimension between forms of not less than 6 inches and clear distance between reinforcing bars or reinforcing bar and face of form of not less than 1 inch
3/4 inch	67	Monolithic concrete slabs and other flatwork having a depth of not less than 2-1/2 inches and a clear distance between reinforcing bars of not less than 1 inch
1/2 inch	7	Concrete joist construction, beams, reinforced walls, and other formed work having a clear distance between reinforcing bars and face of form of less than 1 inch
3/8 inch	8	Nonreinforced slabs and other flatwork having a depth of less than 2-1/2 inches

Maximum size of aggregate may be that required for most critical type of construction using that concrete class.

Specify gradation of aggregates for separate floor topping.

2.8.4 Slump

Provide slump for concrete at time and in location of placement as follows:

TYPE OF CONSTRUCTION	SLUMP
Footings, unreinforced walls	Not less than 1 inch nor more than 3 inches
Columns, beams, reinforced walls, monolithic slabs	Not less than 1 inch nor more than 4 inches
Ramps and other sloping surfaces	0 nor more than 3 inches

2.8.5 Total Air Content

Air content of exposed concrete and interior concrete must be in accordance with ASTM C260/C260M and/or as follows:

LIMITS CONCRETE EXPOSURE	REQUIREMENT FOR AIR ENTRAINMENT	MAXIMUM SIZE OF AGGREGATE	TOTAL AIR CONTENT BY VOLUME
Exposed to freezing and thawing or subjected to hydraulic pressure	Air-entrained	1-1/2 or 2 inches	4 to 6 percent
		3/4 inch	5 to 7 percent
		1/2 or 3/8 inch	6 to 8.5 percent

Provide concrete exposed to freezing and thawing or subjected to hydraulic pressure that is air-entrained by addition of approved air-entraining admixture to concrete mix.

PART 3 EXECUTION

3.1 EXAMINATION

Do not begin installation until substrates have been properly constructed; verify that substrates are plumb and true.

If substrate preparation is the responsibility of another installer, notify Architect/Engineer of unsatisfactory preparation before processing.

Check field dimensions before beginning installation. If dimensions vary too much from design dimensions for proper installation, notify Architect/Engineer and wait for instructions before beginning installation.

3.2 PREPARATION

Determine quantity of concrete needed and minimize the production of excess concrete. Designate locations or uses for potential excess concrete before the concrete is poured.

3.2.1 General

Surfaces against which concrete is to be placed must be free of debris, loose material, standing water, snow, ice, and other deleterious substances before start of concrete placing.

Remove standing water without washing over freshly deposited concrete.

Divert flow of water through side drains provided for such purpose.

3.2.2 Subgrade Under Foundations and Footings

When subgrade material is semiporous and dry, sprinkle subgrade surface with water as required to eliminate suction at the time concrete is deposited. When subgrade material is porous, seal subgrade surface by covering surface with specified vapor retarder; this may also be used over semiporous, dry subgrade material instead of water sprinkling.

3.2.3 Subgrade Under Slabs on Ground

Before construction of slabs on ground, have underground work on pipes and conduits completed and approved.

Previously constructed subgrade or fill must be cleaned of foreign materials and inspected by the Contractor for adequate compaction and surface tolerances as specified.

Actual density of top 12 inches of subgrade soil material-in-place must not be less than the following percentages of maximum density of same soil material compacted at optimum moisture content in accordance with ASTM D 1557.

SOIL MATERIAL	PERCENT MAXIMUM DENSITY
Capillary water barrier	100
Cohesionless soil material	100
Cohesive soil material	95

Finish surface of capillary water barrier under interior slabs on ground must not show deviation in excess of 1/4 inch when tested with a 10-foot straightedge parallel with and at right angles to building lines.

Finished surface of subgrade or fill under exterior slabs on ground must not be more than 0.02-foot above or 0.10-foot below elevation indicated.

Prepare subgrade or fill surface under exterior slabs on ground as specified for subgrade under foundations and footings.

3.2.4 Formwork

Complete and approve formwork. Remove debris and foreign material from interior of forms before start of concrete placing.

3.2.5 Edge Forms and Screed Strips for Slabs

Set edge forms or bulkheads and intermediate screed strips for slabs to obtain indicated elevations and contours in finished slab surface and must be strong enough to support vibrating bridge screeds or roller pipe screeds if nature of specified slab finish requires use of such equipment. Align concrete surface to elevation of screed strips by use of strike-off templates or approved compacting-type screeds.

3.2.6 Reinforcement and Other Embedded Items

Secure reinforcement, joint materials, and other embedded materials in

position, inspected, and approved before start of concrete placing.

3.3 FORMS

ACI/MCP-2. Provide forms, shoring, and scaffolding for concrete placement. Set forms mortar-tight and true to line and grade. Chamfer above grade exposed joints, edges, and external corners of concrete 0.75 inch unless otherwise indicated. Provide formwork with clean-out openings to permit inspection and removal of debris. Forms submerged in water must be watertight.

3.3.1 General

Construct forms to conform, within the tolerances specified, to shapes dimensions, lines, elevations, and positions of cast-in-place concrete members as indicated. Forms must be supported, braced, and maintained sufficiently rigid to prevent deformation under load.

3.3.2 Design and Construction of Formwork

Provide formwork design and construction that conforms to ACI/MCP-2, Chapter 4.

Provide forms that are tight to prevent leakage of cement paste during concrete placing.

Support form facing materials by structural members spaced close to prevent deflection of form facing material. Fit forms placed in successive units for continuous surfaces to accurate alignment to ensure a smooth completed surface within the tolerances specified. Where necessary to maintain the tolerances specified, such as long spans where immediate supports are not possible, camber formwork for anticipated deflections in formwork due to weight and pressure of fresh concrete and to construction loads.

Chamfer exposed joints, edges, and external corners a minimum of 3/4 inch by moldings placed in corners of column, beam, and wall forms.

Provide shores and struts with a positive means of adjustment capable of taking up formwork settlement during concrete placing operations. Obtain adjustment with wedges or jacks or a combination thereof. When adequate foundations for shores and struts cannot be secured, provide trussed supports.

Provide temporary openings in wall forms, column forms, and at other points where necessary to permit inspection and to facilitate cleaning.

Provide forms that are readily removable without impact, shock, or damage to concrete.

3.3.3 Coating

Before concrete placement, coat the contact surfaces of forms with a nonstaining mineral oil, nonstaining form coating compound, or two coats of nitrocellulose lacquer. Do not use mineral oil on forms for surfaces to which adhesive, paint, or other finish material is to be applied.

3.3.4 Reshoring

Reshore concrete elements where forms are removed prior to the specified

time period. Do not permit elements to deflect or accept loads during form stripping or reshoring. Forms on columns, walls, or other load-bearing members may be stripped after 2 days if loads are not applied to the members. After forms are removed, reshore slabs and beams over 10 feet in span and cantilevers over 4 feet for the remainder of the specified time period in accordance with paragraph entitled "Removal of Forms." Perform reshoring operations to prevent subjecting concrete members to overloads, eccentric loading, or reverse bending. Provide reshoring elements with the same load-carrying capabilities as original shoring and spaced similar to original shoring. Firmly secure and brace reshoring elements to provide solid bearing and support.

3.3.5 Reuse

Reuse forms providing the structural integrity of concrete and the aesthetics of exposed concrete are not compromised.

3.3.6 Forms for Standard Rough Form Finish

Give rough form finish concrete formed surfaces that are to be concealed by other construction, unless otherwise specified.

Form facing material for standard rough form finish must be the specified concrete form plywood or other approved form facing material that produces concrete surfaces equivalent in smoothness and appearance to that produced by new concrete form plywood panels.

For concrete surfaces exposed only to the ground, undressed, square-edge, 1-inch nominal thickness lumber may be used. Provide horizontal joints that are level and vertical joints that are plumb.

3.3.7 Forms for Standard Smooth Form Finish

Give smooth form finish concrete formed surfaces that are to be exposed to view or that are to be covered with coating material applied directly to concrete or with covering material bonded to concrete, such as waterproofing, dampproofing, painting, or other similar coating system.

Form facing material for standard smooth finish must be the specified overlaid concrete form plywood or other approved form facing material that is nonreactive with concrete and that produce concrete surfaces equivalent in smoothness and appearance to that produced by new overlaid concrete form plywood panels.

Maximum deflection of form facing material between supports and maximum deflection of form supports such as studs and wales must not exceed 0.0025 times the span.

Provide arrangement of form facing sheets that are orderly and symmetrical, and sheets that are in sizes as large as practical.

Arrange panels to make a symmetrical pattern of joints. Horizontal and vertical joints must be solidly backed and butted tight to prevent leakage and fins.

3.3.8 Form Ties

Provide ties that are factory fabricated metal, adjustable in length, removable or snap-off type that do allow form deflection or do not spall

concrete upon removal. Portion of form ties remaining within concrete after removal of exterior parts must be at least 1-1/2 inches back from concrete surface. Provide form ties that are free of devices that leave a hole larger than 7/8 inch or less than 1/2 inch in diameter in concrete surface. Form ties fabricated at the project site or wire ties of any type are not acceptable.

3.3.9 Forms for Concrete Pan Joist Construction

Provide forms that are well-fitting, undamaged, factory-fabricated pan form units for concrete joist construction as indicated.

Form units complete with covers and end closures as required for the installation must be one of the following materials:

Steel, 16-gage, free from irregularities, dents, sag, and rust

Hardboard conforming to FS LLL-B-810, 1/4-inch thick, coated with waterproof plastic

Glass-fiber-reinforced plastic, molded under pressure, with matched dies, 0.11-inch maximum wall thickness

Asphalt-impregnated, corrugated material treated for moisture resistance with factory-applied polyethylene coating, with top and side cover joints taped where concrete is exposed.

Provide tight forms for concrete pan joist construction to prevent cement paste loss during concrete placing and to form a true, clean, smooth surface, free of honeycomb and rough exposed-aggregate areas. Take precautions, including blocking of adjoining pan units, to avoid lateral deflection of formwork during compaction of concrete.

3.3.10 Tolerances for Form Construction

Construct formwork to ensure that after removal of forms and prior to patching and finishing of formed surfaces, provide concrete surfaces in accordance with tolerances specified in ACI/MCP-1 and ACI/MCP-2.

3.3.11 Removal of Forms and Supports

After placing concrete, forms must remain in place for the time periods specified in ACI/MCP-4. Do not remove forms and shores (except those used for slabs on grade and slip forms) until the client determines that the concrete has gained sufficient strength to support its weight and superimposed loads. Base such determination on compliance with one of the following:

a. The plans and specifications stipulate conditions for removal of forms and shores, and such conditions have been followed, or

b. The concrete has been properly tested with an appropriate ASTM standard test method designed to indicate the concrete compressive strength, and the test results indicate that the concrete has gained sufficient strength to support its weight and superimposed loads.

Prevent concrete damage during form removal. Clean all forms immediately after removal.

3.3.11.1 Special Requirements for Reduced Time Period

Forms may be removed earlier than specified if ASTM C 39/C 39M test results of field-cured samples from a representative portion of the structure indicate that the concrete has reached a minimum of 85 percent of the design strength.

3.4 WATERSTOP SPLICES

Fusion weld in the field.

3.5 FORMED SURFACES

3.5.1 Preparation of Form Surfaces

Coat contact surfaces of forms with form-coating compound before reinforcement is placed. Provide a commercial formulation form-coating compound that does not bond with, stain, nor adversely affect concrete surfaces and impair subsequent treatment of concrete surfaces that entails bonding or adhesion nor impede wetting of surfaces to be cured with water or curing compounds. Do not allow excess form-coating compound to stand in puddles in the forms nor to come in contact with concrete against which fresh concrete is placed. Make thinning of form-coating compound with thinning agent of the type, in the amount, and under the conditions recommended by form-coating compound manufacturer's printed or written directions.

3.5.2 Tolerances

ACI/MCP-4 and as indicated.

3.5.3 As-Cast Form

Provide form facing material producing a smooth, hard, uniform texture on the concrete. Arrange facing material in an orderly and symmetrical manner and keep seams to a practical minimum. Support forms as necessary to meet required tolerances. Do not use material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which can impair the texture of the concrete surface.

3.6 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

ACI/MCP-2. Provide bars, wire fabric, wire ties, supports, and other devices necessary to install and secure reinforcement. Reinforcement must not have rust, scale, oil, grease, clay, or foreign substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross-sectional area or the nominal weight per unit length has been reduced. Remove loose rust prior to placing steel. Tack welding is prohibited.

3.6.1 General

Provide details of reinforcement that are in accordance with ACI/MCP-3 and ACI/MCP-4 and as specified.

3.6.2 Vapor Retarder and Vapor Barrier

Provide beneath the on-grade concrete floor slab. Use the greatest widths and lengths practicable to eliminate joints wherever possible. Lap joints

a minimum of 12 inches and tape or cement joints. Remove torn, punctured, or damaged vapor retarder and vapor barrier material and provide with new vapor retarder and vapor barrier prior to placing concrete. Concrete placement must not damage vapor retarder and vapor barrier material. Place a 2 inch layer of clean concrete sand on vapor retarder and vapor barrier before placing concrete.

3.6.3 Reinforcement Supports

Place reinforcement and secure with galvanized or non corrodible chairs, spacers, or metal hangers. For supporting reinforcement on the ground, use concrete or other non corrodible material, having a compressive strength equal to or greater than the concrete being placed.

3.6.4 Epoxy Coated Reinforcing

Not Used.

3.6.5 Splicing

As indicated. For splices not indicated ACI/MCP-2. Do not splice at points of maximum stress. Overlap welded wire fabric the spacing of the cross wires, plus 2 inches.

3.6.6 Future Bonding

Plug exposed, threaded, mechanical reinforcement bar connectors with a greased bolt. Provide bolt threads that match the connector. Countersink the connector in the concrete. Calk the depression after the bolt is installed.

3.6.7 Cover

ACI/MCP-2 for minimum coverage, unless otherwise indicated.

3.6.8 Setting Miscellaneous Material

Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.

3.6.9 Construction Joints

Locate joints to least impair strength. Continue reinforcement across joints unless otherwise indicated.

3.6.10 Expansion Joints and Contraction Joints

Provide expansion joint at edges of interior floor slabs on grade abutting vertical surfaces, and as indicated. Make expansion joints 1/2 inch wide unless indicated otherwise. Fill expansion joints not exposed to weather with preformed joint filler material. Completely fill joints exposed to weather with joint filler material and joint sealant. Do not extend reinforcement or other embedded metal items bonded to the concrete through any expansion joint unless an expansion sleeve is used. Provide contraction joints, either formed or saw cut or cut with a jointing tool, to the indicated depth after the surface has been finished. Complete saw joints within 4 to 12 hours after concrete placement. Protect joints from

intrusion of foreign matter.

3.6.11 Fabrication

Shop fabricate reinforcing bars to conform to shapes and dimensions indicated for reinforcement, and as follows:

Provide fabrication tolerances that are in accordance with ACI/MCP-1, ACI/MCP-2 and ACI/MCP-3.

Provide hooks and bends that are in accordance with ACI/MCP-3 and ACI/MCP-4.

Reinforcement must be bent cold to shapes as indicated. Bending must be done in the shop. Rebending of a reinforcing bar that has been bent incorrectly is not be permitted. Bending must be in accordance with standard approved practice and by approved machine methods.

Tolerance on nominally square-cut, reinforcing bar ends must be in accordance with ACI/MCP-3.

Deliver reinforcing bars bundled, tagged, and marked. Tags must be metal with bar size, length, mark, and other information pressed in by machine. Marks must correspond with those used on the placing drawings.

Do not use reinforcement that has any of the following defects:

a. Bar lengths, depths, and bends beyond specified fabrication tolerances

b. Bends or kinks not indicated on drawings or approved shop drawings

c. Bars with reduced cross-section due to rusting or other cause

Replace defective reinforcement with new reinforcement having required shape, form, and cross-section area.

3.6.12 Placing Reinforcement

Place reinforcement in accordance with ACI/MCP-3 and ACI/MCP-4.

For slabs on grade (over earth or over capillary water barrier) and for footing reinforcement, support bars or welded wire fabric on precast concrete blocks, spaced at intervals required by size of reinforcement, to keep reinforcement the minimum height specified above the underside of slab or footing.

For slabs other than on grade, supports for which any portion is less than 1 inch from concrete surfaces that are exposed to view or to be painted must be of precast concrete units, plastic-coated steel, or stainless steel protected bar supports. Precast concrete units must be wedge shaped, not larger than 3-1/2 by 3-1/2 inches, and of thickness equal to that indicated for concrete protection of reinforcement. Provide precast units that have cast-in galvanized tie wire hooked for anchorage and blend with concrete surfaces after finishing is completed.

Contractor must cooperate with other trades in setting of anchor bolts, inserts, and other embedded items. Where conflicts occur between locating reinforcing and embedded items, the Contractor must notify the Contracting

Officer so that conflicts may be reconciled before placing concrete. Anchors and embedded items must be positioned and supported with appropriate accessories.

Handle epoxy-coated reinforcing bars carefully to prevent damage to the coating. Use plastic-coated tie wire and supports of a type to prevent damage to the reinforcing bars.

Provide reinforcement that is supported and secured together to prevent displacement by construction loads or by placing of wet concrete, and as follows:

Provide supports for reinforcing bars that are sufficient in number and sufficiently heavy to carry the reinforcement they support, and in accordance with ACI/MCP-3, ACI/MCP-4 and CRSI 10MSP. Do not use supports to support runways for concrete conveying equipment and similar construction loads.

Equip supports on ground and similar surfaces with sand-plates.

Support welded wire fabric as required for reinforcing bars.

Secure reinforcements to supports by means of tie wire. Wire must be black, soft iron wire, not less than 16 gage.

With the exception of temperature reinforcement, tied to main steel approximately 24 inches on center, reinforcement must be accurately placed, securely tied at intersections with 18-gage annealed wire, and held in position during placing of concrete by spacers, chairs, or other approved supports. Point wire-tie ends away from the form. Unless otherwise indicated, numbers, type, and spacing of supports must conform to ACI/MCP-3.

Bending of reinforcing bars partially embedded in concrete is permitted only as specified in ACI/MCP-3 and ACI/MCP-4.

3.6.13 Spacing of Reinforcing Bars

Spacing must be as indicated. If not indicated, spacing must be in accordance with the ACI/MCP-3 and ACI/MCP-4.

Reinforcing bars may be relocated to avoid interference with other reinforcement, or with conduit, pipe, or other embedded items. If any reinforcing bar is moved a distance exceeding one bar diameter or specified placing tolerance, resulting rearrangement of reinforcement is subject to approval.

3.6.14 Concrete Protection for Reinforcement

Concrete protection must be in accordance with the ACI/MCP-3 and ACI/MCP-4.

3.6.15 Welding

Welding must be in accordance with AWS D1.4/D1.4M.

3.7 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

ASTM C 94/C 94M, and ACI/MCP-2, except as modified herein. Batching equipment must be such that the concrete ingredients are consistently

measured within the following tolerances: 1 percent for cement and water, 2 percent for aggregate, and 3 percent for admixtures. Furnish mandatory batch ticket information for each load of ready mix concrete.

3.7.1 Measuring

Make measurements at intervals as specified in paragraphs entitled "Sampling" and "Testing."

3.7.2 Mixing

ASTM C 94/C 94M and ACI/MCP-2. Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 84 degrees F. Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 84 degrees F except as follows: if set retarding admixture is used and slump requirements can be met, limit for placing concrete may remain at 90 minutes. Additional water may be added, provided that both the specified maximum slump and water-cement ratio are not exceeded. When additional water is added, an additional 30 revolutions of the mixer at mixing speed is required. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch.

3.7.3 Transporting

Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete which has segregated in transporting and dispose of as directed.

3.8 PLACING CONCRETE

Place concrete as soon as practicable after the forms and the reinforcement have been inspected and approved. Do not place concrete when weather conditions prevent proper placement and consolidation; in uncovered areas during periods of precipitation; or in standing water. Prior to placing concrete, remove dirt, construction debris, water, snow, and ice from within the forms. Deposit concrete as close as practicable to the final position in the forms. Do not exceed a free vertical drop of 3 feet from the point of discharge. Place concrete in one continuous operation from one end of the structure towards the other. Position grade stakes on 10 foot centers maximum in each direction when pouring interior slabs and on 20 foot centers maximum for exterior slabs.

3.8.1 General Placing Requirements

Deposit concrete continuously or in layers of such thickness that no concrete is placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as specified. Perform concrete placing at such a rate that concrete which is being integrated with fresh concrete is still plastic. Deposit concrete as nearly as practical in its final position to avoid segregation due to rehandling or flowing. Do not subject concrete to procedures which cause segregation.

Concrete to receive other construction must be screeded to proper level to avoid excessive skimming or grouting.

Do not use concrete which becomes nonplastic and unworkable or does not meet quality control limits as specified or has been contaminated by foreign materials. Use of retempered concrete is permitted. Remove rejected concrete from the site.

3.8.2 Footing Placement

Concrete for footings may be placed in excavations without forms upon inspection and approval by the Contracting Officer. Excavation width must be a minimum of 4 inches greater than indicated.

3.8.3 Vibration

ACI/MCP-2 and ASTM A934/A934M. Furnish a spare, working, vibrator on the job site whenever concrete is placed. Consolidate concrete slabs greater than 4 inches in depth with high frequency mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs 4 inches or less in depth by wood tampers, spading, and settling with a heavy leveling straightedge. Operate internal vibrators with vibratory element submerged in the concrete, with a minimum frequency of not less than 6000 impulses per minute when submerged. Do not use vibrators to transport the concrete in the forms. Insert and withdraw vibrators approximately 20 inches apart. Penetrate the previously placed lift with the vibrator when more than one lift is required. Place concrete in 20 inch maximum vertical lifts. Use external vibrators on the exterior surface of the forms when internal vibrators do not provide adequate consolidation of the concrete.

3.8.4 Application of Epoxy Bonding Compound

Not Used

3.8.5 Pumping

ACI/MCP-2. Pumping must not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between successive increments. Loss of slump in pumping equipment must not exceed 2 inches. Do not convey concrete through pipe made of aluminum or aluminum alloy. Avoid rapid changes in pipe sizes. Limit maximum size of course aggregate to 33 percent of the diameter of the pipe. Limit maximum size of well rounded aggregate to 40 percent of the pipe diameter. Take samples for testing at both the point of delivery to the pump and at the discharge end.

3.8.5.1 Pumping Lightweight Concrete

Not Used

3.8.6 Cold Weather

ACI/MCP-2. Do not allow concrete temperature to decrease below 50 degrees F Obtain approval prior to placing concrete when the ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours. Cover concrete and provide sufficient heat to maintain 50 degrees F minimum adjacent to both the formwork and the structure while curing. Limit the rate of cooling to 37 degrees F in any 1

hour and 50 degrees F per 24 hours after heat application.

3.8.7 Hot Weather

Maintain required concrete temperature using Figure 2.1.5 in ACI/MCP-2 to prevent the evaporation rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

3.8.8 Follow-up

Check concrete within 24 hours of placement for flatness, levelness, and other specified tolerances. Adjust formwork and placement techniques on subsequent pours to achieve specified tolerances.

3.8.9 Placing Concrete in Forms

Deposit concrete placed in forms in horizontal layers not exceeding 24 inches.

Remove temporary spreaders in forms when concrete placing has reached elevation of spreaders.

Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Design vibrators to operate with vibratory element submerged in concrete and maintain a speed of not less than 9,000 impulses per minute when submerged in concrete. Provide vibrating equipment adequate in number of units and power of each unit to properly consolidate concrete. Vibration of forms and reinforcement is not be permitted. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced points not farther apart than visible effectiveness of machine. Do not insert vibrator into lower courses of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of concrete mix.

Do not start placing of concrete in supporting elements until concrete previously placed in columns and walls is no longer plastic and has been in place a minimum of 2 hours.

3.8.10 Placing Concrete Slabs

Place and consolidate concrete for slabs in a continuous operation, within the limits of approved construction joints until placing of panel or section is completed.

During concrete placing operations, consolidate concrete by mechanical vibrating equipment so that concrete is worked around reinforcement and

other embedded items and into corners. Consolidate concrete placed in beams and girders of supported slabs and against bulkheads of slabs on ground by mechanical vibrators as specified. Consolidate concrete in remainder of slabs by vibrating bridge screeds, roller pipe screeds, or other approved method. Limit consolidation operations to time necessary to obtain consolidation of concrete without bringing an excess of fine aggregate to the surface. Concrete to be consolidated must be as dry as practical and surfaces thereof must not be manipulated prior to finishing operations. Bring concrete correct level with a straightedge and struck-off. Use bull floats or darbies to smooth surface, leaving it free of humps or hollows. Sprinkling of water on plastic surface is not permitted.

Provide finish of slabs as specified.

3.8.11 Bonding

Surfaces of set concrete at joints, except where bonding is obtained by use of concrete bonding agent, must be roughened and cleaned of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner that exposes the aggregate uniformly and does not leave laitance, loosened particles of aggregate, nor damaged concrete at the surface.

Obtain bonding of fresh concrete that has set as follows:

At joints between footings and walls or columns, between walls or columns and the beams or slabs they support, and elsewhere unless otherwise specified; roughened and cleaned surface of set concrete must be dampened, but not saturated, immediately prior to placing of fresh concrete.

At joints in exposed-to-view work; at vertical joints in walls; at joints near midpoint of span in girders, beams, supported slabs, other structural members; in work designed to contain liquids; the roughened and cleaned surface of set concrete must be dampened but not saturated and covered with a cement grout coating.

Provide cement grout that consists of equal parts of portland cement and fine aggregate by weight with not more than 6 gallons of water per sack of cement. Apply cement grout with a stiff broom or brush to a minimum thickness of 1/16 inch. Deposit fresh concrete before cement grout has attained its initial set.

Bonding of fresh concrete to concrete that has set may be obtained by use of a concrete bonding agent. Apply such bonding material to cleaned concrete surface in accordance with approved printed instructions of bonding material manufacturer.

3.9 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES

3.9.1 Defects

Repair formed surfaces by removing minor honeycombs, pits greater than 1 square inch surface area or 0.25 inch maximum depth, or otherwise defective areas. Provide edges perpendicular to the surface and patch with nonshrink grout. Patch tie holes and defects when the forms are removed. Concrete with extensive honeycomb including exposed steel reinforcement, cold joints, entrapped debris, separated aggregate, or other defects which affect the serviceability or structural strength will be rejected, unless

correction of defects is approved. Obtain approval of corrective action prior to repair. The surface of the concrete must not vary more than the allowable tolerances of ACI/MCP-4. Exposed surfaces must be uniform in appearance and finished to a smooth form finish unless otherwise specified.

3.9.2 Not Against Forms (Top of Walls)

Surfaces not otherwise specified must be finished with wood floats to even surfaces. Finish must match adjacent finishes.

3.9.3 Formed Surfaces

3.9.3.1 Tolerances

ACI/MCP-1 and as indicated.

3.9.3.2 As-Cast Rough Form

Provide for surfaces not exposed to public view. Patch these holes and defects and level abrupt irregularities. Remove or rub off fins and other projections exceeding 0.25 inch in height.

3.9.3.3 Standard Smooth Finish

Finish must be as-cast concrete surface as obtained with form facing material for standard smooth finish. Repair and patch defective areas as specified; and all fins and remove other projections on surface.

3.9.4 Finish

Not Used

3.9.5 Surface Finish Samples

Provide a minimum of three sample concrete panels for each finish for each mix design, 3 by 3 feet, 3 inches thick. Use the approved concrete mix design(s). Provide sample panels on-site at locations directed. Once approved, each set of panels must be representative of each of the finishes specified and of the workmanship and finish(es) required. Do not remove or destroy samples until directed by the Contracting Officer.

3.9.6 Grout Finish

Provide finish that is standard, smooth coated with grout as specified.

Give finish to interior and exterior concrete vertical surfaces that are to be exposed to view.

Grout is required consisting of one part portland cement to 1-1/2 parts fine aggregate by volume, mixed with water to produce a consistency of thick paint. Portland cement portion must be a blend of standard portland cement and white portland cement, proportioned as determined by trial mixes so that final color of grout when dry approximates color of surrounding concrete. Fine aggregate must pass No. 30 mesh sieve.

Surface of concrete is required to be wetted, and grout must be applied immediately to wetted surfaces. Spread grout over surface with clean burlap pads or sponge-rubber floats to fill pits, air bubbles, and surface holes. Remove excess grout by scraping, then rubbing surface with clean

burlap to remove visible grout film. Keep grout damp by means of fog spray during setting period. Complete finish the day it is started, and make limits of a finished area at natural breaks in finished surface.

3.10 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

ACI/MCP-2, unless otherwise specified. Slope floors uniformly to drains where drains are provided.

3.10.1 Finish

Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

3.10.1.1 Scratched

Use for surfaces intended to receive bonded applied cementitious applications. After the concrete has been placed, consolidated, struck off, and leveled to a Class C tolerance as defined below,roughen the surface with stiff brushes of rakes before final set.

3.10.1.2 Floated

Use for exterior slabs where not otherwise specified. After the concrete has been placed, consolidated, struck off, and leveled, do not work the concrete further, until ready for floating. Whether floating with a wood, magnesium, or composite hand float, with a bladed power trowel equipped with float shoes, or with a powered disc, float must begin when the surface has stiffened sufficiently to permit the operation. During or after the first floating, check surface with a 10 foot straightedge applied at no less than two different angles, one of which is perpendicular to the direction of strike off. Cut down high spots and fill low spots during this procedure to produce a surface level within 1/4 inch in 10 feet.

3.10.1.3 Concrete Containing Silica Fume

Not Used

3.10.1.4 Steel Troweled

Use for floors intended as walking surfaces. First, provide a floated finish. Next, the finish must be power troweled two times, and finally hand troweled. The first troweling after floating needs to produce a smooth surface which is relatively free of defects but which may still show some trowel marks. Perform additional trowelings done by hand after the surface has hardened sufficiently. The final troweling is done when a ringing sound is produced as the trowel is moved over the surface. Thoroughly consolidate the surface by the hand troweling operations. The finished surface must be essentially free of trowel marks and uniform in texture and appearance. The finished surface must produce a surface level to within 1/4 inch in 10 feet. On surfaces intended to support floor coverings, remove any defects of sufficient magnitude to show through the floor covering by grinding.

3.10.1.5 Nonslip Finish

Not Used

3.10.1.6 Broomed

Use on surfaces of exterior walks, platforms, patios, and ramps, unless otherwise indicated. Perform a floated finish, then draw a broom or burlap belt across the surface to produce a coarse scored texture. Permit surface to harden sufficiently to retain the scoring or ridges. Broom transverse to traffic or at right angles to the slope of the slab.

3.10.1.7 Pavement

Screed the concrete with a template advanced with a combined longitudinal and crosswise motion. Maintain a slight surplus of concrete ahead of the template. After screeding, float the concrete longitudinally. Use a straightedge to check slope and flatness; correct and refloat as necessary. Obtain final finish by a burlap drag. Drag a strip of clean, wet burlap from 3 to 10 feet wide and 2 feet longer than the pavement width across the slab. Produce a fine, granular, sandy textured surface without disfiguring marks. Round edges and joints with an edger having a radius of 1/8 inch.

3.10.1.8 Concrete Toppings Placement

Not Used

3.10.1.9 Chemical-Hardener Treatment

Not Used

3.10.1.10 Colored Wear-Resistant Finish

Not Used

3.10.1.11 Heavy-Duty Wear-Resistant Finish

Not Used

3.10.2 Flat Floor Finishes

ACI/MCP-2. Construct in accordance with one of the methods recommended in Table 7.15.3, "Typical Composite Ff/FL Values for Various Construction Methods." ACI/MCP-1 for tolerance tested by ASTM E 1155.

a. Specified Conventional Value:

Floor Flatness (Ff) 20 minimum
Floor Levelness (FL) 15 minimum

b. Specified Industrial:

Floor Flatness (Ff) 30 minimum
Floor Levelness (FL) 20 minimum

3.10.2.1 Measurement of Floor Tolerances

Test slab within 24 hours of the final troweling. Provide tests to

Contracting Officer within 12 hours after collecting the data. Floor flatness inspector is required to provide a tolerance report which must include:

a. Key plan showing location of data collected.

b. Results required by ASTM E 1155.

3.10.2.2 Remedies for Out of Tolerance Work

Contractor is required to repair and retest any floors not meeting specified tolerances. Prior to repair, Contractor must submit and receive approval for the proposed repair, including product data from any materials proposed. Repairs must not result in damage to structural integrity of the floor. For floors exposed to public view, repairs must prevent any uneven or unusual coloring of the surface.

]3.10.3 Concrete Walks

Provide 4 inches thick minimum. Provide contraction joints spaced every 5 linear feet unless otherwise indicated. Cut contraction joints one inch deep with a jointing tool after the surface has been finished. Provide 0.5 inch thick transverse expansion joints at changes in direction where sidewalk abuts curb, steps, rigid pavement, or other similar structures; space expansion joints every 50 feet maximum. Give walks a broomed finish. Unless indicated otherwise, provide a transverse slope of 1/48. Limit variation in cross section to 1/4 inch in 5 feet.

3.10.4 Pits and Trenches

Place bottoms and walls monolithically or provide waterstops and keys.

3.10.5 Curbs and Gutters

Provide contraction joints spaced every 10 feet maximum unless otherwise indicated. Cut contraction joints 3/4 inch deep with a jointing tool after the surface has been finished. Provide expansion joints 1/2 inch thick and spaced every 100 feet maximum unless otherwise indicated. Perform pavement finish.

3.10.6 Splash Blocks

Provide at outlets of downspouts emptying at grade. Splash blocks may be precast concrete, and must be 24 inches long, 12 inches wide and 4 inches thick, unless otherwise indicated, with smooth-finished countersunk dishes sloped to drain away from the building.

3.11 CURING AND PROTECTION

ACI/MCP-2 unless otherwise specified. Begin curing immediately following form removal. Avoid damage to concrete from vibration created by blasting, pile driving, movement of equipment in the vicinity, disturbance of formwork or protruding reinforcement, and any other activity resulting in ground vibrations. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. Do not use membrane-forming compound on surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete

to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Provide moist curing for those areas receiving liquid chemical sealer-hardener or epoxy coating. Allow curing compound/sealer installations to cure prior to the installation of materials that adsorb VOCs.

3.11.1 General

Protect freshly placed concrete from premature drying and cold or hot temperature and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of cement and proper hardening of concrete.

Start initial curing as soon as free water has disappeared from surface of concrete after placing and finishing. Keep concrete moist for minimum 72 hours.

Final curing must immediately follow initial curing and before concrete has dried. Continue final curing until cumulative number of hours or fraction thereof (not necessarily consecutive) during which temperature of air in contact with the concrete is above 50 degrees F has totaled 168 hours. Alternatively, if tests are made of cylinders kept adjacent to the structure and cured by the same methods, final curing may be terminated when the average compressive strength has reached 70 percent of the 28-day design compressive strength. Prevent rapid drying at end of final curing period.

3.11.2 Moist Curing

Remove water without erosion or damage to the structure. Prevent water run-off.

3.11.2.1 Ponding or Immersion

Continually immerse the concrete throughout the curing period. Water must not be more than 50 degrees F less than the temperature of the concrete. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.

3.11.2.2 Fog Spraying or Sprinkling

Apply water uniformly and continuously throughout the curing period. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.

3.11.2.3 Pervious Sheeting

Completely cover surface and edges of the concrete with two thicknesses of wet sheeting. Overlap sheeting 6 inches over adjacent sheeting. Provide sheeting that is at least as long as the width of the surface to be cured. During application, do not drag the sheeting over the finished concrete nor over sheeting already placed. Wet sheeting thoroughly and keep continuously wet throughout the curing period.

3.11.2.4 Impervious Sheeting

Wet the entire exposed surface of the concrete thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period.

Lay sheeting directly on the concrete surface and overlap edges 12 inches minimum. Provide sheeting not less than 18 inches wider than the concrete surface to be cured. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting. Cover or wrap columns, walls, and other vertical structural elements from the top down with impervious sheeting; overlap and continuously tape sheeting joints; and introduce sufficient water to soak the entire surface prior to completely enclosing.

3.11.3 Liquid Membrane-Forming Curing Compound

Seal or cover joint openings prior to application of curing compound. Prevent curing compound from entering the joint. Apply in accordance with the recommendations of the manufacturer immediately after any water sheen which may develop after finishing has disappeared from the concrete surface. Provide and maintain compound on the concrete surface throughout the curing period. Do not use this method of curing where the use of Figure 2.1.5 in ACI/MCP-2 indicates that hot weather conditions cause an evaporation rate exceeding 0.2 pound of water per square foot per hour.

3.11.3.1 Application

Unless the manufacturer recommends otherwise, apply compound immediately after the surface loses its water sheen and has a dull appearance, and before joints are sawed. Mechanically agitate curing compound thoroughly during use. Use approved power-spraying equipment to uniformly apply two coats of compound in a continuous operation. The total coverage for the two coats must be 200 square feet maximum per gallon of undiluted compound unless otherwise recommended by the manufacturer's written instructions. The compound must form a uniform, continuous, coherent film that does not check, crack, or peel. Immediately apply an additional coat of compound to areas where the film is defective. Re-spray concrete surfaces subjected to rainfall within 3 hours after the curing compound application.

3.11.3.2 Protection of Treated Surfaces

Prohibit pedestrian and vehicular traffic and other sources of abrasion at least 72 hours after compound application. Maintain continuity of the coating for the entire curing period and immediately repair any damage.

3.11.4 Liquid Chemical Sealer-Hardener

Apply sealer-hardener to interior floors not receiving floor covering and floors located under access flooring. Apply the sealer-hardener in accordance with manufacturer's recommendations. Seal or cover joints and openings in which joint sealant is to be applied as required by the joint sealant manufacturer. Do not apply the sealer hardener until the concrete has been moist cured and has aged for a minimum of 30 days. Apply a minimum of two coats of sealer-hardener.

3.11.5 Requirements for Type III, High-Early-Strength Portland Cement

The curing periods are required to be not less than one-fourth of those specified for portland cement, but in no case less than 72 hours.

3.11.6 Curing Periods

ACI/MCP-2 except 10 days for retaining walls, pavement or chimneys, 21 days for concrete that is in full-time or intermittent contact with seawater,

salt spray, alkali soil or waters. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing are subject to approval by the Contracting Officer.

3.11.7 Curing Methods

Accomplish curing by moist curing, by moisture-retaining cover curing, by membrane curing, and by combinations thereof, as specified.

Moist curing:

Accomplish moisture curing by any of the following methods:

Keeping surface of concrete wet by covering with water

Continuous water spraying

Covering concrete surface with specified absorptive cover for curing concrete saturated with water and keeping absorptive cover wet by water spraying or intermittent hosing. Place absorptive cover to provide coverage of concrete surfaces and edges with a slight overlap over adjacent absorptive covers.

Moisture-cover curing:

Accomplish moisture-retaining cover curing by covering concrete surfaces with specified moisture-retaining cover for curing concrete. Place cover directly on concrete in widest practical width, with sides and ends lapped at least 3 inches. Weight cover to prevent displacement; immediately repair tears or holes appearing during curing period by patching with pressure-sensitive, waterproof tape or other approved method.

Membrane curing:

Accomplish membrane curing by applying specified membrane-forming curing compound to damp concrete surfaces as soon as moisture film has disappeared. Apply curing compound uniformly in a two-coat operation by power-spraying equipment using a spray nozzle equipped with a wind guard. Apply second coat in a direction at right angles to direction of first coat. Total coverage for two coats must be not more than 200 square feet per gallon of curing compound. Respray concrete surfaces which are subjected to heavy rainfall within 3 hours after curing compound has been applied by method and at rate specified. Maintain continuity of coating for entire curing period and immediately repair damage to coating during this period.

Membrane-curing compounds must not be used on surfaces that are to be covered with coating material applied directly to concrete or with a covering material bonded to concrete, such as other concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, painting, and other coatings and finish materials.

3.11.8 Curing Formed Surfaces

Accomplish curing of formed surfaces, including undersurfaces of girders,

beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed before end of curing period, accomplish final curing of formed surfaces by any of the curing methods specified above, as applicable.

3.11.9 Curing Unformed Surfaces

Accomplish initial curing of unformed surfaces, such as monolithic slabs, floor topping, and other flat surfaces, by membrane curing.

Unless otherwise specified, accomplish final curing of unformed surfaces by any of curing methods specified above, as applicable.

Accomplish final curing of concrete surfaces to receive liquid floor hardener of finish flooring by moisture-retaining cover curing.

3.11.10 Temperature of Concrete During Curing

When temperature of atmosphere is 41 degrees F and below, maintain temperature of concrete at not less than 55 degrees F throughout concrete curing period or 45 degrees F when the curing period is measured by maturity. When necessary, make arrangements before start of concrete placing for heating, covering, insulation, or housing as required to maintain specified temperature and moisture conditions for concrete during curing period.

When the temperature of atmosphere is 80 degrees F and above or during other climatic conditions which cause too rapid drying of concrete, make arrangements before start of concrete placing for installation of wind breaks, of shading, and for fog spraying, wet sprinkling, or moisture-retaining covering of light color as required to protect concrete during curing period.

Changes in temperature of concrete must be uniform and not exceed 37 degrees F in any 1 hour nor 80 degrees F in any 24-hour period.

3.11.11 Protection from Mechanical Injury

During curing period, protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration and from damage caused by rain or running water.

3.11.12 Protection After Curing

Protect finished concrete surfaces from damage by construction operations.

3.12 FIELD QUALITY CONTROL

3.12.1 Sampling

ASTM C172/C172M. Collect samples of fresh concrete to perform tests specified. ASTM C 31/C 31M for making test specimens.

3.12.2 Testing

3.12.2.1 Slump Tests

ASTM C 143/C 143M. Take concrete samples during concrete placement. The maximum slump may be increased as specified with the addition of an

approved admixture provided that the water-cement ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 20 cubic yards (maximum) of concrete.

3.12.2.2 Temperature Tests

Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 50 degrees F and above 80 degrees F) for each batch (minimum) or every 20 cubic yards (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

3.12.2.3 Compressive Strength Tests

ASTM C 39/C 39M. Make five test cylinders for each set of tests in accordance with ASTM C 31/C 31M. Take precautions to prevent evaporation and loss of water from the specimen. Test two cylinders at 7 days, two cylinders at 28 days, and hold one cylinder in reserve. Take samples for strength tests of each mix design for concrete placed each day not less than once a day, nor less than once for each 160 cubic yards of concrete, nor less than once for each 5400 square feet of surface area for slabs or walls. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result must be the average of two cylinders from the same concrete sample tested at 28 days. If the average of any three consecutive strength test results is less than f'c or if any strength test result falls below f'c by more than 450 psi, take a minimum of three ASTM C 42/C 42M core samples from the in-place work represented by the low test cylinder results and test. Concrete represented by core test is considered structurally adequate if the average of three cores is equal to at least 85 percent of f'c and if no single core is less than 75 percent of f'c. Retest locations represented by erratic core strengths. Remove concrete not meeting strength criteria and provide new acceptable concrete. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete.

3.12.2.4 Air Content

ASTM C 173/C 173M or ASTM C231/C231M for normal weight concrete. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

3.12.2.5 Unit Weight of Structural Lightweight Concrete

Not Used

3.12.2.6 Ion Concentration

ACI/MCP-3. Determine water soluble ion concentration. Perform test once for each mix design.

3.12.2.7 Strength of Concrete Structure

Compliance with the following is considered deficient if it fails to meet the requirements which control strength of structure in place, including following conditions:

Failure to meet compressive strength tests as evaluated

Reinforcement not conforming to requirements specified

Concrete which differs from required dimensions or location in such a manner as to reduce strength

Concrete curing and protection of concrete against extremes of temperature during curing, not conforming to requirements specified

Concrete subjected to damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration

Poor workmanship likely to result in deficient strength

3.12.2.8 Testing Concrete Structure for Strength

When there is evidence that strength of concrete structure in place does not meet specification requirements, make cores drilled from hardened concrete for compressive strength determination in accordance with ASTM C 42/C 42M, and as follows:

Take at least three representative cores from each member or area of concrete-in-place that is considered potentially deficient. Location of cores will be determined by the Contracting Officer.

Test cores after moisture conditioning in accordance with ASTM C 42/C 42M if concrete they represent is more than superficially wet under service.

Air dry cores, (60 to 80 degrees F with relative humidity less than 60 percent) for 7 days before test and test dry if concrete they represent is dry under service conditions.

Strength of cores from each member or area are considered satisfactory if their average is equal to or greater than 85 percent of the 28-day design compressive strength of the class of concrete.

Core specimens will be taken and tested by the Government. If the results of core-boring tests indicate that the concrete as placed does not conform to the drawings and specification, the cost of such tests and restoration required must be borne by the Contractor.

Fill core holes solid with patching mortar and finished to match adjacent concrete surfaces.

Correct concrete work that is found inadequate by core tests in a manner approved by the Contracting Officer.

3.13 WASTE MANAGEMENT

As specified in the Waste Management Plan and as follows.

3.13.1 Mixing Equipment

Before concrete pours, designate on-site area to be paved later in project for cleaning out concrete mixing trucks. Minimize water used to wash equipment.

3.13.2 Hardened, Cured Waste Concrete

Crush and reuse hardened, cured waste concrete as fill or as a base course for pavement.

3.13.3 Reinforcing Steel

Collect reinforcing steel and place in designated area for recycling.

3.13.4 Other Waste

Identify concrete manufacturer's or supplier's policy for collection or return of construction waste, unused material, deconstruction waste, and/or packaging material. Return excess cement to supplier. Institute deconstruction and construction waste separation and recycling for use in manufacturer's programs. When such a program is not available, seek local recyclers to reclaim the materials.

3.14 JOINTS

3.14.1 Construction Joints

Make and locate joints not indicated so as not to impair strength and appearance of the structure, as approved. Locate construction joints as follows:

a. In walls at not more than 60 feet in any horizontal direction; at top of footing; at top of slabs on ground; at top and bottom of door and window openings or where required to conform to architectural details; and at underside of deepest beam or girder framing into wall

b. In columns or piers, at top of footing; at top of slabs on ground; and at underside of deepest beam or girder framing into column or pier

c. Near midpoint of spans for supported slabs, beams, and girders unless a beam intersects a girder at the center, in which case construction joints in girder must offset a distance equal to twice the width of the beam. Make transfer of shear through construction joint by use of inclined reinforcement.

d. In slabs on ground, so as to divide slab into areas not in excess of 1,200 square feet

Provide keyways at least 1-1/2-inches deep in construction joints in walls and slabs and between walls and footings; approved bulkheads may be used for slabs.

Joints must be perpendicular to main reinforcement. Reinforcement must be continued across construction joints.

3.14.2 Waterstops

Provide waterstops in construction joints as indicated.

Install waterstops to form a continuous diaphragm in each joint. Make adequate provisions to support and protect waterstops during progress of work. Make field joints in waterstops in accordance with waterstop manufacturer's printed instructions, as approved. Protect waterstops protruding from joints from damage.

3.14.3 Isolation Joints in Slabs on Ground

Provide joints at points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

Fill joints with premolded joint filler strips 1/2 inch thick, extending full slab depth. Install filler strips at proper level below finish floor elevation with a slightly tapered, dress-and-oiled wood strip temporarily secured to top of filler strip to form a groove not less than 3/4 inch in depth where joint is sealed with sealing compound and not less than 1/4 inch in depth where joint sealing is not required. Remove wood strip after concrete has set. Contractor must clean groove of foreign matter and loose particles after surface has dried.

3.14.4 Control Joints in Slabs on Ground

Provide joints to form panels as indicated.

Under and on exact line of each control joint, cut 50 percent of welded wire fabric reinforcement before placing concrete.

Joints must be 1/8-inch wide by 1/5 to 1/4 of slab depth and formed by inserting hand-pressed fiberboard strip into fresh concrete until top surface of strip is flush with slab surface or by cutting the concrete with a saw after the concrete has set. After concrete has cured for at least 7 days, the Contractor must remove inserts and clean groove of foreign matter and loose particles.

3.14.5 Sealing Joints in Slabs on Ground

Isolation and control joints which are to receive finish flooring material must be sealed with joint sealing compound after concrete curing period. Slightly underfill groove with joint sealing compound to prevent extrusion of compound. Remove excess material as soon after sealing as possible.

Sealing is not required for isolation and control joints to be covered with finish flooring material. Groove must be left ready to receive filling material that is provided as part of finish floor covering work.

3.15 INSTALLATION OF ANCHORAGE DEVICES

3.15.1 General

Anchorage devices and embedded items required for other work that is attached to, or supported by, set and build in cast-in-place concrete as part of the work of this section, using setting drawings, instructions, and directions for work to be attached thereto.

3.15.2 Placing Anchorage Devices

Anchorage devices and embedded items must be positioned accurately and supported against displacement. Fill openings in anchorage devices such as slots and threaded holes with an approved, removable material to prevent entry of concrete into openings.

3.16 CONCRETE CONVEYING

3.16.1 Transfer of Concrete At Project Site

Handle concrete from point of delivery and transfer to concrete conveying equipment and to locations of final deposit as rapidly as practical by methods which prevent segregation and loss of concrete mix materials.

3.16.2 Mechanical Equipment for Conveying Concrete

Equipment must ensure a continuous flow of concrete at delivery end, as approved. Provide runways for wheeled concrete-conveying equipment from concrete delivery point to locations of final deposit. Interior surfaces of concrete conveying equipment must be free of hardened concrete, debris, water, snow, ice, and other deleterious substances.

3.17 CONCRETE FLOOR TOPPING

3.17.1 Standard Floor Topping

Provide topping for treads and platforms of metal steel stairs and elsewhere as indicated.

Materials

Provide materials that conform to requirements specified, except aggregate must be as follows:

TYPE OF AGGREGATE	SIEVE	PERCENT PASSING
Fine aggregate	3/8 inch	100
	No. 4	95 to 100
	No. 8	80 to 90
	No. 16	50 to 75
	No. 30	30 to 50
	No. 50	10 to 20
	No. 100	2 to 5
Coarse aggregate	1/2 inch	100
	3/8 inch	95 to 100
	No. 4	40 to 60
	No. 8	0 to 5

Standard Topping Mixture

Provide mixture that consists of one part portland cement, one part fine aggregate, and two parts coarse aggregate, by volume. Adjust exact proportions of fine and coarse aggregates to produce a well-graded total aggregate. Mixing water must not exceed 5 gallons

per 94-pound sack of cement including unabsorbed moisture in aggregate. Maximum slump must be 2 inches.

Preparations Prior to Placing

When mixture is placed on a green concrete base slab, screed surface of base slab to a level not more than 1-1/2 inches nor less than 1 inch below required finish surface. Remove water and laitance from surface of base slab before placing topping mixture. As soon as water ceases to rise to surface of base slab, place topping mixture as specified.

When mixture is placed on a hardened concrete base slab, remove dirt, loose material, oil, grease, asphalt, paint, and other contaminants from base slab surface, leaving a clean surface. Prior to placing topping mixture, (2-1/2-inches minimum) slab surface must be dampened and left free of standing water. Immediately before topping mixture is placed, broom a coat of neat cement grout onto surface of slab. Do not allow cement grout to set or dry before topping mixture is placed.

When mixture is placed on a metal surface, such as metal pans for steel stairs, remove dirt, loose material, oil, grease, asphalt, paint, and other contaminants from metal surface. Immediately before topping mixture is placed, spray or brush a coating of concrete bonding agent onto metal surfaces and do not be allow to set or dry before topping mixture is applied.

Mixing

Do the mixing of topping material at the site in a mechanical mixer of the batch type. Equip batch mixer with a suitable charging hopper, water storage tank, and water-measuring device and must be capable of mixing aggregates, cement, and water into a uniform mix within specified mixing time and of discharging mix without segregation. Provide mixer that bear a rating plate indicating rated capacity and recommended revolutions per minute.

Mix each batch of 2 cubic yards or less for not less than 1-1/2 minutes. Increase mixing time 15 seconds for each additional cubic yard or fraction thereof.

Clean mixer, and replace blades in drum when they have lost 10 percent of their original depth.

Truck-mixed topping may be used when approved. Specify truck-mixed topping for ready-mix concrete.

Placing

Spread standard topping mixture evenly on previously prepared base slab or metal surface, brought to correct level with a straightedge, and struck off. Topping must be consolidated, floated, checked for trueness of surface, and refloated as specified for float finish.

Finishing

Give trowel finish standard floor topping surfaces.

Give other finishes standard floor topping surfaces as indicated. Specify such finishes for required finish.

3.17.2 Heavy-Duty Floor Topping

Provide topping where indicated.

Heavy-duty Topping Mixture

Provide mixture that consists of 1 part portland cement and 2-1/2 parts emery aggregate or 1 part fine aggregate and 1-1/2 parts traprock coarse aggregate, by volume. Exact proportions of mixture must conform to recommendations of aggregate manufacturer. Mixing water must not exceed 3-1/4 gallons per 95-pound sack of cement including unabsorbed moisture in aggregate. Maximum slump must be 1 inch.

Base Slab

Screed surface of slab to a level no more than 1-1/2 inches nor less than 1 inch below grade of finished floor.

Give slab a scratch finish as specified.

Preparations prior to placing

Remove dirt, loose material, oil, grease, asphalt, paint and other contaminants from base slab surface. Prior to placing topping mixture, dampen slab surface and leave free of standing water. Immediately before topping mixture is placed, broom a coat of neat cement grout onto surface of slab. Allow cement grout to set or dry before topping mixture is placed.

Mixing

Do mixing of topping material at the site in a mechanical mixer of the batch type. Equip batch mixer with a charging hopper, water storage tank, and a water-measuring device and the batch mixer must be capable of mixing aggregates, cement, and water into a uniform mix within the specified mixing time and of discharging mix without segregation. Provide mixer that bears a rating plate indicating rated capacity and recommended revolutions per minute.

Mix each batch of 2 cubic yards or less for not less than 1-1/2 minutes.

Increase mixing time 15 seconds for each additional cubic yard or fraction thereof. Clean mixer, and replace pick-up and throw-over blades in drum when they have lost 10 percent of their original depth.

Placing

Spread heavy-duty topping mixture evenly on previously prepared base slab, and bring to correct level with a straightedge, and strike off. Provide topping that is consolidated, floated, and checked for trueness of surface as specified for float finish, except that power-driven

floats is the impact type.

Finishing

Give trowel finish heavy-duty floor topping surfaces. Provide trowel finish as specified, except that additional troweling after first power troweling must be not less than three hand-troweling operations.

-- End of Section --

SECTION 03 40 00.00 10

PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION
08/06

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.

ACI INTERNATIONAL (ACI)

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 305R	(1999; Errata 2006) Hot Weather Concreting
ACI 306.1	(1990; R 2002) Standard Specification for Cold Weather Concreting
ACI 318	(2008; Errata 2008) Building Code Requirements for Structural Concrete and Commentary

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

ACPA 01-102	(2000) Concrete Pipe Handbook
ACPA 01-110	(1984) Design Manual for Sulfide and Corrosion Prediction and Control
ACPA QPC	(2005; Ver 3.0) QCast Plant Certification Manual

ASTM INTERNATIONAL (ASTM)

ASTM C 1244	(2005e1) Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
ASTM C 1478	(2008) Standard Specification for Storm Drain Resilient Connectors Between Reinforced Concrete Storm Sewer Structures, Pipes and Laterals
ASTM C 150	(2007) Standard Specification for Portland Cement
ASTM C 171	(2007) Standard Specification for Sheet Materials for Curing Concrete

ASTM C 231	(2008c) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(2006) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 309	(2007) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 330	(2005) Standard Specification for Lightweight Aggregates for Structural Concrete
ASTM C 443	(2005a) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C 595	(2008a) 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 877	(2008) External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
ASTM C 891	(1990; R 2003) Installation of Underground Precast Concrete Utility Structures
ASTM C 920	(2008) Standard Specification for Elastomeric Joint Sealants
ASTM C 923	(2008) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C 989	(2009) Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 990	(2008) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants

CANADIAN STANDARDS ASSOCIATION (CSA)

CAN/CSA A23.4	(2005) Precast Concrete - Materials and Construction

NATIONAL PRECAST CONCRETE ASSOCIATION (NPCA)

NPCA QC Manual	(2005; R 2006) Quality Control Manual for Precast Plants

1.2 SUBMITTALS

All submittals are the responsibility of the precast concrete producer. 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-01 Preconstruction Submittals

Quality Control Procedures; G

Quality control procedures established by the precast manufacturer in accordance with NPCA QC Manual and/or ACPA QPC.

SD-02 Shop Drawings

Standard Precast Units; G

Drawings for standard precast concrete units furnished by the precast concrete producer for approval by the Contracting Officer. These drawings shall demonstrate that the applicable industry design standards have been met. Include installation and construction information on shop drawings. Include details of steel reinforcement size and placement as well as supporting design calculations, if appropriate. Produce precast concrete units in accordance with the approved drawings.

Custom-Made Precast Units; G

Drawings for custom-made precast concrete units furnished by the precast concrete producer for approval by the Contracting Officer. Show on these drawings complete design, installation, and construction information in such detail as to enable the Contracting Officer to determine the adequacy of the proposed units for the intended purpose. Include details of steel reinforcement size and placement as well as supporting design calculations, if appropriate. Produce precast concrete units in accordance with the approved drawings.

SD-03 Product Data

Standard Precast Units

Cut sheets, for standard precast concrete units, showing conformance to project drawings and requirements, and to applicable industry design standards listed in this specification.

Proprietary Precast Units

Standard plans or informative literature, for proprietary precast concrete units. Make available supporting calculations and design details upon request. Provide sufficient information as to demonstrate that such products will perform the intended task.

Embedded Items

Product data sheets and proper installation instruction for anchors, lifting inserts and other devices. Clearly indicate the products dimensions and safe working load.

Accessories

Proper installation instructions and relevant product data for items including, but not limited to, sealants, gaskets, connectors, steps, cable racks and other items installed before or after delivery.

SD-05 Design Data

Design Calculations; G
Concrete Mix Proportions; G

Precast concrete unit design calculations, and concrete mix proportions.

SD-06 Test Reports

Test Reports; G

a. Copies of material certifications and/or laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolans, ground granulated blast furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.

b. Copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. Such tests may include compressive strength, flexural strength, plastic or hardened air content, freeze thaw durability, abrasion and absorption. Clearly detail in the specifications special tests for precast concrete or cast-in items.

c. Sufficient documentation, when the use of self-consolidating concrete (SCC) is proposed, showing a minimum of 30-days production track records demonstrating that SCC is appropriate for casting of the product.

d. Copies of in-plant QA/QC inspection reports, upon the request of the Contracting Officer.

SD-07 Certificates

Quality Control Procedures; G

Quality control procedures established in accordance with NPCA QC Manual and/or ACPA QPC.

1.3 GENERAL REQUIREMENTS

Furnish precast concrete units designed and fabricated by an experienced and acceptable precast concrete manufacturer who has been, for at least 3 years, regularly and continuously engaged in the manufacture of precast concrete work similar to that indicated on the drawings. Coordinate precast work with the work of other trades.

1.4 DESIGN

1.4.1 Standard Precast Units

Design standard precast concrete units to withstand indicated design load conditions in accordance with applicable industry design standards ACI 318, ASTM, ACPA 01-102, Chapter 7-Design for Sulfide Control. Design must also consider stresses induced during handling, shipping and installation as to avoid product cracking or other handling damage. Indicate design loads for precast concrete units on the shop drawings.

1.4.2 Custom-Made Precast Units

Submit design calculations and drawings of custom-made precast units, prepared and sealed by a registered professional engineer, for approval prior to fabrication. Include in the calculations the analysis of units for lifting stresses and the sizing of lifting devices.

1.4.3 Proprietary Precast Units

Products manufactured under franchise arrangements must conform to all the requirements specified by the franchiser. Items not included in the franchise specification, but included in this specification, must conform to the requirements in this specification.

1.4.4 Joints and Sealants

Provide joints and sealants between adjacent units of the type and configuration indicated on shop drawings meeting specified design and performance requirements.

1.4.5 Concrete Mix Design

1.4.5.1 Concrete Mix Proportions

Base selection of proportions for concrete on the methodology presented in ACI 211.1 for normal weight concrete and ACI 211.2 for lightweight concrete. Develop the concrete proportions using the same type and brand of cement, the same type and brand of pozzolan, the same type and gradation of aggregates, and the same type and brand of admixture that will be used in the manufacture of precast concrete units for the project. Do not use calcium chloride in precast concrete containing reinforcing steel or other embedded metal items. At a minimum of thirty days prior to precast concrete unit manufacturing, the precast concrete producer will submit a mix design for each strength and type of concrete that will be used. Furnish a complete list of materials, including quantity, type, brand and applicable data sheets for all mix design constituents as well as applicable reference specifications. The use of self-consolidating concrete is permitted, provided that mix design proportions and constituents meet the requirements of this specification.

1.4.5.2 Concrete Strength

Provide precast concrete units with a 28-day compressive strength (f'c) of 4,000 psi.

1.4.5.3 Water-to-Cement Ratio

Furnish concrete, that will be exposed to freezing and thawing, containing entrained air and with water-cement ratios of 0.45 or less. Furnish concrete which will not be exposed to freezing, but which is required to be watertight, with a water-cement ratio of 0.48 or less if the concrete is exposed to fresh water, or 0.45 or less if exposed to brackish water or sea water. Furnish reinforced concrete exposed to deicer salts, brackish water or seawater with a water-cement ratio of 0.40 or less for corrosion protection.

1.4.5.4 Air Content

The air content of concrete that will be exposed to freezing conditions must be within the limits given below.

NOMINAL MAXIMUM AGGREGATE SIZE	AIR CONTENT % SEVERE EXPOSURE	MODERATE EXPOSURE
3/8 inch	6.0 to 9.0	4.5 to 7.5
1/2 inch	5.5 to 8.5	4.0 to 7.0
3/4 inch	4.5 to 7.5	3.5 to 6.5
1.0 inch	4.5 to 7.5	3.0 to 6.0
1.5 inch	4.5 to 7.0	3.0 to 6.0

Note: For specified compressive strengths greater than 5000 psi, air content may be reduced 1%

1.4.5.5 Corrosion Control for Sanitary Sewer Systems

Follow design recommendations outlined in Chapter 7 of ACPA 01-102 or the ACPA 01-110 when hydrogen sulfide is indicated as a potential problem.

1.5 QUALITY ASSURANCE

Demonstrate adherence to the standards set forth in NPCA QC Manual and/or ACPA QPC. Meet requirements written in the subparagraphs below.

1.5.1 NPCA and ACPA Plant Certification

The precast concrete producer shall be certified by the National Precast Concrete Association's and/or the American Concrete Pipe Association's Plant Certification Program prior to and during production of the products for this project.

1.5.2 Qualifications, Quality Control and Inspection

1.5.2.1 Qualifications

Select a precast concrete producer that has been in the business of producing precast concrete units similar to those specified for a minimum of 3 years. The precast concrete producer must maintain a permanent quality control department or retain an independent testing agency on a continuing basis.

1.5.2.2 Quality Control Procedures

Show that the following QC tests are performed as required and in accordance with the ASTM standards indicated.

a. Slump: Perform a slump test for each 150 cu yd of concrete produced, or once a day, whichever comes first. Perform slump tests in accordance with ASTM C 143.

b. Temperature: Measure the temperature of fresh concrete when slump or air content tests are made and when compressive test specimens are made in accordance with ASTM C 1064.

c. Compressive Strength: Make at least four compressive strength specimens for each 150 cubic yards of concrete of each mix in accordance with the following Standards: ASTM C 31, ASTM C 192, ASTM C 39.

d. Air Content: Perform tests for air content on air-entrained, wet-cast concrete for each 150 cu yd of concrete, but not less often than once each day when air-entrained concrete is used. Determine the air content in accordance with either ASTM C 231 or ASTM C 173 for normal weight aggregates and ASTM C 173 for lightweight aggregates.

e. Unit Weight: Perform tests for unit weight a minimum of once per week to verify the yield of batch mixes. Perform unit weight tests for each 100 cu yd of lightweight concrete in accordance with ASTM C 138.

Submit test reports as specified in the Submittals paragraph and documentation to demonstrate compliance with the above subparagraphs.

1.5.2.3 Inspection

The Contracting Officer may place an inspector in the plant when the units covered by this specification are being manufactured. The burden of payment for plant inspection will be clearly detailed in the specification. The precast concrete producer shall give notice 14 days prior to the time the units will be available for plant inspection. Neither the exercise nor waiver of inspection at the plant will affect the Government's right to enforce contractual provisions after units are transported or erected.

1.6 HANDLING, STORAGE AND DELIVERY

1.6.1 Handling

Handle, transport, and store products in a manner to minimize damage. Lifting devices or holes shall be consistent with industry standards. Perform lifting with methods or devices intended for this purpose as indicated on shop drawings.

1.6.2 Storage

Store units off the ground or in a manner that will minimize potential damage.

1.6.3 Delivery

Deliver precast units to the site in accordance with the delivery schedule to avoid excessive build-up of units in storage at the site. Upon delivery to the jobsite, all precast concrete units will be inspected by the Contracting Officer for quality and final acceptance.

PART 2 PRODUCTS

2.1 MATERIALS

Except as otherwise specified in the following paragraphs, conform material to Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE and Section 03 20 01.00 10 CONCRETE REINFORCEMENT.

2.1.1 Cement

Furnish cement conforming to ASTM C 150, Type I, II, III or V. Furnish blended cements that conform to ASTM C 595.

2.1.2 Fly Ash and Pozzolans

Fly ash is used as an admixture conforming to ASTM C 618, Class C or F with 4 percent maximum loss on ignition and 35 percent maximum cement replacement by weight.

2.1.3 Ground Granulated Blast-Furnace Slag

Ground granulated blast furnace slag is used as an admixture conforming to ASTM C 989, Grade 120 with between 25 to 50 percent maximum cement replacement by weight.

2.1.4 Water

Furnish water potable or free of deleterious substances in amounts harmful to concrete or embedded metals.

2.1.5 Aggregates

2.1.5.1 Selection

Furnish aggregates conforming to ASTM C 33. Provide aggregates not containing any substance, which may be deleteriously reactive with the alkalies in the cement.

2.1.5.2 Aggregates for Lightweight Concrete

ASTM C 330

2.1.6 Admixtures

2.1.6.1 Air-Entraining

ASTM C 260

2.1.6.2 Accelerating, Retarding, Water Reducing Moderate to High

ASTM C 494

2.1.6.3 Pigments

Non-fading and lime-resistant

2.1.7 Reinforcement

2.1.7.1 Reinforcing Bars

a. Deformed Billet-steel: ASTM A 615
b. Deformed Low-alloy steel: ASTM A 706

2.1.7.2 Reinforcing Wire

a. Plain Wire: ASTM A 82
b. Deformed Wire: ASTM A 496

2.1.7.3 Welded Wire Fabric

a. Plain Wire: ASTM A 185
b. Deformed Wire: ASTM A 497

2.1.7.4 Epoxy Coated Reinforcement

a. Reinforcing Bars: ASTM A 775
b. Wires and Fabric: ASTM A 884

2.1.7.5 Galvanized Reinforcement

Provide galvanized reinforcement conforming to ASTM A 767.

2.1.8 Synthetic Fiber Reinforcement

Synthetic fiber shall be polypropylene with a denier less than 100 and a nominal fiber length of 2 inch.

2.1.9 Inserts and Embedded Metal

All items embedded in concrete shall be of the type required for the intended task, and meet the following standards.

a. Structural Steel Plates, Angles, etc.: ASTM A 36
b. Hot-dipped Galvanized: ASTM A 153
c. Proprietary Items: In accordance with manufacturers published literature

2.1.10 Accessories

a. Rubber Gaskets for Circular Concrete Sewer Pipe and Culvert Pipe: ASTM C 443.

b. External Sealing Bands for Noncircular Sewer, Storm Drain and Culvert Pipe: ASTM C 877.

c. Preformed Flexible Joint Sealants for Concrete Pipe, Manholes, and Manufactured Box Sections: ASTM C 990.

d. Elastomeric Joint Sealants: ASTM C 920

2.1.11 Pipe Entry Connectors

Pipe entry connectors shall conform to ASTM C 923 or ASTM C 1478.

2.1.12 Grout

Nonshrink Grout shall conform to ASTM C 1107. Cementitious grout shall be a mixture of portland cement, sand, and water. Proportion one part cement to approximately 2.5 parts sand, with the amount of water based on placement method.

PART 3 EXECUTION

3.1 FABRICATION AND PLACEMENT

Perform fabrication in accordance with NPCA QC Manual and/or ACPA QPC unless specified otherwise.

3.1.1 Forms

Use forms, for manufacturing precast concrete products, of the type and design consistent with industry standards and practices. They should be capable of consistently providing uniform products and dimensions. Construct forms so that the forces and vibrations to which the forms will be subjected can cause no product damage. Clean forms of concrete build-up after each use. Apply form release agents according to the manufacturers recommendations and do not allow to build up on the form casting surfaces.

3.1.2 Reinforcement

Follow applicable ASTM Standard or ACI 318 for placement and splicing. Fabricate cages of reinforcement either by tying the bars, wires or welded wire fabric into rigid assemblies or by welding, where permissible, in accordance with AWS D1.4. Position reinforcing as specified by the design and so that the concrete cover conforms to requirements. The tolerance on concrete cover shall be one-third of that specified but not more than 1/2 inch. Provide concrete cover not less than 1/2 inch. Take positive means to assure that the reinforcement does not move significantly during the casting operations.

3.1.3 Embedded Items

Position embedded items at locations specified in the design documents. Perform welding in accordance with AWS D1.1 when necessary. Hold rigidly in place inserts, plates, weldments, lifting devices and other items to be imbedded in precast concrete products so that they do not move significantly during casting operations.

3.2 CONCRETE

3.2.1 Concrete Mixing

Mixing operations shall produce batch-to-batch uniformity of strength, consistency, and appearance.

3.2.2 Concrete Placing

Deposit concrete into forms as near to its final location as practical. Keep the free fall of the concrete to a minimum. Consolidate concrete in such a manner that segregation of the concrete is minimized and honeycombed areas are kept to a minimum. Use vibrators to consolidate concrete with frequencies and amplitudes sufficient to produce well consolidated concrete.

3.2.2.1 Cold Weather Concreting

Perform cold weather concreting in accordance with ACI 306.1.

a. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather.

b. Free from frost all concrete materials and all reinforcement, forms, fillers, and ground with which concrete is to come in contact.

c. Do not use frozen materials or materials containing ice.

d. In cold weather the temperature of concrete at the time of placing shall not be below 45 degrees F. Discard concrete that freezes before its compressive strength reaches 500 psi.

3.2.2.2 Hot Weather Concreting

Recommendations for hot weather concreting are given in detail in ACI 305R. During hot weather, give proper attention to constituents, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation that could impair required strength or serviceability of the member or structure. The temperature of concrete at the time of placing shall not exceed 90 degrees F.

3.2.3 Concrete Curing

Commence curing immediately following the initial set and completion of surface finishing.

3.2.3.1 Curing by Moisture Retention

Prevent moisture evaporation from exposed surfaces until adequate strength for stripping is reached by one of the following methods:

a. Cover with polyethylene sheets a minimum of 6 mils thick in accordance with ASTM C 171.

b. Cover with burlap or other absorptive material and keep continually moist.

c. Use of a membrane-curing compound applied at a rate not to exceed 200 square ft/gallon, or in accordance with manufacturers' recommendations according to ASTM C 309.

3.2.3.2 Curing with Heat and Moisture

Do not subject concrete to steam or hot air until after the concrete has attained its initial set. Apply steam, if used, within a suitable enclosure, which permits free circulation of the steam in accordance with CAN/CSA A23.4. If hot air is used for curing, take precautions to prevent moisture loss from the concrete. The temperature of the concrete shall not be permitted to exceed 150 degrees F. These requirements do not apply to products cured with steam under pressure in an autoclave.

3.2.4 Surface Finish

Finish unformed surfaces of wet-cast precast concrete products as specified. If no finishing procedure is specified, finish such surfaces

using a strike-off to level the concrete with the top of the form.

3.2.4.1 Formed Non-Architectural Surfaces

Cast surfaces against approved forms following industry practices in cleaning forms, designing concrete mixes, placing and curing concrete. Normal color variations, form joint marks, small surface holes caused by air bubbles, and minor chips and spalls will be accepted but no major imperfections, honeycombs or other major defects will be permitted.

3.2.4.2 Unformed Surfaces

Finish unformed surfaces with a vibrating screed, or by hand with a float. Normal color variations, minor indentations, minor chips and spalls will be accepted but no major imperfections, honeycombs, or other major defects shall be permitted.

3.2.4.3 Special Finishes

Troweled, broom or other finishes shall be according to the requirements of project documents and performed in accordance with industry standards or supplier specifications. Submit finishes for approval when required by the project documents. The sample finishes shall be approved prior to the start of production.

3.2.5 Stripping Products from Forms

Do not remove products from the forms until the concrete reaches the compressive strength for stripping required by the design. If no such requirement exists, products may be removed from the forms after the final set of concrete provided that stripping damage is minimal.

3.2.6 Patching and Repair

No repair is required to formed surfaces that are relatively free of air voids and honeycombed areas, unless the surfaces are required by the design to be finished.

3.2.6.1 Repairing Minor Defects

Defects that will not impair the functional use or expected life of a precast concrete product may be repaired by any method that does not impair the product.

3.2.6.2 Repairing Honeycombed Areas

When honeycombed areas are to be repaired, remove all loose material and cut back the areas into essentially horizontal or vertical planes to a depth at which coarse aggregate particles break under chipping rather than being dislodged. Use proprietary repair materials in accordance with the manufacturer's instructions. If a proprietary repair material is not used, saturate the area with water. Immediately prior to repair, the area should be damp, but free of excess water. Apply a cement-sand grout or an approved bonding agent to the chipped surfaces, followed immediately by consolidating an appropriate repair material into the cavity.

3.2.6.3 Repairing Major Defects

Evaluate, by qualified personnel, defects in precast concrete products

which impair the functional use or the expected life of products to determine if repairs are feasible and, if so, to establish the repair procedure.

3.2.7 Shipping Products

Do not ship products until they are at least 5 days old, unless it can be shown that the concrete strength has reached at least 75% of the specified 28-day strength, or that damage will not result, impairing the performance of the product.

3.3 INSTALLATION

3.3.1 Site Access

It is the Contractor's responsibility to provide adequate access to the site to facilitate hauling, storage and proper handling of the precast concrete products.

3.3.2 General Requirements

a. Install precast concrete products to the lines and grades shown in the contract documents or otherwise specified.

b. Lift products by suitable lifting devices at points provided by the precast concrete producer.

c. Install products in accordance with the precast concrete producer's instructions. In the absence of such instructions, install underground utility structures in accordance with ASTM C 891. Install pipe and manhole sections in accordance with the procedures outlined by the American Concrete Pipe Association.

d. Field modifications to the product will relieve the precast producer of liability even if such modifications result in the failure of the product.

3.3.3 Water Tightness

Where water tightness is a necessary performance characteristic of the precast concrete product's end use, watertight joints, connectors and inserts should be used to ensure the integrity of the entire system.

3.4 FIELD QUALITY CONTROL

3.4.1 Site Tests

When water tightness testing is required for an underground product, use one of the following methods:

3.4.2 Vacuum Testing

Prior to backfill vacuum test system according to ASTM C 1244.

3.4.3 Water Testing

Perform water testing according to the contract documents and precast concrete producer's recommendations.

-- End of Section --

SECTION 21 30 00

FIRE PUMPS
10/11

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 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 C500	(2009) Metal-Seated Gate Valves for Water Supply Service
AWWA C606	(2006) Grooved and Shouldered Joints

ASME INTERNATIONAL (ASME)

ASME B16.11	(2009) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(2001; R 2005) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(2011) Nonmetallic Flat Gaskets for Pipe Flanges
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 B16.3	(2006) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.39	(2009) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.5	(2009) Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	(2007) Standard for Factory-Made Wrought Steel Buttwelding Fittings

ASME B31.1	(2010) Power Piping

ASTM INTERNATIONAL (ASTM)

ASTM A183	(2003; R 2009) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A193/A193M	(2010a) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A194/A194M	(2010a) Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A47/A47M	(1999; R 2009) Standard Specification for Ferritic Malleable Iron Castings
ASTM A53/A53M	(2010) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A536	(1984; R 2009) Standard Specification for Ductile Iron Castings
ASTM A795/A795M	(2008) Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM B 135	(2010a) Standard Specification for Seamless Brass Tube
ASTM B 42	(2010) Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B 62	(2009) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B 75	(2002; R 2010) Standard Specification for Seamless Copper Tube
ASTM B 88	(2009) Standard Specification for Seamless Copper Water Tube
ASTM C 533	(2009) Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
ASTM D 2000	(2008) Standard Classification System for Rubber Products in Automotive Applications
ASTM D 3308	(2006) PTFE Resin Skived Tape
ASTM F 436	(2010) Hardened Steel Washers

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

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 1963	(2009; Errata 09-1) Standard for Fire Hose Connections
NFPA 20	(2010; TIA 10-1) Standard for the Installation of Stationary Pumps for Fire Protection
NFPA 24	(2010) Standard for the Installation of Private Fire Service Mains and Their Appurtenances
NFPA 37	(2010; TIA 10-1) Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 70	(2011) National Electrical Code
NFPA 72	(2010; TIA 10-4) National Fire Alarm and Signaling Code

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1014-7	(2003) Program Detail Manual for Certification in the Field of Fire Protection Engineering Technology (Field Code 003) Subfield of Automatic Sprinkler System Layout

UNDERWRITERS LABORATORIES (UL)

UL 1247	(2007; Reprint Oct 2010) Diesel Engines for Driving Stationary Fire Pumps
UL 142	(2006; Reprint Jan 2008) Steel Aboveground Tanks for Flammable and Combustible Liquids
UL 262	(2004; Reprint Jun 2008) Gate Valves for Fire-Protection Service
UL 448	(2007; Reprint Jan 2011) Centrifugal Stationary Pumps for Fire-Protection Service
UL 80	(2007; Reprint Aug 2009) Standard for Steel Tanks for Oil-Burner Fuels and Other

Combustible Liquids

UL Fire Prot Dir (2011) Fire Protection Equipment Directory

1.2 SYSTEM DESCRIPTION

a. Except as modified in this Section or on the drawings, install fire pumps in conformance with 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" had been substituted for the word "should" wherever it appears. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification governs. Devices and equipment for fire protection service shall be UL Fire Prot Dir listed or FM APP GUIDE approved. Interpret all reference to the authority having jurisdiction to mean the Army Corps of Engineers.

b. Submit 3 copies of the Fire Pump Installation Drawings consisting of a detailed plan view, detailed elevations and sections of the pump room, equipment and piping, drawn to a scale of not less than 1/2 inch = 1 foot. Drawings shall indicate equipment, piping, and associated pump equipment to scale. All clearance, such as those between piping and equipment; between equipment and walls, ceiling and floors; and for electrical working distance clearance around all electrical equipment shall be indicated. Drawings shall include a legend identifying all symbols, nomenclatures, and abbreviations. Drawings shall indicate a complete piping and equipment layout including elevations and/or section views of the following:

1. Fire pumps, controllers, piping, valves, and associated equipment.

2. Sensing line for each pump including the pressure maintenance pump.

3. Engine fuel system for diesel driven pumps.

4. Engine cooling system for diesel driven pumps.

5. Pipe hangers and sway bracing including support for diesel muffler and exhaust piping.

6. Restraint of underground water main at entry-and exit-points to the building including details of pipe clamps, tie rods, mechanical retainer glands, and thrust blocks.

7. A one-line schematic diagram indicating layout and sizes of all piping, devices, valves and fittings.

8. A complete point-to-point connection drawing of the pump power, control and alarm systems, as well as interior wiring schematics of each controller.

c. Tank supports, piping offsets, fittings, and any other accessories required shall be furnished as specified to provide a complete installation and to eliminate interference with other construction.

d. Show detail plan view of the pump room including elevations and

sections showing the fire pumps, associated equipment, and piping. Submit working drawings on sheets not smaller than 24 by 36 inches; include data for the proper installation of each system. Show piping schematic of pumps, devices, valves, pipe, and fittings. Provide an isometric drawing of the fire pump and all associated piping. Show point to point electrical wiring diagrams. Show piping layout and sensing piping arrangement. Show engine fuel and cooling system. Include:

(1) Pumps, drivers, and controllers

(2) Hose valve manifold test header

(3) Circuit diagrams for pumps

(4) Wiring diagrams of each controller

e. Post operating instructions for pumps, drivers, controllers, and flow meters.

f. Fully enclose or properly guard coupling, rotating parts, gears, projecting equipment, etc. so as to prevent possible injury to persons that come in close proximity of the equipment. Conduct testing of the fire pumps in a safe manner and ensure that all equipment is safely secured. Hoses and nozzles used to conduct flow tests shall be in excellent condition and shall be safely anchored and secured to prevent any misdirection of the hose streams.

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-02 Shop Drawings

Installation Drawings; G
As-Built Drawings; G
Piping Layout; G
Pump Room; G

SD-03 Product Data

Fire Pump Installation Related Submittals
Catalog Data; G
Spare Parts; G
Preliminary Tests; G
Field Tests; G
Fire Protection Specialist; G
Manufacturer's Representative; G
Field Training; G
Army Final Acceptance Test

SD-06 Test Reports

Preliminary Tests Report
Army Final Acceptance Test

SD-07 Certificates

Fire Protection Specialist; G
Qualifications of Welders; G
Qualifications of Installer; G
Preliminary Test Certification; G

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions; G
Flow Meter; G

1.4 QUALITY ASSURANCE

1.4.1 Fire Protection Specialist

Work specified in this section shall be performed under the supervision of and certified by the Fire Protection Specialist. Submit the name and documentation of certification of the proposed Fire Protection Specialists, no later than 14 days after the Notice to Proceed and prior to the submittal of the fire pump installation drawings. The Fire Protection Specialist shall be an individual who is a registered professional engineer and a Full Member of the Society of Fire Protection Engineers or who is certified as a Level IV Technician by National Institute for Certification in Engineering Technologies (NICET) in the Automatic Sprinkler System Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014-7. The Fire Protection Specialist shall be regularly engaged in the design and installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months. Concurrent with the Final Acceptance Test Report, submit certification by the Fire Protection Specialist that the fire pump installation is in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports. Submit data for approval showing the name and certification of all involved individuals with such qualifications at or prior to submittal of drawings.

1.4.2 Qualifications of Welders

Submit certificates of each welder's qualifications prior to site welding; certifications shall not be more than one year old.

1.4.3 Qualifications of Installer

Prior to installation, submit data for approval showing that the Contractor has successfully installed fire pumps and associated equipment of the same type and design as specified herein, or that he has a firm contractual agreement with a subcontractor having such required experience. The data shall include the names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months.

1.4.4 Preliminary Test Certification

When preliminary tests have been completed and corrections made, submit a signed and dated certificate with a request for a formal inspection and tests.

1.4.5 Manufacturer's Representative

Work specified in this section shall be performed under the supervision of and certified by a representative of the fire pump manufacturer. Submit the name and documentation of certification of the proposed Manufacturer's Representative, concurrent with submittal of the Fire Protection Specialist Qualifications. The Manufacturer's Representative shall be regularly engaged in the installation of the type and complexity of fire pump(s) specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage from the weather, excessive humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall be either capped or plugged until installed.

1.6 SEQUENCING

1.6.1 Primary Fire Pump

Primary fire pump shall automatically operate when the pressure drops to 140 psi, or manually when the starter is operated. Pump shall continue to run until shut down manually.

1.6.2 Secondary Fire Pump

Provide a secondary fire pump identical to the primary fire pump. Secondary fire pump shall operate only on failure of the primary fire pump. Fire pumps shall be prevented from starting simultaneously. Fire Pumps shall be prevented from running simultaneously Secondary fire pump is only provided for backup.

1.6.3 Pressure Maintenance Pump

Pressure maintenance pump shall operate when the system pressure drops to 121 psi. Pump shall automatically stop when the system pressure reaches 131 psi and after the pump has operated for the minimum pump run time specified herein.

1.7 EXTRA MATERIALS

Submit Spare Parts data for each different item of equipment and material 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 year and 3 years of service. Include a list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

a. Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

b. Submit manufacturer's catalog data included with the Fire Pump Installation Drawings for each separate piece of equipment proposed for use in the system. Catalog data shall indicate the name of the manufacturer of each item of equipment, with data annotated to indicate model to be provided. In addition, a complete equipment list that includes equipment description, model number and quantity shall be provided. Catalog data for material and equipment shall include, but not be limited to, the following:

1. Fire pumps, drivers and controllers including manufacturer's certified shop test characteristic curve for each pump. Shop test curve may be submitted after approval of catalog data but shall be submitted prior to the final tests.

2. Pressure maintenance pump and controller.

3. Piping components.

4. Valves, including gate, check, globe and relief valves.

5. Gauges.

6. Hose valve manifold test header and hose valves.

7. Flow meter.

8. Restrictive orifice union.

9. Associated devices and equipment.

c. All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number. Pumps and motors shall have standard nameplates securely affixed in a conspicuous place and easy to read. Fire pump shall have nameplates and markings in accordance with UL 448. Diesel driver shall have nameplate and markings in accordance with UL 1247. Electric motor nameplates shall provide the minimum information required by NFPA 70, Section 430-7.

2.2 FIRE PUMP

Fire pump shall be diesel engine driven. Each pump capacity shall be rated at 750 gpm with a rated net pressure of 100 psi. Fire pump shall furnish not less than 150 percent of rated flow capacity at not less than 65 percent of rated net pressure. Pump shall be centrifugal horizontal split case fire pump. Horizontal pump shall be equipped with automatic air release devices. The maximum rated pump speed shall be 2100 rpm when driving the pump at rated capacity. Pump shall be automatic start and manual stop. Pump shall conform to the requirements of UL 448. Fire pump discharge and suction gauges shall be oil-filled type.

2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

2.3.1 General Requirements

Materials and Equipment shall have been tested by Underwriters Laboratories, Inc. and listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM APP GUIDE. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM APP GUIDE.

2.3.2 Alarms

Provide audible and visual alarms as required by NFPA 20 on the controller. Provide remote supervision as required by NFPA 20, in accordance with NFPA 72. Provide remote alarm devices located at the new COF Admin Facility. Supervisory signal shall be activated upon the following conditions: engine drive controller has operated into an engine running condition, engine drive controller main switch has been turned to OFF or to MANUAL position, trouble on engine driven controller or engine. Exterior alarm devices shall be weatherproof type. Provide alarm silencing switch and red signal lamp, with signal lamp arranged to come on when switch is placed in OFF position.

2.4 UNDERGROUND PIPING COMPONENTS

2.4.1 Pipe and Fittings

Provide outside-coated, cement mortar-lined, ductile-iron pipe (with a rated working pressure of 175 psi) conforming to NFPA 24 for piping under the building and less than 5 feet outside of the building walls. Anchor the joints in accordance with NFPA 24; provide concrete thrust block at the elbow where the pipe turns up toward the floor, and restrain the pipe riser with steel rods from the elbow to the flange above the floor. Minimum pipe size shall be 6 inches. Minimum depth of cover shall be as required by NFPA 24, but no less than 3 feet. Piping more than 5 feet outside of the building walls shall be provided under Section 33 11 00 WATER DISTRIBUTION.

2.4.2 Fittings and Gaskets

Fittings shall be ductile iron conforming to AWWA C110/A21.10. Gaskets shall be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for ductile iron pipe joints shall conform to AWWA C111/A21.11.

2.4.3 Valves and Valve Boxes

Valves shall be gate valves conforming to AWWA C500 or UL 262. Valves shall have cast-iron body and bronze trim. Valve shall open by counterclockwise rotation. Except for post indicator valves, all underground valves shall be provided with an adjustable cast-iron or ductile iron valve box of a size suitable for the valve on which the box is to be used, but not less than 5.25 inches in diameter. The box shall be coated with bituminous coating. A cast-iron or ductile-iron cover with the word "WATER" cast on the cover shall be provided for each box.

2.4.4 Gate Valve and Indicator Posts

Gate valves for underground installation shall be of the inside screw type

with counterclockwise rotation to open. Where indicating type valves are shown or required, indicating valves shall be gate valves with an approved indicator post of a length to permit the top of the post to be located 3 feet above finished grade. Gate valves and indicator posts shall be provided with one coat of primer and two coats of red enamel paint and shall be listed in UL Fire Prot Dir or FM APP GUIDE.

2.4.5 Buried Utility Warning and Identification Tape

Detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping shall be provided for all buried piping. Tape shall be detectable by an electronic detection instrument. Tape shall be provided in rolls, 3 inches minimum width, color-coded for the utility involved and imprinted in bold black letters continuously and repeatedly over the entire tape length. Warning and identification shall be "CAUTION BURIED WATER PIPING BELOW" or similar wording. Code and lettering shall be permanent and unaffected by moisture and other substances contained in the trench backfill material. Tape shall be buried at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavement.

2.5 ABOVEGROUND PIPING COMPONENTS

2.5.1 Pipe Sizes 2.5 inches and Larger

2.5.1.1 Pipe

Piping shall be ASTM A795/A795M, Weight Class STD (Standard), Schedule 40 (except for Schedule 30 for pipe sizes 8 inchesand greater in diameter), Type E or Type S, Grade A; black steel pipe. Steel pipe shall be joined by means of flanges welded to the pipe or mechanical grooved joints only. Piping shall not be jointed by welding or weld fittings. Suction piping shall be galvanized on the inside in accordance with NFPA 20.

2.5.1.2 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 175 psi service and shall be the product of the same manufacturer. Fitting and coupling houses shall be malleable iron conforming to ASTM A47/A47M, Grade 32510; ductile iron conforming to ASTM A536, Grade 65-45-12. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A183 and shall be cadmium plated or zinc electroplated.

2.5.1.3 Flanges

Flanges shall be ASME B16.5, Class 150 flanges. Flanges shall be provided at valves, connections to equipment, and where indicated.

2.5.1.4 Gaskets

Gaskets shall be AWWA C111/A21.11, cloth inserted red rubber gaskets.

2.5.1.5 Bolts

Bolts shall be ASTM A193/A193M, Grade B7. Bolts shall extend no less than three full threads beyond the nut with bolts tightened to the required torque.

2.5.1.6 Nuts

Nuts shall be ASTM A194/A194M, Grade 7.

2.5.1.7 Washers

Washers shall meet the requirements of ASTM F 436. Flat circular washers shall be provided under all bolt heads and nuts.

2.5.2 Piping Sizes 2 inches and Smaller

2.5.2.1 Steel Pipe

Steel piping shall be ASTM A795/A795M, Weight Class STD (Standard), Schedule 40, Type E or Type S, Grade A, zinc-coated steel pipe with threaded end connections. Fittings shall be ASME B16.3, Class 150, zinc-coated threaded fittings. Unions shall be ASME B16.39, Class 150, zinc-coated unions.

2.5.2.2 Copper Tubing

Copper tubing shall be ASTM B 88, Type L or K, soft annealed. Fittings shall be ASME B16.26, flared joint fittings. Pipe nipples shall be ASTM B 42 copper pipe with threaded end connections.

2.5.3 Pipe Hangers and Supports

Pipe hangers and support shall be UL listed UL Fire Prot Dir or FM approved FM APP GUIDE and shall be the adjustable type. Finish of rods, nuts, washers, hangers, and supports shall be zinc-plated after fabrication.

2.5.4 Valves

Valves shall be UL listed UL Fire Prot Dir or FM approved FM APP GUIDE for fire protection service. Valves shall have flange or threaded end connections.

2.5.4.1 Gate Valves and Control Valves

Gate valves and control valves shall be outside screw and yoke (O.S.&Y.) type which open by counterclockwise rotation. Butterfly-type control valves are not permitted.

2.5.4.2 Tamper Switch

The suction control valves, the discharge control valves, valves to test header and flow meter, and the by-pass control valves shall be equipped with valve tamper switches for monitoring by the fire alarm system.

2.5.4.3 Check Valve

Check valve shall be clear open, swing type check valve with flange or threaded inspection plate.

2.5.4.4 Relief Valve

Relief valve shall be pilot operated type conforming to NFPA 20. A means of detecting water motion in the relief lines shall be provided where the discharge is not visible within the pump house.

2.5.4.5 Circulating Relief Valve

An adjustable circulating relief valve shall be provided for each fire pump in accordance with NFPA 20.

2.5.4.6 Suction Pressure Regulating Valve

Suction pressure regulating valve shall be FM approved FM APP GUIDE. Suction pressure shall be monitored through a pressure line to the controlling mechanism of the regulating valve. Valve shall be arranged in accordance with the manufacturer's recommendations.

2.5.5 Hose Valve Manifold Test Header

Construct header of steel pipe. Provide ASME B16.5, Class 150 flanged inlet connection to hose valve manifold assembly. Provide approved bronze hose gate valve with 2.5 inch National Standard male hose threads with cap and chain; locate 3 feet above grade in the horizontal position for each test header outlet. Welding shall be metallic arc process in accordance with ASME B31.1.

2.5.6 Pipe Sleeves

A pipe sleeve shall be provided at each location where piping passes entirely through walls, ceilings, roofs, and floors, including pipe entering buildings from the exterior. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, and floors. Provide one inch minimum clearance between exterior of piping or pipe insulation, and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of the sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, a fire seal shall be provided between the pipe and the sleeve in accordance with Section 07 84 00 FIRESTOPPING.

a. Sleeves in Masonry and Concrete Walls, Ceilings, Roofs, and Floors: Provide hot-dip galvanized steel, ductile-iron, or cast-iron pipe sleeves. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves provided that cavities in the core-drilled hole be completely grouted smooth.

b. Sleeves in Other Than Masonry and Concrete Walls, Ceilings, Roofs, and Floors: Provide galvanized steel sheet pipe not less than 0.90 psf.

2.5.7 Escutcheon Plates

Provide one-piece or split-hinge metal plates for piping entering floors, walls, and ceilings in exposed areas. Provide polished stainless steel or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on plates in unfinished spaces. Plates shall be secured in place.

2.6 DIESEL ENGINE DRIVER

Diesel engine driver shall conform to the requirements of UL 1247 and shall be UL listed UL Fire Prot Dir or FM approved FM APP GUIDE for fire pump service. Driver shall be of the make recommended by the pump

manufacturer. The engine shall be closed circuit, liquid-cooled with radiator and engine-driven fan. Diesel engine shall be electric start type taking current from 2 battery units. Engine shall be equipped with a fuel in-line filter-water separator. Engine conditions shall be monitored with engine instrumentation panel that has a tachometer, hour meter, fuel pressure gauge, lubricating oil pressure gauge, water temperature gauge, and ammeter gauge. Engine shall be connected to horizontal-shaft pump by flexible couplings. For connections to vertical-shaft fire pumps, right-angle gear drives and universal joints shall be used. An engine jacket water heater shall be provided to maintain a temperature of 120 degrees F in accordance with NFPA 20.

2.6.1 Engine Capacity

Engine shall have adequate horsepower to drive the pump at all conditions of speed and load over the full range of the pump performance curve. The horsepower rating of the engine driver shall be as recommended by the pump manufacturer and shall be derated for temperature and elevation in accordance with NFPA 20. Site elevation shall be 670 feet above mean sea level (MSL).

2.6.2 Exhaust System External to Engine

Exhaust system shall comply with the requirements of NFPA 20 and NFPA 37. An exhaust muffler shall be provided for each diesel engine driver to reduce noise levels less than 95 dBA. A flexible connector with flange connections shall be provided at the engine. Flexible sections shall be stainless steel suitable for diesel-engines exhaust gas at 1000 degrees F.

2.6.2.1 Steel Pipe and Fittings

ASTM A53/A53M, Schedule 40, black steel, welding end connections. ASME B16.9 or ASME B16.11 welding fittings shall be of the same material and weight as the piping.

2.6.2.2 Flanges

ASME B16.5, Class 300. Flanges shall be provided at connections to diesel engines, exhaust mufflers, and flexible connections. Gaskets shall be ASME B16.21, composition ring, 0.0625 inch. ASTM A193/A193M, Grade B8 bolts and ASTM A194/A194M, Grade 8 nuts shall be provided.

2.6.2.3 Piping Insulation

Comply with EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS. Products containing asbestos will not be permitted. Exhaust piping system including the muffler shall be insulated with ASTM C 533 calcium silicate insulation, minimum of 3 inches. Insulation shall be secured with not less than 0.375 inch width fibrous glass reinforced waterproof tape or Type 304 stainless steel bands spaced not more than 8 inches on center. An aluminum jacket encasing the insulation shall be provided. The aluminum jacket shall have a minimum thickness of 0.016 inches, a factory-applied polyethylene and kraft paper moisture barrier on the inside surface. The jacket shall be secured with not less than 0.5 inch wide stainless steel bands, spaced not less than 8 inches on centers. Longitudinal and circumferential seams of the jacket shall be lapped not less than 3 inches. Jackets on horizontal line shall be installed so that the longitudinal seams are on the bottom side of the pipe. The seams of the jacket for the vertical lines shall be placed on

the off-weather side of the pipe. On vertical lines, the circumferential seams of the jacket shall overlap so the lower edge of each jacket overlaps the upper edge of the jacket below.

2.7 FIRE PUMP CONTROLLER

Controller shall be the automatic type and UL listed UL Fire Prot Dir or FM approved FM APP GUIDE for fire pump service. Pump shall be arranged for automatic start and stop, and manual push-button stop. Automatic stopping shall be accomplished only after all starting causes have returned to normal and after a minimum pump run time has elapsed. Controllers shall be completely terminally wired, ready for field connections, and mounted in a NEMA Type 4 watertight and dust tight enclosure arranged so that controller current carrying parts will not be less than 12 inches above the floor. Controller shall be provided with voltage surge arresters installed in accordance with NFPA 20. Controller shall be equipped with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments, automatic starting relay actuated from normally closed contacts, visual alarm lamps and supervisory power light. Controller shall be equipped with a thermostat switch with adjustable setting to monitor the pump room temperature and to provide an alarm when temperatures falls below 40 degrees F The controller shall be factory-equipped with a heater operated by thermostat to prevent moisture in the cabinet.

2.7.1 Controller for Diesel Engine Driven Fire Pump

Controller shall require the pump to run for 30 minutes prior to automatic shutdown. Controller shall be equipped with two battery chargers; two ammeters; two voltmeters, one for each set of batteries. Controller shall automatically alternate the battery sets for starting the pumps. Controller shall be equipped with the following supervisory alarm functions:

a. Engine Trouble (individually monitored)

(1) Engine overspeed

(2) Low Oil Pressure

(3) High Water Temperature

(4) Engine Failure to Start

(5) Battery

(6) Battery Charger/AC Power Failure

b. Main Switch Mis-set

c. Pump Running

d. Pump Room Trouble (individually monitored)

(1) Low Fuel

(2) Low Pump Room Temperature

Alarms shall be individually displayed in front of panel by lighting of

visual lamps, except that individual lamps are not required for pump running and main switch mis-set. Controller shall be equipped with a 7-day electric pressure recorder with 24-hour back-up mounted inside the controller. The pressure recorder shall provide a readout of the system pressure from 0 to 300 psi, time, and date. The controller shall be equipped with an audible alarm which will activate upon any engine trouble or pump room trouble alarm condition and alarm silence switch. Controller shall be equipped with terminals for field connection of a remote alarm for main switch mis-set, pump running, engine trouble and pump room trouble; and terminals for remote start. When engine emergency overspeed device operates, the controller shall cause the engine to shut down without time delay and lock out until manually reset.

2.8 BATTERIES

Batteries for diesel engine driver shall be sealed lead calcium batteries. Batteries shall be mounted in a steel rack with non-corrosive, non-conductive base, not less than 12 inches above the floor.

2.9 PRESSURE SENSING LINE

A completely separate pressure sensing line shall be provided for each fire pump and for the jockey pump. The sensing line shall be arranged in accordance with Figure A-7-5.2.1. of NFPA 20. The sensing line shall be 1/2 inchH58 brass tubing complying with ASTM B 135. The sensing line shall be equipped with two restrictive orifice unions each. Restricted orifice unions shall be ground-face unions with brass restricted diaphragms drilled for a 3/32 inch. Restricted orifice unions shall be mounted in the horizontal position, not less than 5 feet apart on the sensing line. Two test connections shall be provided for each sensing line. Test connections shall consist of two brass 1/2 inch globe valves and 1/4 inch gauge connection tee arranged in accordance with NFPA 20. One of the test connections shall be equipped with a 0 to 300 psi water oil-filled gauge. Sensing line shall be connected to the pump discharge piping between the discharge piping control valve and the check valve.

2.10 PRESSURE MAINTENANCE PUMP

2.10.1 General

Pressure maintenance pump shall be electric motor driven, horizontal shaft or in-line vertical shaft, centrifugal type with a rated discharge of 10 gpm at 125 psig. Pump shall draft from the suction supply side of the suction pipe gate valve of the fire pump and shall discharge into the system at the downstream side of the pump discharge gate valve. An approved indicating gate valve of the outside screw and yoke (O.S.&Y.) type shall be provided in the maintenance pump discharge and suction piping. Oil-filled water pressure gauge and approved check valve in the maintenance pump discharge piping shall be provided. Check valve shall be swing type with removable inspection plate.

2.10.2 Pressure Maintenance Pump Controller

Pressure maintenance pump controller shall be arranged for automatic and manual starting and stopping and equipped with a "manual-off-automatic" switch. The controller shall be completely prewired, ready for field connections, and wall-mounted in a NEMA Type 2 drip-proof enclosure. The controller shall be equipped with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments for automatic starting and stopping. A sensing line shall be provided

connected to the pressure maintenance pump discharge piping between the control valve and the check valve. The sensing line shall conform to paragraph, PRESSURE SENSING LINE. The sensing line shall be completely separate from the fire pump sensing lines. An adjustable run timer shall be provided to prevent frequent starting and stopping of the pump motor. The run timer shall be set for 2 minutes.

2.11 DIESEL FUEL SYSTEM EXTERNAL TO ENGINE

Fuel system shall be provided that meets all requirements and advisory provisions of NFPA 20 and NFPA 37. The fuel tank vent piping shall be equipped with screened weatherproof vent cap. Vents shall be extended to the outside. Each tank shall be equipped with a fuel level gauge. Flexible bronze or stainless steel piping connectors with single braid shall be provided at each piping connection to the diesel engine. Supply, return, and fill piping shall be steel piping, except supply and return piping may be copper tubing. Fuel lines shall be protected against mechanical damage. Fill line shall be equipped with 16 mesh removable wire screen. Fill lines shall be extended to the exterior. A weatherproof tank gauge shall be mounted on the exterior wall near each fill line for each tank. The fill cap shall be able to be locked by padlock. The engine supply (suction) connection shall be located on the side of the fuel tank so that 5 percent of the tank volume provides a sump volume not useable by the engine. The elevation of the fuel tank shall be such that the inlet of the fuel supply line is located so that its opening is no lower than the level of the engine fuel transfer pump. The bottom of the tank shall be pitched 1/4 inch/foot to the side opposite the suction inlet connection, and to an accessible 1 inchplugged globe drain valve.

2.11.1 Steel pipe

ASTM A53/A53M, hot-dipped zinc-coated, Schedule 40, threaded connections. Fittings shall be ASME B16.3, zinc-coated, threaded malleable iron fittings. Unions shall be ASME B16.39 zinc-coated, threaded unions.

2.11.2 Copper Tubing

ASTM B 88, Type K, soft annealed, with ASME B16.26 flared fittings.

2.11.3 Diesel Fuel Tanks

UL 80 or UL 142 for aboveground tanks.

2.11.4 Valves

An indicating and lockable ball valve shall be provided in the supply line adjacent to the tank suction inlet connection. A check valve shall be provided in fuel return line. Valves shall be suitable for oil service. Valves shall have union end connections or threaded end connections.

a. Globe valve: MSS SP-80 Class 125

b. Check valve: MSS SP-80, Class 125, swing check

c. Ball valve: Full port design, copper alloy body, 2-position lever handle.

2.12 JOINTS AND FITTINGS FOR COPPER TUBE

Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75. Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used. Grooved mechanical joints and fittings shall be designed for not less than 125 psig service and shall be the product of the same manufacturer. Grooved fitting and mechanical coupling housing shall be ductile iron conforming to ASTM A536. Gaskets for use in grooved joints shall be molded synthetic polymer of pressure responsive design and shall conform to ASTM D 2000 for circulating medium up to 239 degrees F. Grooved joints shall conform to AWWA C606 Coupling nuts and bolts for use in grooved joints shall be steel and shall conform to ASTM A183.

2.13 PUMP BASE PLATE AND PAD

A common base plate shall be provided for each horizontal-shaft fire pump for mounting pump and driver unit. The base plate shall be constructed of cast iron with raised lip tapped for drainage or welded steel shapes with suitable drainage. Each base plate for the horizontal fire pumps shall be provided with a 1 inchgalvanized steel drain line piped to the nearest floor drain. For vertical shaft pumps, pump head shall be provided with a cast-iron base plate and shall serve as the sole plate for mounting the discharge head assembly. Pump units and bases shall be mounted on a raised 6 inchesreinforced concrete pad that is an integral part of the reinforced concrete floor.

2.14 HOSE VALVE MANIFOLD TEST HEADER

Hose valve test header shall be connected by ASME B16.5, Class 150 flange inlet connection. Hose valves shall be UL listed UL Fire Prot Dir or FM approved FM APP GUIDE bronze hose gate valves with 2.5 inches American National Fire Hose Connection Screw Standard Threads (NH) in accordance with NFPA 1963. The number of valves shall be in accordance with NFPA 20. Each hose valve shall be equipped with a cap and chain, and located no more than 3 feet and no less than 2 feet above grade.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 FIRE PUMP INSTALLATION RELATED SUBMITTALS

The Fire Protection Specialist shall prepare a list of the submittals, from the Contract Submittal Register, that relate to the successful installation of the fire pump(s), no later than 7 days after the approval of the Fire Protection Specialist and the Manufacturer's Representative. The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Fire Protection Specialist when submitted to the Government.

3.3 INSPECTION BY FIRE PROTECTION SPECIALIST

The Fire Protection Specialist shall periodically perform a thorough inspection of the fire pump installation, including visual observation of the pump while running, to assure that the installation conforms to the contract requirements. There shall be no excessive vibration, leaks (oil or water), unusual noises, overheating, or other potential problems. Inspection shall include piping and equipment clearance, access, supports, and guards. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered. The Fire Protection Specialist shall witness the preliminary and final acceptance tests and, after completion of the inspections and a successful final acceptance test, shall sign test results and certify in writing that the installation the fire pump installation is in accordance with the contract requirements.

3.4 INSTALLATION REQUIREMENTS

Carefully remove materials so as not to damage material which is to remain. Replace existing work damaged by the Contractor's operations with new work of the same construction. Equipment, materials, workmanship, fabrication, assembly, erection, installation, examination, inspection and testing shall be in accordance NFPA 20, except as modified herein. In addition, the fire pump and engine shall be installed in accordance with the written instructions of the manufacturer.

3.5 PIPE AND FITTINGS

Piping shall be inspected, tested and approved before burying, covering, or concealing. Fittings shall be provided for changes in direction of piping and for all connections. Changes in piping sizes shall be made using tapered reducing pipe fittings. Bushings shall not be used.

3.5.1 Cleaning of Piping

Interior and ends of piping shall be clean and free of any water or foreign material. Piping shall be kept clean during installation by means of plugs or other approved methods. When work is not in progress, open ends of the piping shall be securely closed so that no water or foreign matter will enter the pipes or fittings. Piping shall be inspected before placing in position.

3.5.2 Threaded Connections

Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread tape conforming to ASTM D 3308 and shall be applied to male threads only. Exposed ferrous pipe threads shall be provided with one coat of zinc molybdate primer applied to a minimum of dry film thickness of 1 mil.

3.5.3 Pipe Hangers and Supports

Additional hangers and supports shall be provided for concentrated loads in aboveground piping, such as for valves and risers.

3.5.3.1 Vertical Piping

Piping shall be supported at each floor, at not more than 10 foot intervals.

3.5.3.2 Horizontal Piping

Horizontal piping supports shall be spaced as follows:

MAXIMUM SPACING (FEET)

Nominal Pipe Size (inches)	1 and Under	1.25	1.5	2	2.5	3	3.5	4	5	6+
Copper Tube	6	7	8							
Steel Pipe	7	8	9	10	11	12	13	14	16	17

3.5.4 Underground Piping

Installation of underground piping and fittings shall conform to NFPA 24. Joints shall be anchored in accordance with NFPA 24. Concrete thrust block shall be provided at elbow where pipe turns up towards floor, and the pipe riser shall be restrained with steel rods from the elbow to the flange above the floor. After installation in accordance with NFPA 24, rods and nuts shall be thoroughly cleaned and coated with asphalt or other corrosion-retard material approved by the Contracting Officer. Minimum depth of cover shall be 3 feet.

3.5.5 Grooved Mechanical Joint

Grooves shall be prepared according to the coupling manufacturer's instructions. Grooved fittings, couplings, and grooving tools shall be products of the same manufacturer. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

3.6 ELECTRICAL WORK

Electric motor and controls shall be in accordance with NFPA 20, NFPA 72 and NFPA 70, unless more stringent requirements are specified herein or are indicated on the drawings. Electrical wiring and associated equipment shall be provided in accordance with NFPA 20 and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide wiring in rigid metal conduit or intermediate metal conduit, except electrical metallic tubing conduit may be provided in dry locations not enclosed in concrete or where not subject to mechanical damage.

3.7 PIPE COLOR CODE MARKING

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.8 FLUSHING

The fire pump suction and discharge piping shall be flushed at 120 percent of rated capacity of each pump. Where the pump installation consists of more than one pump, the flushing shall be the total quantity of water flowing when all pumps are discharging at 120 percent of their rated capacities. The new pumps may be used to attain the required flushing volume. No underground piping shall be flushed by using the fire pumps. Flushing operations shall continue until water is clear, but not less than 10 minutes. Submit a signed and dated flushing certificate before requesting field testing.

3.9 FIELD TESTS

Submit, at least 2 weeks before starting field tests, system diagrams that show the layout of equipment, piping, and storage units, and typed condensed sequence of operation, wiring and control diagrams, and operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system shall be framed under glass or laminated plastic. After approval, these items shall be posted where directed.Proposed diagrams, at least 2 weeks prior to start of related testing.

3.9.1 Hydrostatic Test

Piping shall be hydrostatically tested at 225 psigfor a period of 2-hours, or at least 50 psiin excess of the maximum pressure, when the maximum pressure in the system is in excess of 175 psi in accordance with NFPA 20.

3.9.2 Preliminary Tests

Submit proposed procedures for Preliminary Tests, at least 14 days prior to the proposed date and time to begin Preliminary Tests. The Fire Protection Specialist shall take all readings and measurements. The Manufacturer's Representative, a representative of the fire pump controller manufacturer, and a representative of the diesel engine manufacturer (when supplied) shall witness the complete operational testing of the fire pump and drivers. The fire pump controller manufacturer's representative and the diesel engine manufacturer's representative shall each be an experienced technician employed by the respective manufacturers and capable of demonstrating operation of all features of respective components including trouble alarms and operating features. Fire pumps, drivers and equipment shall be thoroughly inspected and tested to insure that the system is correct, complete, and ready for operation. Tests shall ensure that pumps are operating at rated capacity, pressure and speed. Tests shall include manual starting and running to ensure proper operation and to detect leakage or other abnormal conditions, flow testing, automatic start testing, testing of automatic settings, sequence of operation check, test of required accessories; test of pump alarms devices and supervisory signals, test of pump cooling, operational test of relief valves, and test of automatic power transfer, if provided. Pumps shall run without abnormal noise, vibration or heating. If any component or system was found to be defective, inoperative, or not in compliance with the contract requirements during the tests and inspection, the corrections shall be made and the entire preliminary test shall be repeated. Submit 3 copies of the completed Preliminary Tests Reports, no later that 7 days after the completion of the Preliminary Tests. The Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the

Contractor's Material and Test Certificate for Aboveground Piping. All items in the Report shall be signed by the Fire Protection Specialist and the Manufacturer's Representative.

3.9.3 Army Final Acceptance Test

The Fire Protection Specialist shall take all readings and measurements. The Manufacturer's Representative, the fire pump controller manufacturer's representative, and the diesel engine manufacturer's representative (when supplied) shall also witness for the final tests. Repair any damage caused by hose streams or other aspects of the test. Submit proposed date and time to begin Army Final Acceptance Test, with the Acceptance Procedures. Notification shall be provided at least 14 days prior to the proposed start of the test. Submit 3 copies of the completed Army Final Acceptance Test Reports, no later that 7 days after the completion of the tests. All items in the reports shall be signed by the Fire Protection Specialist and the Manufacturer's Representative. Test reports in booklet form (each copy furnished in a properly labeled three ring binder) showing all field tests and measurements taken during the preliminary and final testing, and documentation that proves compliance with the specified performance criteria, upon completion of the installation and final testing of the installed system. Each test report shall indicate the final position of the controls and pressure switches. The test reports shall include the description of the hydrostatic test conducted on the piping and flushing of the suction and discharge piping. A copy of the manufacturer's certified pump curve for each fire pump shall be included in the report. Notification shall include a copy of the Contractor's Material & Test Certificates. Include the following in the final acceptance test:

3.9.3.1 Flow Tests

Flow tests using the test header, hoses and playpipe nozzles shall be conducted. Flow tests shall be performed at churn (no flow), 75, 100, 125 and 150 percent capacity for each pump and at full capacity of the pump installation. Flow readings shall be taken from each nozzle by means of a calibrated pitot tube with gauge or other approved measuring equipment. Rpm, suction pressure and discharge pressure reading shall be taken as part of each flow test. Voltage and ampere readings shall taken on each phase as part of each flow test for electric-motor driven pumps.

3.9.3.2 Starting Tests

Pumps shall be tested for automatic starting and sequential starting. Setting of the pressure switches shall be tested when pumps are operated by pressure drop. Tests may be performed by operating the test connection on the pressure sensing lines. As a minimum, each pump shall be started automatically 10 times and manually 10 times, in accordance with NFPA 20. Tests of engine-driven pumps shall be divided equally between both set of batteries. The fire pumps shall be operated for a period of a least 10 minutes for each of the starts; except that electric motors over 200 horsepowershall be operated for at least 15 minutes and shall not be started more than 2 times in 10 hours. Pressure settings that include automatic starting and stopping of the fire pump(s) shall be indicated on an etched plastic placard, attached to the corresponding pump controller.

3.9.3.3 Battery Changeover

Diesel driven fire pumps shall be tested for automatic battery changeover in event of failure of initial battery units.

3.9.3.4 Alarms

All pump alarms, both local and remote, shall be tested. Supervisory alarms for diesel drivers shall be electrically tested for low oil pressure, high engine jacket coolant temperature, shutdown from overspeed, battery failure and battery charger failure.

3.9.3.5 Miscellaneous

Valve tamper switches shall be tested. Pressure recorder operation relief valve settings, valve operations, operation and accuracy of meters and gauges, and other accessory devices shall be verified.

3.9.3.6 Correction of Deficiencies

If equipment was found to be defective or non-compliant with contract requirements, perform corrective actions and repeat the tests. Tests shall be conducted and repeated if necessary until the system has been demonstrated to comply with all contract requirements.

3.9.3.7 Test Documentation

The Manufacturer's Representative shall supply a copy of the manufacturer's certified curve for each fire pump at the time of the test. The Fire Protection Specialist shall record all test results and plot curve of each pump performance during the test. Complete pump acceptance test data of each fire pump shall be recorded. The pump acceptance test data shall be on forms that give the detail pump information such as that which is indicated in Figure A-11-2.6.3(f) of NFPA 20. All test data records shall be submitted in a three ring binder.

3.9.4 Test Equipment

Provide all equipment and instruments necessary to conduct a complete final test, including 2.5 inch diameter hoses, playpipe nozzles, pitot tube gauges, portable digital tachometer, voltage and ampere meters, and calibrated oil-filled water pressure gauges. Provide all necessary supports to safely secure hoses and nozzles during the test. The Government will furnish water for the tests.

3.9.5 As-Built Drawings

Submit As-Built Drawings, no later than 14 days after completion of the Final Tests. The Fire Pump Installation Drawings shall be updated to reflect as-built conditions after all related work is completed and shall be on reproducible full-size mylar film.

3.10 FIELD TRAINING

The Fire Protection Specialist and the Manufacturer's Representative shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Submit the proposed schedule for field training at least 14 days prior to the start of related training. Training shall be provided for a period of 2 hours of normal working time and shall start after the fire pump installation is functionally complete and after the Final Acceptance Test. The field instruction shall cover all of the items contained in the approved Operating and Maintenance Instructions. Submit 6 manuals listing step-by-step procedures required

for system startup, operation, shutdown, and routine maintenance, at least days prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Data Package 3 shall be submitted for fire pumps and drivers in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

-- End of Section --

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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; 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 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; TIA 11-1; Errata 2011) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to certain sections of Division 02, EXISTING CONDITIONS. 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 56 00 EXTERIOR LIGHTING

Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION
Section 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP)

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 12.47/7.2 kV primary, three phase, 60 Hz, and 480/277 volts secondary, three phase, four wire. Final connections to the power distribution system at the existing pole shall be made by the utility, Nolin RECC.

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 pad-mounted transformers, pad-mounted switches, 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. PPSO710D72 or approved equal.

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 --

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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.

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

ASTM INTERNATIONAL (ASTM)

ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

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

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA C136.10	(2010) American National Standard for Roadway and Area Lighting Equipment-Locking-Type Photocontrol Devices and Mating Receptacles--Physical and Electrical Interchangeability and Testing
NEMA ICS 6	(1993; R 2006) Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; TIA 11-1; Errata 2011) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

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 Mar 2011) 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

SD-03 Product Data

Lighting contactor; G

Time switch; G

Photocell switch; G

Steel poles; G

Brackets

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

Not Used

1.4.2 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.

1.4.3 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.

1.4.3.1 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.

1.4.3.2 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 Steel Poles

Not Used

1.6 SUSTAINABLE DESIGN REQUIREMENTS

1.6.1 Energy Efficiency

Not Used

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 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 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.2 LUMINAIRES

Not Used

2.2.1 Ballasts for High-Intensity-Discharge (HID) Luminaires

Not Used

2.3 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 3R enclosure conforming to NEMA ICS 6.

2.4 PHOTOCELL 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 high-impact-resistant, noncorroding and nonconductive molded

plastic housing with a fixture mounted, locking-type receptacle conforming to NEMA C136.10 and rated 1800 VA, minimum.

2.5 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.

2.5.1 Steel Poles

Not Used

2.6 BRACKETS AND SUPPORTS

Not Used

2.7 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 A153/A153M. Concrete shall be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.8 EQUIPMENT IDENTIFICATION

2.8.1 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.

2.8.2 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.

2.9 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 Steel 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 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION. 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. After installation, paint exposed surfaces of steel poles with two finish coats of epoxy paint of a color as indicated.

3.1.2 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.

3.1.3 Photocell Switch Aiming

Aim switch according to manufacturer's recommendations.

3.1.4 GROUNDING

Ground noncurrent-carrying parts of equipment including metal poles, luminaires, mounting arms, brackets, and metallic enclosures as specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.1.5 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces

or to meet the indicated or specified safety criteria.

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 --

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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 WATER WORKS ASSOCIATION (AWWA)

AWWA C600	(2005) Installation of Ductile-Iron Water Mains and Their Appurtenances

ASTM INTERNATIONAL (ASTM)

ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse 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	(2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 2487	(2006e1) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 422	(1963; R 2007) Particle-Size Analysis of Soils
ASTM D 4318	(2005) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 698	(2007e1) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

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. Satisfactory materials for grading shall be free from roots and other organic matter, trash, debris, frozen material, and stones larger 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.

1.2.5 Topsoil

Material suitable for topsoils obtained from required stripping of the project site and/or off the installation 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. Topsoil shall be suitable for specified plants.

Material obtained from off-installation areas suitable for topsoil shall meet the requirements specified for topsoil in Section 32 93 00 EXTERIOR PLANTS.

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 material 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 consisting of materials classified as GW, GP, SW, SP 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 1 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 1 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 30 when tested in accordance with ASTM D 4318.

1.2.12 Nonfrost Susceptible (NFS) Material

Nonfrost susceptible material are a uniformly graded washed sand with a maximum particle size of 0.01 inch and less than 5 percent passing the No. 200 size sieve, and with not more than 3 percent by weight finer than 0.02 mm grain size.

1.2.13 Pile Supported Structure

As used herein, a structure where both the foundation and floor slab are pile supported.

1.3 SYSTEM DESCRIPTION

Subsurface soil boring logs are appended to the RFP in Appendix A. The subsoil investigation report and samples of materials taken from subsurface investigations may be examined at TTL, 5010 Linbar Drive, Suite 153, Nashville, TN 37211 (615.531.7770). 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. Finish the specified excavation on a classified basis, in accordance with the following designations and classifications.

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

Submit 15 days prior to starting work.

SD-03 Product Data

Procedure and location for disposal of unused satisfactory 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; G

Within 24 hours of conclusion of physical tests, 3 copies of test results.

Field Density Tests; G

Copies of all laboratory and field test reports within 24 hours of the completion of the test. Each report shall be properly identified. Test methods used and compliance with specified test standards shall be described. Summary sheets specified herein shall be submitted as indicated.

SD-07 Certificates

Certificates of Compliance; G

Certificates of compliance indicating conformance with specified requirements shall be furnished for capillary water barrier materials.

Testing; G, RE

Qualifications of the Corps validated commercial testing laboratory or the Contractor's validated testing facilities.

Testing facilities for the performance of laboratory soil tests must be approved by the Contracting Officer prior to work being performed.

1.4.1 Earthwork Beneath Buildings

SD-06 Test Reports

Field Density Tests

Copies of all laboratory and field test reports within 24 hours of the completion of the test. Each report shall be properly identified. Test methods used and compliance with specified test standards shall be described. Summary sheets specified herein shall be submitted as indicated.

SD-07 Certificates

Certificates of Compliance

Certificates of compliance indicating conformance with specified requirements shall be furnished for capillary water barrier materials.

Testing; G, RE

Testing facilities for the performance of laboratory soil tests must be approved by the Contracting Officer prior to work being performed.

1.4.2 Earthwork for Utilities System

SD-04 Samples

SD-06 Test Reports

Field Density Tests

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

SD-07 Certificates

Testing; G, RE

Qualifications of the commercial testing laboratory.

SD-09 Manufacturer's Field Reports

Utilization of Excavated Materials

PART 2 PRODUCTS

2.1 BURIED WARNING AND IDENTIFICATION TAPE

Provide polyethylene plastic and 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 inch 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

2.1.1 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.

2.1.2 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.

2.2 DETECTION WIRE FOR NON-METALLIC PIPING

Insulate a single strand, solid copper detection wire with a minimum of 12 AWG.

2.3 MATERIAL FOR RIP-RAP

Provide Bedding material Filter fabric and rock conforming to these requirements: KYTC Section 805, for construction indicated.

2.3.1 Bedding Material

Provide bedding material consisting of sand, gravel, or crushed rock, well graded, with a maximum particle size of 2 inch. Compose material of tough, durable particles. Allow fines passing the No. 200 standard sieve with a plasticity index less than six.

2.3.2 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.

2.3.3 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.

2.4 CAPILLARY WATER BARRIER

Capillary water barrier shall consist of clean, crushed, nonporous stone, crushed gravel, or uncrushed gravel conforming to the requirements of ASTM C33 for coarse aggregate grading size 57, 67, 78, or 89.

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Where needed or directed, strip topsoil to full depth of topsoil. 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 inch in diameter, and other materials that would interfere with planting and maintenance operations. Remove from the site 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. 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.

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 and 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 below the working level. The Contractor shall provide drainage and dewatering as required to ensure that all foundation excavations are accomplished with the subgrade soils remaining dry and firm until after the foundations are constructed and backfilled.

3.2.5 Trench Excavation Requirements

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical, except that trench construction shall be in accordance with OSHA. Trench walls more

than 3 feet deep shall be cut back, excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter and shall not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor 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 3 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 4 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 inch clear between the outer structure surfaces and the face of the excavation or support members 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 of 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. Excavation made with power-driven equipment is not permitted within two feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer. 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. 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. Borrow material must be obtained from approved locations as shown on the plans.

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

When shoring is required, submit a Shoring and Sheeting 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 sheeting of excavations. Finish shoring, including sheet piling, and install as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Remove shoring, bracing, and sheeting 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

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 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. In areas which have not been recently graded, scarify the surface to a depth of 6 inch 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 inch, 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 inch 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 inch below finished grade; under pavements and slabs, bury tape 6 inch 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 inch 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 as specified in paragraph GROUND SURFACE PREPARATION. 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 as needed prior to performing the required pressure tests.

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 inch loose thickness.

3.11.1.3 Bedding and Initial Backfill

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 in accordance with drawings.

d. Clean, coarsely graded natural gravel, crushed stone or a combination thereof in accordance with drawings.

3.11.1.4 Final Backfill

Fill the remainder of the trench, except for special materials for roadways, with satisfactory material. Place backfill material and compact as follows:

a. Roadways: 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 inch loose thickness, and compact it to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Do not permit compaction by water flooding or jetting. 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, 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 inch 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 3.5 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

3.12.3 Electrical Distribution System

Provide a minimum cover of 24 inch from the finished grade to direct burial cable and conduit or duct line, unless otherwise indicated.

3.12.4 Rip-Rap Construction

Construct rip-rap on filter fabric with grout in accordance with KYTC Section 805 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.

3.12.4.1 Bedding Placement

Spread bedding material uniformly to a thickness of at least 3 inch on prepared subgrade as indicated.

3.12.4.2 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.

3.13 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 inch 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 brake 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. Proof roll the existing subgrade 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 to a depth of 6 inch 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 inch 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. 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 90 percent of laboratory maximum density.

3.14.3.1 Subgrade for Pavements

Compact subgrade for pavements to at least 92 percentage laboratory maximum density for the depth below the subgrade of 12 inches in fill or backfill and 8 inches in undistrubed native soil or cut.

3.14.3.2 Subgrade for Shoulders

Compact subgrade for shoulders to at least 92 percentage laboratory maximum density for a depth of 8-inches below finish grade.

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 no 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 inch depth for bonding of topsoil with subsoil. Spread topsoil evenly to a thickness of 6 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 offsite areas.

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 1556. 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 200 yards stockpiled or in-place source material. Determine gradation of fill and backfill material in accordance with ASTM D 422 and ASTM D 1140 (wash 0.003 inches, without hydrometer). Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318. Classification of soils shall be in accordance with ASTM D 2487. Moisture content shall be determined in accordance with ASTM D 2216.

3.18.2 In-Place Densities

a. One test per 2,000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.

b. One test per 1,500 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

c. One test per 1,500 linear feet, or fraction thereof, of each lift of embankment or backfill for roads .

3.18.3 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.

3.18.4 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 7,000 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.18.5 Tolerance Tests for Subgrades

Perform continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION during construction of the subgrades.

3.18.6 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 inch, 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 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 Contractor Quality Control approval. 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
Termiticides; G
Foundation Exterior
Utilities and Vents
Crawl and Plenum Air Spaces
Verification of Measurement
Application Equipment; G
Warranty; G

SD-04 Samples

Termiticides; G

SD-06 Test Reports

Equipment Calibration and Tank Measurement
Soil Moisture
Quality Assurance; G

SD-07 Certificates

Qualifications; G

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 signed by an officer of the Contractor,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. Submit written verification that utilities and vents have been located and treated as specified.

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

Submit a copy of Contractor's 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

Submit manufacturer's label and Material Safety Data Sheet (MSDS) for termiticides proposed for use. 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. Submit 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.

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 that the volume of termiticide used meets the application rate.

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 00 00 EARTHWORK, 32 92 19 SEEDING, 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 with proposed sequence of treatment work with dates and times for approval before starting the specified treatment. 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.

3.4 TERMITICIDE TREATMENT

3.4.1 Equipment Calibration and Tank Measurement

Submit a listing of equipment to be used. 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. Submit 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 --

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SECTION 31 32 11

SOIL SURFACE EROSION CONTROL

08/08

PART 1 GENERAL

1.1 MEASUREMENT AND PAYMENT

1.1.1 Standard and Geosynthetic Binder

Measure the standard and geosynthetic binder by the square yard of surface area covered. No measurement for payment will be made for fine grading, trenching or other miscellaneous materials necessary for placement of the binder.

1.1.2 Mulch and Compost

Measure mulch and compost by the square yard of surface area covered. No measurement for payment will be made for binder, dye or other miscellaneous materials or equipment necessary for placement of the mulch or compost.

1.1.3 Hydraulic Mulch

Measure hydraulic mulch by the square yard of surface area covered. Measurement for payment will include binder, dye or both. No measurement for payment will be made for other miscellaneous materials or equipment necessary for placement of the hydraulic mulch.

1.1.4 Geotextile Fabric

Measure geotextile fabrics by the square yard of surface area covered. No measurement for payment will be made for fine grading, trenching or other miscellaneous materials necessary for placement of the fabric.

1.1.5 Erosion Control Blankets

Measure erosion control blankets by the square yard of surface area covered. No measurement for payment will be made for fine grading, trenching or other miscellaneous materials necessary for placement of the erosion control blankets.

1.1.6 Synthetic Grid/Sheet Systems

Measure synthetic grid/sheet system by the square yard of surface area covered. No measurement for payment will be made for fine grading, trenching, geotextile, seams, grout, rock, topsoil or other miscellaneous materials necessary for placement of the articulating cellular concrete block system.

1.1.7 Cellular Concrete Block Systems

Measure articulating cellular concrete block system by the square yard of surface area covered. No measurement for payment will be made for fine grading, trenching, geotextile, seams, grout, rock, topsoil or other miscellaneous materials necessary for placement of the articulating

cellular concrete block system.

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 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; R 2011) Standard Test Method for Mass Per Unit Area (Weight) of Fabric
ASTM D 3787	(2007) Bursting Strength of Textiles - Constant-Rate-of-Traverse (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 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 2009) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.3 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. Submit a listing of equipment to be used for the application of erosion control materials. Coordinate this section with the requirements of Section 31 00 00 EARTHWORK. 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.

1.4 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-01 Preconstruction Submittals

Work sequence schedule; G
Erosion control plan; G; (LEED)

SD-02 Shop Drawings

Layout;
Obstructions Below Ground;
Erosion Control;
Seed Establishment Period
Maintenance Record

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;
Aggregate
Synthetic Grid Systems;
Equipment
Finished Grade
Erosion Control Blankets

SD-04 Samples

Materials

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.

1.5 QUALITY ASSURANCE

1.5.1 Installer's Qualification

The installer shall be certified by the manufacturer for training and experience installing the material.

1.5.2 Substitutions

Substitutions will not be allowed without written request and approval from the Contracting Officer.

1.5.3 SUSTAINABLE DESIGN REQUIREMENTS

1.5.3.1 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. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Erosion control materials may be locally available.

1.6 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.

d. Submit the following materials and items in the quantities specified:

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.

1.7 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 contaminates 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. Wood cellulose fiber shall not contain environmentally hazardous levels of heavy metals. Materials may be bulk tested or tested by toxicity characteristic leaching procedure (TCLP).

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 $\pm$ 0.1
Organic Matter (oven dried basis),	percent 99.3 within $\pm$ 0.2
Inorganic Ash (oven dried basis),	percent 0.7 within $\pm$ 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.

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 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, Type (percent strength retained)	58 percent X 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

Material Content

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

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.

Material Content

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
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/yd^2 weight.
Netting	Top and bottom sides,Leno woven 100% biodegradable natural organic fiber with approximately 9.3 $lb/1,000ft^2$ weight.

Material Content	
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/yd^2 weight. 30 percent coconut fiber cured in fresh water with approximately 0.15 lb/yd^2 weight.
Netting	Both sides woven 100% biodegradable natural organic fiber with approximately 9.3 lbs/1,000 ft^2 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 cuspated (crimped) middle netting overlaid with a heavy duty UV stabilized top net. The cuspated 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

Property	Test Method	Value	Units
Elongation	ASTM D 5035		percent
Tensile Strength	ASTM D 5035		960 lb/ft
Elongation	ASTM D 5035	31	percent
Tensile Strength	ASTM D 5035		177 lbs
Elongation	ASTM D 5035	22	percent
Resiliency	ASTM D 1777	greater than 80	percent
UV Stability*	ASTM D 4355		151 lbs
		86	percent
Color(permanent net)		UV Black	
Porosity(permanent net)Calculated		greater than 95	percent
Minimum Filament Diameter (permanent net)	Measured		0.03 in

NOTE 1: * ASTM D 5035 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 5035	89	lbs
Elongation	ASTM D 5035	21	percent
UV Stability*	ASTM D 4355	81*	lbs
		90*	percent

NOTE 1: *ASTM D 5035 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.

Property	Test Method	Value	Units

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 ft^2 weight.

Seed 0.033 lbs/yd^2 (160 lbs/acre)

0.017 lbs/yd^2 (80 lbs/acre)

Bottom ply 1-ply recycled unbleached cellulose issue with approximately 4.3 lbs/(1,000 ft^2) weight.

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 calendar time for 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.

2.5.12.2 Permanent Seed Species and Mixtures

Not Used

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 SYNTHETIC GRID AND SHEET SYSTEMS

Synthetic grid and sheet systems shall be formed of recycled plastic in accordance with paragraph RECYCLED PLASTICS and have interlocking components to form a uniform underlayment or strata to receive fill.

2.6.1 Synthetic Grid Systems

Grids shall be made of modular interlocking components. Form blocks as rigid interlocking components or as expandable sheets and manufacture to allow articulation upward and downward while restricting lateral movement. The assembled grid system shall articulate over three-directional vertical curves, both upward and downward. Provide 100 percent coverage of the area with the cells back filled.

2.6.2 Synthetic Sheet System

Not Used

2.7 AGGREGATE

Aggregate shall be onsite or offsite material generated from grading and demolition operations, as available. Recycled crushed concrete shall be free of steel, free-draining and graded between a minimum 3/4 inch and a maximum 1.5 inches. Submit sieve test results for both gravel and sand.

2.8 ARTICULATING CELLULAR CONCRETE BLOCK SYSTEMS

Not Used

2.9 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

Provide condition of finish grade status prior to installation, location of

underground utilities and facilities. 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. Submit scale drawings defining areas to receive recommended materials as required by federal, state or local regulations.

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 Synthetic Binders

Apply synthetic binders heaviest at edges of areas and at crests of ridges and banks to prevent displacement.

3.3.2 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.

3.3.3 Mulch Installation

Install mulch in the areas indicated. Apply mulch evenly.

3.3.4 Mulch Control Netting

Netting may be stapled over mulch according to manufacturer's recommendations.

3.3.5 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.

3.3.6 Asphalt Adhesive Tackifier

Asphalt adhesive tackifier shall be sprayed at a rate between 10 to 13 gallons/1000 square feet. Do no completely exclude sunlight from penetrating to the ground surface.

3.3.7 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.

3.3.8 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.

3.3.9 Wood Cellulose Fiber, Paper Fiber, and Recycled Paper

Apply wood cellulose fiber, paper fiber, or recycled paper as part of the hydraulic mulch operation.

3.3.10 Hydraulic Mulch Application

3.3.10.1 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.

3.3.10.2 Seeded Area

For drill or broadcast seeded areas, apply hydraulic mulch evenly. For hydraulic seeded areas, apply mulch with the seed and fertilizer in a second application of mulch only.

3.3.11 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.

3.3.12 Synthetic Sheet System

Anchor synthetic sheet systems in accordance with the manufacturer's recommendation. Place systems on a well graded surface and then backfill, a maximum seven days after placement, to protect the material from ultraviolet radiation. Include contiguous perimeter termination trenches as the installation progresses.

3.3.12.1 Sheet System Revegetation

For areas not requiring re-vegetation, backfill openings to grade with well graded fill material and surface prepared for finish as indicated on the drawings. For areas requiring re-vegetation, backfill openings using well graded fill and topsoil as indicated on the drawings.

3.3.12.2 Sheet System Grids

Each pair of grids shall cover grade without gaps or open spaces between them. Provide 100 percent coverage of the area with the cells backfilled.

3.3.12.3 Sheet System Seeding

Install seed in accordance with Section 32 92 19 SEEDING.

3.3.12.4 Grid System Grids

Anchor synthetic grid systems in accordance with the manufacturer's recommendation. Place interlocking grid systems on well graded surface. Complete the backfilling of openings a maximum 7 days after placement to protect the material from ultraviolet radiation. As the installation progresses, backfilling shall include contiguous perimeter termination trenches.

3.3.13 Grids

3.3.13.1 Grid System Revegetation

For areas not requiring re-vegetation, backfill openings with a minimum 1/2 inch nominal size crushed rock, to a minimum 2 inch depth.

3.3.13.2 Synthetic Grids

Each pair of grids shall cover grade without gaps or open spaces between them. The system shall provide 100 percent coverage of the area with the cells backfilled.

3.3.13.3 Grid System Seeding

Install seed in accordance with Section 32 92 19 SEEDING.

3.3.14 Articulating Cellular Concrete Block System Installation

Not Used

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.

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 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 5893	(2004) Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements
ASTM D 6690	(2007) 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
ASTM D 789	(2007) Determination of Relative Viscosity and Moisture Content of Polyamide (PA)

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 525	(1989) 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 2) 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 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.

1.2.1.2 Sandblasting Equipment

Include with the sandblasting equipment an air compressor, hose, and long-wearing venturi-type nozzle of proper size, shape and opening. The maximum nozzle opening should not exceed 1/4 inch. The air compressor shall be portable and capable of furnishing not less than 150 cfm and maintaining a line pressure of not less than 90 psi at the nozzle while in use. Demonstrate compressor capability, under job conditions, before approval. 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 approximately 1 inch above the pavement surface. Adjust the height, angle of inclination and the size of the nozzle as necessary to secure satisfactory results.

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 and ASTM D 7116 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 D 5893 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 Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Manufacturer's Recommendations.

Printed copies of manufacturer's recommendations, 15 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, 15 days prior to use

on the project.

SD-04 Samples

Materials.

Samples of the materials (sealant, primer if required, and backup material), in sufficient quantity for testing and approval 15 days prior to the beginning of work. No material will be allowed to be used until it has been approved.

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. No material shall be used at the project prior to receipt of written notice that the materials meet the laboratory requirements. If the samples fail to meet specification requirements, replace the materials represented by the sample and test the new materials at the Contractor's expense. Perform testing of the materials in an approved independent laboratory and submit certified copies of the test reports for approval 15 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
All Areas	ASTM D 6690, Type III 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 Sawing

3.1.1.1 Facing of Joints

Accomplish facing of joints using a concrete saw as specified in paragraph

EQUIPMENT. 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 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 or waterblasted 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.

3.1.3 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.

3.1.4 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.

3.1.5 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.

3.3 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 to 1/4 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 --

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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
ASTM D 6155	(2006) Nontraditional Coarse Aggregate for Bituminous Paving Mixtures

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 2009) 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

95 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 applies to this section for installation of seed requirements, with additions and modifications herein.

Section 32 93 00 EXTERIOR PLANTS applies to this section for installation of trees, shrubs, ground cover, and 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 Contractor Quality Control approval. 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

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.

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, Lime, Iron, Mulch Storage

Material shall be stored in designated areas. Lime and 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 minimum percentages, by weight, of plant food nutrients as recommended by the manufacturer.

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 60 percent post-consumer rubber or plastic.

2.3 MULCHES TOPDRESSING

Free from noxious weeds, mold, or other deleterious materials.

2.3.1 Inert Mulch Materials

Recycled porcelain, concrete, stone, or other recycled material complying with ASTM D 6155. Provide materials from site and construction waste to the greatest extent possible. Mulch shall contain a minimum of 5 percent post-consumer recycled content, or a minimum of 20 percent post-industrial recycled content.

2.3.2 Organic Mulch Materials

Wood cellulose fiber 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.

2.3.3 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 weed and pest management strategies. Use biological pest controls as approved in the Plan.

PART 3 EXECUTION

3.1 EXTENT OF WORK

Provide landscape construction maintenance to include irrigation equipment cleaning and adjustments, mowing, edging, overseeding, fertilizing, watering, weeding, pruning, stake and guy adjusting, 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 plans 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 95 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, aerate, 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 4 inches for spring/summer maintenance and to a minimum average height of 4 inches for fall 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, 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 Aeration

Upon completion of weed eradication operations and Contracting Officer's approval to proceed, aerate turf areas by approved device. Core, by pulling soil plugs. Leave all soil plugs that are produced in the turf area.

Blend all parts of topdressing mixture to a uniform consistency throughout.] Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean all soil plugs off of other paving when work is complete. This work shall commence prior final acceptance of the maintenance establishment period.

3.3.8 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.

3.3.9 Replanting

Replant in accordance with Section 32 92 19 SEEDING and within specified

planting dates areas which do not have a satisfactory stand of turf.

3.3.10 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 has 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 and turnbuckles, watering, fertilizing, pest control, mulching, pruning for health and safety . Stakes, ties, guy supports and turnbuckles 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 Slope Erosion Control Maintenance

The Contractor shall provide slope erosion control maintenance to prevent undermining of all slopes in newly landscaped. Maintenance tasks include immediate repairs to weak spots in sloped areas, and maintaining clean, clear culverts, and graded berms, and terraces to intercept and direct water flow to prevent development of large gullies and slope erosion Eroded areas shall be filled with amended topsoil and replanted with the same plant species. Erosion control blankets damaged due to slope erosion shall be reinstalled.

3.4.5 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 stakes, guys, 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.

3.4.6 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.

3.4.7 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:

3.4.7.1 Total Plants on Site

Plants have been accepted and required number of replacements have been installed.

3.4.7.2 Mulching and Weeding

Planter beds and earth mound water basins are properly mulched and free of weeds.

3.4.7.3 Tree Supports

Stakes guys and turnbuckles are in good condition.

3.4.7.4 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 Plant Quantities

The Contractor shall provide Contracting Officer with the number of plant quantities. In addition, provide total exterior area of hardscape and landscaping such as turf and total number of shrubs.

3.5.3 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 16

BASE COURSE FOR RIGID AND FLEXIBLE PAVING
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	(2001; R 2004) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457-mm (18-in) Drop
AASHTO T 224	(2001; R 2004) 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 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 D 1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 2167	(2008) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(2006e1) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 4318	(2005) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 6938	(2007a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

ASTM D 75 (2003) Standard Practice for Sampling Aggregates

1.2 DEFINITION

Degree of compaction required 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. One exception is as follos: 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 will be 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. Provide equipment which is adequate and has 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 Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment; G

List of proposed equipment to be used in performance of construction work, including descriptive data.

SD-06 Test Reports

Sampling and Testing; G
Field Density Tests; G

Certified copies of test results for approval not less than 30 days before material is required for the work.

Calibration curves and related test results prior to using the device or equipment being calibrated.

Copies of field test results within 24 hours after the tests are performed.

1.5 QUALITY ASSURANCE

Sampling and testing are the responsibility of the Contractor, to be performed by an approved testing laboratory. Perform tests at the specified frequency. No work requiring testing will be permitted until the testing laboratory has been inspected and approved. Test the materials to

establish compliance with the specified requirements.

1.5.1 Sampling

Take samples for laboratory testing in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.5.2 Tests

1.5.2.1 Sieve Analysis

Make sieve analysis in conformance with ASTM C 117 and ASTM C 136.

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 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 and adjust the calibration curves, 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 will 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, in ASTM D 6938, on each different type of material to be tested at the beginning of a job and at intervals as directed. The nuclear methods of testing is acceptable for this project; however, every 15th sample will require a sand cone test for comparison.

1.5.2.5 Wear Test

Perform wear tests in conformance with ASTM C 131.

1.5.2.6 Weight of Slag

Determine weight per cubic foot of slag in accordance with ASTM C 29.

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 prior to installation.

a. Sieve Analysis including 0.02 mm size material
b. Liquid limit and plasticity index
c. Wear
d. Weight per cubic foot of Slag

1.5.3.2 In-Place Tests

Perform one of each of the following tests on samples taken from the placed and compacted rigid pavement base course. Samples shall be taken and tested at the rates indicated.

a. Perform density tests on every lift of material placed and at a frequency of one set of tests for every 500 square yards, or portion thereof, of completed area.

b. Perform sieve analysis on every lift of material placed and at a frequency of one sieve analysis for every 1000 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 thickness of each course at intervals providing at least one measurement for each 500 square yards or part thereof. The thickness measurement shall be made by test holes, at least 3 inches in diameter through the course.

1.5.4 Approval of Material

Select the source of materials 30 days prior to the time the material will be required in the work. Tentative approval will be based on initial test results. Final approval of the materials will be based on tests for gradation, liquid limit, and plasticity index performed on samples taken from the completed and compacted course.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Rigid Pavement Base Course

Provide aggregates consisting of crushed stone or slag, gravel, shell, sand, or other sound, durable, approved materials processed and blended or naturally combined. Provide aggregates which are durable and sound, free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign material. Material retained on the No. 4 sieve shall have a percentage of wear not to exceed 50 percent after 500 revolutions when tested as specified in ASTM C 131. At least 50 percent by weight retained on each sieve shall have one freshly fractured face with the area at least equal to 75 percent of the smallest midsectional area of the piece. Aggregate shall be reasonably uniform in density and quality. Slag shall be an air-cooled, blast-furnace product having a dry weight of not less than 65 pcf. Aggregates shall have a maximum size of 2 inches and shall be within the limits specified as follows:

Maximum Allowable Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	Rigid Pavement Base Course
2"	100
1 1/2"	97-100

Maximum Allowable Percentage by Weight
Passing Square-Mesh Sieve

Sieve Designation	Rigid Pavement Base Course
3/4"	60-90
No. 10	50
No. 60	5-3
No. 200	4-11

PART 3 EXECUTION

3.1 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 work, 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 and authorities.

3.2 STOCKPILING MATERIAL

Prior to stockpiling of material, clear and level storage sites. 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.

3.3 PREPARATION OF UNDERLYING MATERIAL

Prior to constructing the rigid pavement base course, clean the underlying course or subgrade of all foreign substances. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. Correct ruts, or soft yielding spots, in the underlying courses, subgrade areas having inadequate compaction, and deviations of the surface from the specified requirements, 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 or subgrades containing sands or gravels, as defined in ASTM D 2487, the surface shall be stabilized prior to placement of the overlying course. Accomplish stabilization by mixing the overlying course material into the underlying course, and compacting by approved methods. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained in a satisfactory condition until the overlying course is placed.

3.4 GRADE CONTROL

The finished and completed course shall conform to the lines, grades, and cross sections shown. The lines, grades, and cross sections shown shall be maintained by means of line and grade stakes placed by the Contractor at the work site.

3.5 MIXING AND PLACING MATERIALS

Mix and place the materials to obtain uniformity of the material at the water content specified. Make such adjustments in mixing or placing procedures or in equipment as may be directed to obtain the true grades, to minimize segregation and degradation, to reduce or accelerate loss or increase of water, and to insure a satisfactory subbase course.

3.6 LAYER THICKNESS

The compacted thickness of the completed course shall be as indicated. When a compacted layer of 6 inches is specified, the material may be placed in a single layer; when a compacted thickness of more than 6 inches is required, no layer shall be thicker than 6 inches nor be thinner than 3 inches when compacted.

3.7 COMPACTION

Compact each layer of the material, as specified, with approved compaction equipment. Maintain water content during the compaction procedure to within plus or minus 2 percent of optimum water content, as determined from laboratory tests, as specified in paragraph SAMPLING AND TESTING. In all places not accessible to the rollers, compact the mixture with hand-operated power tampers. Compaction of the rigid base course shall continue until each layer is compacted through the full depth to at least 95 percent of laboratory maximum density. 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 subbase 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.

3.8 PROOF ROLLING

Areas designated on the drawings to be proof rolled shall receive an application of 4 coverages with a heavy pneumatic-tired roller having four or more tires abreast, each tire loaded to a minimum of 30,000 pounds and inflated to a minimum of 125 psi. A coverage is defined as the application of one tire print over the designated area. In the areas designated, apply proof rolling to the top layer of the subbase course. Maintain water content of the top layer of the subbase course such that the water content is within plus or minus 2 percent of optimum water content, as determined from laboratory tests, as specified in paragraph SAMPLING AND TESTING. Any material in the subbase courses or underlying materials indicated to be unsatisfactory by the proof rolling shall be removed, dried, and recompacted, or removed and replaced with satisfactory materials.

3.9 EDGES

Place approved material along the edges of the subbase course in such quantity as will compact to the thickness of the course being constructed. When the course is being constructed in two or more layers, at least a 1 foot width of the shoulder shall be rolled and compacted simultaneously with the rolling and compacting of each layer of the subbase course, as directed.

3.10 SMOOTHNESS TEST

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. Correct deviations exceeding this amount by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

3.11 THICKNESS CONTROL

The completed thickness of the course(s) shall be in accordance with the thickness and grade indicated on the drawings. The completed course shall not be more than 1/2 inch deficient in thickness nor more than 1/2 inch above or below the established grade. Where any of these tolerances are exceeded, correct such areas by scarifying, adding new material of proper gradation or removing material, and compacting, as directed. Where the measured thickness is 1/2 inch or more thicker than shown, the course will be considered as conforming with the specified thickness requirements plus 1/2 inch. The average job thickness shall be the average of the job measurements as specified above but within 1/4 inch of the thickness shown.

3.12 MAINTENANCE

Maintain the completed course in a satisfactory condition until accepted.

-- End of Section --

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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 T 102	(1983; R 2004) Spot Test of Asphaltic Materials
AASHTO T 40	(2002; R 2006) Sampling Bituminous Materials

ASTM INTERNATIONAL (ASTM)

ASTM D 140	(2001; R 2007) Sampling Bituminous Materials
ASTM D 2028	(1997; R 2004) Cutback Asphalt (Rapid-Curing Type)
ASTM D 2995	(1999; R 2004) Determining Application Rate of Bituminous Distributors
ASTM D 977	(2005) Emulsified Asphalt

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)

1.2 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. This work is limited to the placement of tack coat on PCC pavement where it abutts the asphalt pavement and as shown on Detail 021CS-503.

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 Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

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 TACK COAT

Provide asphalt conforming to ASTM D 977 Grade 70.

2.1.1 Cutback Asphalt

Provide cutback asphalt conforming to ASTM D 2028, Grade RC-70.

2.1.2 Emulsified Asphalt

Provide emulsified asphalt conforming to ASTM D 977, Type SS-1. Dilute the emulsified asphalt with equal parts of water. The base asphalt used to manufacture the emulsion shall show a negative spot when tested in accordance with AASHTO T 102 using standard naphtha.

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.

3.3 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	
RC-70	120-200 degrees F*
Paving Grade Asphalts	
Penetration Grades	
200-300	plus 265 degrees F
Viscosity Grades	
AC 2.5	plus 270 degrees F
AR 1000	plus 275 degrees F
AR 2000	plus 285 degrees F
Emulsions	
SS-1	70-160 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 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 of not less than 0.05 gallon nor more than 0.15 gallon of diluted emulsion per square yard. 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 250 tons.

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 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 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 17

HOT MIX BITUMINOUS PAVEMENT
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 MP 1a	(2004) Performance Graded Asphalt Binder

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 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 188	(2009) Standard Test Method for Density of Hydraulic Cement
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 1073	(2007) Fine Aggregate for Bituminous Paving Mixtures

ASTM D 1188	(2007e1) Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
ASTM D 140/D 140M	(2009) Standard Practice for Sampling Bituminous Materials
ASTM D 1559	(1989) Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 242/D 242M	(2009) Mineral Filler for Bituminous Paving Mixtures
ASTM D 2726	(2010) Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
ASTM D 4867/D 4867M	(2009) Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D 546	(2010) Sieve Analysis of Mineral Filler for Bituminous Paving Mixtures
ASTM D 692/D 692M	(2009) Coarse Aggregate for Bituminous Paving Mixtures
ASTM D 70	(2009e1) Specific Gravity and Density of Semi-Solid Bituminous Materials (Pycnometer Method)
ASTM D 75/D 75M	(2009) Standard Practice for Sampling Aggregates
ASTM D 854	(2010) Specific Gravity of Soil Solids by Water Pycnometer
ASTM D 979	(2001; R 2006e1) Sampling Bituminous Paving Mixtures
ASTM D 995	(1995b; R 2002) Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
ASTM D2041/D2041M	(2011) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D2172/D2172M	(2011) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures

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. 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-04 Samples

Bituminous pavement

SD-05 Design Data

Job-mix formula; G

Submit a job-mix formula, prepared specifically for this project within one year of submittal for roads, for approval by the Government prior to preparing and placing the bituminous mixture. Design mix using procedures contained in Chapter V, Marshall Method of Mix Design, of AI MS-02. Formulas shall indicate physical properties of the mixes as shown by tests made by a commercial laboratory approved by the Contracting Officer, using materials identical to those to be provided on this project. Submit formulas with material samples. Job-mix formula for each mixture shall be in effect until modified in writing by the Contractor and approved by the Contracting Officer. Provide a new job-mix formula for each source change. Submittal shall include all tests indicated in MIX DESIGN section of this specification.

ASPHALT CEMENT BINDER

MIX DESIGN; G

SD-06 Test Reports

Specific gravity test of asphalt

Coarse aggregate tests; G

Weight of slag test; G

Percent of crushed pieces in gravel; G

Fine aggregate tests; G

Specific gravity of mineral filler; G

Bituminous mixture tests; G

Aggregates tests; G

Bituminous mix tests; G

Pavement courses; G

Submit in accordance with paragraph entitled "Mock-Up Test Section."

1.3 QUALITY ASSURANCE

1.3.1 Safety Requirements

Provide adequate and safe stairways with handrails to the mixer platform, and safe and protected ladders or other means for accessibility to plant operations. Guard equipment and exposed steam or other high temperature

lines or cover with a suitable type of insulation.

1.3.2 Required Data

Job-mix formula shall show the following:

a. Source and proportions, percent by weight, of each ingredient of the mixture;

b. Correct gradation, the percentages passing each size sieve listed in the specifications for the mixture to be used, for the aggregate and mineral filler from each separate source and from each different size to be used in the mixture and for the composite mixture;

c. Amount of material passing the No. 200 sieve determined by dry sieving;

d. Number of blows of hammer compaction per side of molded specimen;

e. Temperature viscosity relationship of the asphalt cement;

f. Stability, flow, percent voids in mineral aggregate, percent air voids, unit weight;

g. Asphalt absorption by the aggregate;

h. Effective asphalt content as percent by weight of total mix;

i. Temperature of the mixture immediately upon completion of mixing;

j. Asphalt performance grade viscosity grade; and

k. Curves for the leveling, binder, and wearing courses.

1.3.3 Charts

Plot and submit, on a grain size chart, the specified aggregate gradation band, the job-mix gradation and the job-mix tolerance band.

1.3.4 Selection of Optimum Asphalt Content

Base selection on percent of total mix and the average of values at the following points on the curves for each mix:

a. Stability: Peak

b. Unit Weight: Peak

c. Percent Air Voids: Median

1.4 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the site for damage and store with a minimum of handling. Store aggregates in such a manner as to prevent segregation, contamination, or intermixing of the different aggregate sizes.

1.5 ENVIRONMENTAL CONDITIONS

Place bituminous mixture only during dry weather and on dry surfaces. Place courses only when the surface temperature of the underlying course is

greater than 45 degrees F for course thicknesses greater than one inch and 55 degrees F for course thicknesses one inch or less.

1.6 CONSTRUCTION EQUIPMENT

Calibrated equipment, such as scales, batching equipment, spreaders and similar equipment, shall have been recalibrated by a calibration laboratory approved by the Contracting Officer within 12 months of commencing work.

1.6.1 Mixing Plant

Design, coordinate, and operate the mixing plant to produce a mixture within the job-mix formula tolerances and to meet the requirements of ASTM D 995, including additional plant requirements specified herein. The plant shall be a batch type, continuous mix type or drum-dryer mixer type, and shall have sufficient capacity to handle the new bituminous construction. Minimum plant capacity shall be 100 tons per hour. The mixing plant and equipment shall remain accessible at all times for inspecting operation, verifying weights, proportions and character of materials, and checking mixture temperatures. The plant and plant site shall meet the requirements of Section 01 57 19.00 20 TEMPORARY ENVIRONMENTAL CONTROLS.

1.6.1.1 Cold Aggregate Feeder

Provide plant with a feeder or feeders capable of delivering the maximum number of aggregate sizes required in their proper proportion. Provide adjustment for total and proportional feed and feeders capable of being locked in any position. When more than one cold elevator is used, feed each elevator as a separate unit and install individual controls integrated with a master control.

1.6.1.2 Dryer

Provide rotary drum-dryer which continuously agitates the mineral aggregate during the heating and drying process. When one dryer does not dry the aggregate to specified moisture requirements, provide additional dryers.

1.6.1.3 Plant Screens and Bins for Batch and Continuous Mix Plants

Use screen to obtain accurate gradation and allow no bin to contain more than 10 percent oversize or undersize. Inspect screens each day prior to commencing work for plugged, worn, or broken screens. Clean plugged screens and replace worn or broken screens with new screens prior to beginning operations. Divide hot aggregate bins into at least three compartments arranged to ensure separate and adequate storage of appropriate fractions of the aggregate.

1.6.1.4 Testing Laboratory

Provide a testing laboratory for control and acceptance testing functions during periods of mix production, sampling and testing, and whenever materials subject to the provisions of these specifications are being supplied or tested. The laboratory shall provide adequate equipment, space, and utilities as required for the performance of the specified tests.

1.6.1.5 Surge and Storage Bins

Use for temporary storage of hot bituminous mixtures will be permitted

under the following conditions:

a. When stored in surge bins for a period of time not to exceed 3 hours.

b. When stored in insulated and heated storage bins for a period of time not to exceed 12 hours. If it is determined by the Contracting Officer that there is an excessive amount of heat loss, segregation and oxidation of the mixture due to temporary storage, discontinue use of surge bins or storage bins.

1.6.1.6 Drum-Dryer Mixer

Do not use drum-dryer mixer if specified requirements of the bituminous mixture or of the completed bituminous pavement course cannot be met. If drum-dryer mixer is prohibited, use either batch or continuous mix plants meeting the specifications and producing a satisfactory mix.

1.6.2 Paving Equipment

1.6.2.1 Spreading Equipment

Self-propelled electronically controlled type, unless other equipment is authorized by the Contracting Officer. Equip spreading equipment of the self-propelled electronically controlled type with hoppers, tamping or vibrating devices, distributing screws, electronically adjustable screeds, and equalizing devices. Capable of spreading hot bituminous mixtures without tearing, shoving, or gouging and to produce a finished surface of specified grade and smoothness. Operate spreaders, when laying mixture, at variable speeds between 5 and 45 feet per minute. Design spreader with a quick and efficient steering device; a forward and reverse traveling speed; and automatic devices to adjust to grade and confine the edges of the mixture to true lines. The use of a spreader that leaves indented areas or other objectionable irregularities in the fresh laid mix during operations is prohibited.

1.6.2.2 Rolling Equipment

Self-propelled pneumatic-tired rollers supplemented by three-wheel and tandem type steel wheel rollers. The number, type and weight of rollers shall be sufficient to compact the mixture to the required density without detrimentally affecting the compacted material. Rollers shall be suitable for rolling hot-mix bituminous pavements and capable of reversing without backlash. Pneumatic-tired rollers shall be capable of being operated both forward and backward without turning on the mat, and without loosening the surface being rolled. Equip rollers with suitable devices and apparatus to keep the rolling surfaces wet and prevent adherence of bituminous mixture. Vibratory rollers especially designed for bituminous concrete compaction may be used provided rollers do not impair stability of pavement structure and underlying layers. Repair depressions in pavement surfaces resulting from use of vibratory rollers. Rollers shall be self-propelled, single or dual vibrating drums, and steel drive wheels, as applicable; equipped with variable amplitude and separate controls for energy and propulsion.

1.6.2.3 Hand Tampers

Minimum weight of 25 pounds with a tamping face of not more than 50 square inches.

1.6.2.4 Mechanical Hand Tampers

Commercial type, operated by pneumatic pressure or by internal combustion.

PART 2 PRODUCTS

2.1 AGGREGATES

Grade and proportion aggregates and filler so that combined mineral aggregate conforms to specified grading.

2.1.1 Coarse Aggregates

ASTM D 692/D 692M, except as modified herein. At least 75 percent by weight of aggregate retained on the No. 4 sieve shall have two or more fractured faces. Percentage of wear, Los Angeles test, except for slag, shall not exceed 40 in accordance with ASTM C 131. Weight of slag shall not be less than 70 pounds per cubic foot. Soundness test is required in accordance with ASTM C 88; after 5 cycles, loss shall not be more than 12 percent when tested with sodium sulfate or 18 percent when tested with magnesium sulfate.

2.1.2 Fine Aggregate

ASTM D 1073, except as modified herein. Fine aggregate shall be produced by crushing stone, slag or gravel that meets requirements for wear and soundness specified for coarse aggregate. Where necessary to obtain the gradation of aggregate blend or workability, natural sand may be used. Quantity of natural sand to be added shall be approved by the Contracting Officer and shall not exceed 15 percent of weight of coarse and fine aggregate and material passing the No. 200sieve.

2.1.3 Mineral Filler

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 I, 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.

Table I. Aggregate Gradations

	Gradation 1	Gradation 2
Sieve Size, inch	Percent Passing by Mass	Percent Passing by Mass
1	100	---
3/4	76-96	100
1/2	68-88	76-96
3/8	60-82	69-89
No. 4	45-67	53-73
No. 8	32-54	38-60
No. 16	22-44	26-48
No. 30	15-35	18-38
No. 50	9-25	11-27

No. 100	6-18	6-18
No. 200	3-6	3-6

2.2 ASPHALT CEMENT BINDER

Asphalt cement binder shall conform to AASHTO MP 1a 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 by the Contractor 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. Samples of the asphalt cement specified shall be submitted for approval not less than 14 days before start of the test section.

2.3 MIX DESIGN

The Contractor shall 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). No hot-mix asphalt for payment shall be produced until a JMF has been approved. The hot-mix asphalt shall be designed using procedures contained in AI MS-02 and the criteria shown in Table II. 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. If an antistrip agent is required, it shall be provided by the Contractor at no additional cost.

2.3.1 JMF Requirements

The job mix formula shall be submitted in writing by the Contractor for approval at least 14 days prior to the start of the test section and shall include 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.

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 of stability, flow, air voids, voids in the mineral aggregate, and unit weight versus asphalt content as shown in AI MS-02.

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.

q. Antistrip agent (if required) and amount.

r. List of all modifiers and amount.

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 II. Marshall Design Criteria

Test Property	50 Blow Mix
Stability, pounds minimum	*1350
Flow, 0.01 inch	8-18
Air voids, percent	3-5
Percent Voids in mineral aggregate (minimum)	See Table III
TSR, minimum percent	75

* This is a minimum requirement. The average during construction shall be significantly higher than this number to ensure compliance with the specifications.

Table III. Minimum Percent Voids in Mineral Aggregate (VMA)**

Aggregate (See Table 2)	Minimum VMA, percent
Gradation 1	13.0
Gradation 2	14.0
Gradation 3	15.0

** 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 adjust the JMF within the limits specified below to optimize mix volumetric properties. Adjustments to the JMF shall be limited to plus or minus 3 percent on the 1/2 inch, No. 4, and No. 8 sieves; plus or minus 1.0 percent on the No. 200 sieve; and plus or minus 0.40 percent binder content. If adjustments are needed that exceed these limits, a new mix design shall be developed. Tolerances given above may permit the aggregate grading to be outside the limits shown in Table I; this is acceptable.

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. When RAP is fed into the plant, the maximum RAP chunk size shall not exceed 2 inches. 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 should 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, viscosity, dynamic shear rheometer at high temperature and bending beam at low temperature 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.

2.5 SOURCE QUALITY CONTROL

Employ a commercial laboratory approved by the Contracting Officer to perform testing. The laboratory used to develop the JMF and the laboratory used to perform all sampling and testing shall meet the requirements of ASTM D 3666. A certification 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 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.

2.5.1 Tests

Perform testing in accordance with the following:

a. Specific Gravity Test of Asphalt: ASTM D 70

b. Coarse Aggregate Tests:

(1) Bulk Specific Gravity: ASTM C 127

(2) Abrasion Loss: ASTM C 131

(3) Soundness Loss: ASTM C 88

c. Weight of Slag Test: ASTM C 29/C 29M

d. Percent of Crushed Pieces in Gravel: Count by observation and weight

e. Fine Aggregate Tests:

(1) Bulk Specific Gravity: ASTM C 128

(2) Soundness Loss: ASTM C 88

f. Specific Gravity of Mineral Filler: ASTM C 188 or ASTM D 854

g. Bituminous Mixture Tests:

(1) Bulk Specific Gravity: ASTM D 1188 or ASTM D 2726

(2) Theoretical Maximum Specific Gravity: ASTM D2041/D2041M

(3) Tensile Strength Ratio: ASTM D 4867/D 4867M

2.5.2 Specimens

ASTM D 1559 for the making and testing of bituminous specimens with the following exceptions:

a. Compaction: Apply specimens and 50 blows of the hammer to each flat face of the specimens for mix numbers 1 and 2.

b. Curves: Plot curves for the binder and wearing courses to show the effect on the test properties of at least four different percentages of asphalt on the unit weight, stability, flow, air voids, and voids in mineral aggregate; each point on the curves shall represent the average of at least four specimens.

c. Cooling of Specimen: After compaction is completed, allow the specimen to cool in air to the same temperature approximately as that of the water, 77 degrees F, to be used in the specific gravity determination.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 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 160 degrees C 325 degrees F when added to the aggregates. Modified asphalts shall be no more than 174 degrees C 350 degrees F when added to the aggregate.

3.1.2 Preparation of Mineral Aggregates

Store different size aggregate in separate stockpiles so that different sizes will not mix. Stockpile different-sized aggregates in uniform layers by use of a clam shell or other approved method so as to prevent segregation. The use of bulldozers in stockpiling of aggregate or in feeding aggregate to the dryer is prohibited. Feed aggregates into the cold elevator by means of separate mechanical feeders so that aggregates are graded within requirements of the job-mix formulas and tolerances specified. Regulate rates of feed of the aggregates so that moisture content and temperature of aggregates are within tolerances specified herein. Dry and heat aggregates to the temperature necessary to achieve the mixture determined by the job mix formula within the job tolerance specified. Provide adequate dry storage for mineral filler.

3.1.3 Preparation of Bituminous Mixture

Accurately weigh aggregates and dry mineral filler and convey into the mixer in the proportionate amounts of each aggregate size required to meet the job-mix formula. In batch mixing, after aggregates and mineral filler have been introduced into the mixer and mixed for not less than 15 seconds, add asphalt by spraying or other approved methods and continue mixing for a period of not less than 20 seconds, or as long as required to obtain a homogeneous mixture. The time required to add or spray asphalt into the mixer will not be added to the total wet-mixing time provided the operation does not exceed 10 seconds and a homogeneous mixture is obtained. When a continuous mixer is employed, mixing time shall be more than 35 seconds to obtain a homogeneous mixture. Additional mixing time, when required, will be as directed by the Contracting Officer. When mixture is prepared in a twin-pugmill mixer, volume of the aggregates, mineral filler, and asphalt shall not extend above tips of mixer blades when blades are in a vertical position. Overheated and carbonized mixtures, or mixtures that foam or show indication of free moisture, will be rejected. When free moisture is detected in batch or continuous mix plant produced mixtures, waste the mix and withdraw the aggregates in the hot bins immediately and return to the respective stockpiles; for drum-dryer mixer plants, waste the mix, including that in surge or storage bins that is affected by free moisture.

3.1.4 Transportation of Bituminous Mixtures

Transport bituminous material from the mixing plant to the paving site in trucks having tight, clean, smooth beds that have been coated with a minimum amount of concentrated solution of hydrated lime and water or other approved coating to prevent adhesion of the mixture to the truck. Petroleum products will not be permitted for coating truck. If air temperature is less than 60 degrees F or if haul time is greater than 30 minutes, cover

each load with canvas or other approved material of ample size to protect the mixture from the loss of heat. Make deliveries so that the spreading and rolling of all the mixture prepared for one day's run can be completed during daylight, unless adequate approved artificial lighting is provided. Deliver mixture to area to be paved so that the temperature at the time of dumping into the spreader is within the range specified herein. Reject loads that are below minimum temperature, that have crusts of cold unworkable material, or that have been wet excessively by rain. Hauling over freshly laid material is prohibited.

3.1.5 Surface Preparation of Underlying Course

Prior to the laying of the asphalt concrete, clean underlying course of foreign or objectionable matter with power blowers or power brooms, supplemented by hand brooms and other cleaning methods where necessary. During the placement of multiple lifts of bituminous concrete, each succeeding lift of bituminous concrete shall have its underlying lift cleaned and provided with a bituminous tack coat if the time period between the placement of each lift of bituminous concrete exceeds 14 days, or the underlying bituminous concrete has become dirty.

3.1.6 Spraying of Contact Surfaces

Spray contact surfaces of previously constructed pavement with a thin coat of bituminous materials to act as an anti-stripping agent, conforming to Section 32 12 10 BITUMINOUS TACK AND PRIME COATS. Paint contact surfaces of structures with a thin coat of emulsion or other approved bituminous material prior to placing the bituminous mixture. Tack coat the previously placed primed coats on base courses when surface has become excessively dirty and cannot be cleaned or when primed surface has cured to the extent that it has lost all bonding effect.

3.2 PLACEMENT

3.2.1 Machine Spreading

The range of temperatures of the mixtures at the time of spreading shall be between 250 degrees F and 300 degrees F. Bituminous concrete having temperatures less than minimum spreading temperature when dumped into the spreader will be rejected. Adjust spreader and regulate speed so that the surface of the course is smooth and continuous without tears and pulling, and of such depth that, when compacted, the surface conforms with the cross section, grade, and contour indicated. Unless otherwise directed, begin the placing along the centerline of areas to be paved on a crowned section or on the high side of areas with a one-way slope. Place mixture in consecutive adjacent strips having a minimum width of 10 feet, except where the edge lanes require strips less than 10 feet to complete the area. Construct longitudinal joints and edges to true line markings. Establish lines parallel to the centerline of the area to be paved, and place string lines coinciding with the established lines for the spreading machine to follow. Provide the number and location of the lines needed to accomplish proper grade control. When specified grade and smoothness requirements can be met for initial lane construction by use of an approved long ski-type device of not less than 30 feet in length and for subsequent lane construction by use of a short ski or shoe, in-place string lines for grade control may be omitted. Place mixture as nearly continuous as possible and adjust the speed of placing as needed to permit proper rolling.

3.2.2 Shoveling, Raking, and Tamping After Machine-Spreading

Shovelers and rakers shall follow the spreading machine. Add or remove hot mixture and rake the mixture as required to obtain a course that when completed will conform to requirements specified herein. Broadcasting or fanning of mixture over areas being compacted is prohibited. When segregation occurs in the mixture during placing, suspend spreading operation until the cause is determined and corrected. Correct irregularities in alignment left by the spreader by trimming directly behind the machine. Immediately after trimming, compact edges of the course by tamping laterally with a metal lute or by other approved methods. Distortion of the course during tamping is prohibited.

3.2.3 Hand-Spreading in Lieu of Machine-Spreading

In areas where the use of machine spreading is impractical, spread mixture by hand. The range of temperatures of the mixtures when dumped onto the area to be paved shall be between 250 and 300 degrees F. Mixtures having temperatures less than minimum spreading temperature when dumped onto the area to be paved will be rejected. Spread hot mixture with rakes in a uniformly loose layer of a thickness that, when compacted, will conform to the required grade, thickness, and smoothness. During hand spreading, place each shovelful of mixture by turning the shovel over in a manner that will prevent segregation. Do not place mixture by throwing or broadcasting from a shovel. Do not dump loads any faster than can be properly handled by the shovelers and rakers.

3.3 COMPACTION OF MIXTURE

Compact mixture by rolling. Begin rolling as soon as placement of mixture will bear rollers. Delays in rolling freshly spread mixture shall not be permitted. Start rolling longitudinally at the extreme sides of the lanes and proceed toward center of pavement, or toward high side of pavement with a one-way slope. Operate rollers so that each trip overlaps the previous adjacent strip by at least one foot. Alternate trips of the roller shall be of slightly different lengths. Conduct tests for conformity with the specified crown, grade and smoothness immediately after initial rolling. Before continuing rolling, correct variations by removing or adding materials as necessary. If required, subject course to diagonal rolling with the steel wheeled roller crossing the lines of the previous rolling while mixture is hot and in a compactible condition. Speed of the rollers shall be slow enough to avoid displacement of hot mixture. Correct displacement of mixture immediately by use of rakes and fresh mixture, or remove and replace mixture as directed. Continue rolling until roller marks are eliminated and course has a density of at least 96 percent but not more than 100 percent of that attained in a laboratory specimen of the same mixture prepared in accordance with ASTM D 1559. During rolling, moisten wheels of the rollers enough to prevent adhesion of mixture to wheels, but excessive water is prohibited. Operation of rollers shall be by competent and experienced operators. Provide sufficient rollers for each spreading machine in operation on the job and to handle plant output. In places not accessible to the rollers, compact mixture thoroughly with hot hand tampers. Skin patching of an area after compaction is prohibited. Remove mixture that becomes mixed with foreign materials or is defective and replace with fresh mixture compacted to the density specified herein. Roller shall pass over unprotected edge of the course only when laying of course is to be discontinued for such length of time as to permit mixture to become cold.

3.4 JOINTS

Joints shall present the same texture and smoothness as other portions of the course, except permissible density at the joint may be up to 2 percent less than the specified course density. Carefully make joints between old and new pavement or within new pavements in a manner to ensure a thorough and continuous bond between old and new sections of the course. Vertical contact surfaces of previously constructed sections that are coated with dust, sand, or other objectionable material shall be painted with a thin uniform coat of emulsion or other approved bituminous material just before placing fresh mixture.

3.4.1 Transverse

Roller shall pass over unprotected end of freshly laid mixture only when laying of course is to be discontinued. Except when an approved bulkhead is used, cut back the edge of previously laid course to expose an even, vertical surface for the full thickness of the course. When required, rake fresh mixture against joints, thoroughly tamp with hot tampers, smooth with hot smoothers, and roll. Transverse joints in adjacent lanes shall be offset a minimum of 2 feet.

3.4.2 Longitudinal Joints

Space 6 inches apart. Do not allow joints to coincide with joints of existing pavement or previously placed courses. Spreader screed shall overlap previously placed lanes 2 to 3 inches and be of such height to permit compaction to produce a smooth dense joint. With a lute, push back mixture placed on the surface of previous lanes to the joint edge. Do not scatter mix. Remove and waste excess material. When edges of longitudinal joints are irregular, honeycombed, or poorly compacted, cut back unsatisfactory sections of joint and expose an even vertical surface for the full thickness of the course. When required, rake fresh mixture against joint, thoroughly tamp with hot tampers, smooth with hot smoothers, and roll while hot.

3.5 FIELD QUALITY CONTROL

3.5.1 Sampling

3.5.1.1 Aggregates At Source

Prior to production and delivery of aggregates, take at least one initial sample in accordance with ASTM D 75/D 75M from each stockpile. Collect each sample by taking three incremental samples at random from the source material to make a composite sample of not less than 50 pounds. Repeat the sampling when the material source changes or when testing reveals unacceptable deficiencies or variations from the specified grading of materials.

3.5.1.2 Cold Feed Aggregate Sampling

Take two samples daily from the belt conveying materials from the cold feed. Collect materials in three increments at random to make a representative composite sample of not less than 50 pounds. Take samples in accordance with ASTM D 75/D 75M.

3.5.1.3 Coarse and Fine Aggregates

Take a 50 pound sample from the cold feed at least once daily for sieve analyses and specific gravity tests. Additional samples may be required to perform more frequent tests when analyses show deficiencies, or unacceptable variances or deviations. The method of sampling is as specified herein for aggregates.

3.5.1.4 Mineral Filler

ASTM D 546. Take samples large enough to provide ample material for testing.

3.5.1.5 Pavement and Mixture

Take plant samples for the determination of mix properties and field samples for thickness and density of the completed pavements. Furnish tools, labor and material for samples, and satisfactory replacement of pavement. Take samples and tests at not less than frequency specified hereinafter and at the beginning of plant operations; for each day's work as a minimum; each change in the mix or equipment; and as often as directed. Accomplish sampling in accordance with ASTM D 979.

3.5.2 Testing

3.5.2.1 Aggregates Tests

a. Gradation: ASTM C 136.

b. Mineral Filler Content: ASTM D 546.

c. Abrasion: ASTM C 131 for wear (Los Angeles test). Perform one test initially prior to incorporation into the work and each time the source is changed.

3.5.2.2 Bituminous Mix Tests

Test one sample for each 500 tons, or fraction thereof, of the uncompacted mix for extraction in accordance with ASTM D2172/D2172M; perform a sieve analysis on each extraction sample in accordance with ASTM C 136 and ASTM C 117. Test one sample for each 500 tons or fraction thereof for stability and flow in accordance with ASTM D 1559. Test one sample for each material blend for Tensile Strength Ratio in accordance with ASTM D 4867/D 4867M.

3.5.2.3 Pavement Courses

Perform the following tests:

a. Density: For each 1000 tons of bituminous mixture placed, determine the representative laboratory density by averaging the density of four laboratory specimens prepared in accordance with ASTM D 1559. Samples for laboratory specimens shall be taken from trucks delivering mixture to the site; record in a manner approved by the Contracting Officer the project areas represented by the laboratory densities. From each representative area recorded, determine field density of pavement by averaging densities of 4 inch diameter cores obtained from binder and wearing courses; take one core for each 2000 square yards or fraction thereof of course placed. Determine density of laboratory prepared

specimens and cored samples in accordance with ASTM D 1188 or ASTM D 2726, as applicable. Separate pavement layers by sawing or other approved means. Maximum allowable deficiency at any point, excluding joints, shall not be more than 2 percent less than the specified density for any course. The average density of each course, excluding joints, shall be not less than the specified density. Joint densities shall not be more than 2 percent less than specified course densities and are not included when calculating average course densities. When the deficiency exceeds the specified tolerances, correct each such representative area or areas by removing the deficient pavement and replacing with new pavement.

b. Thickness: Determine thickness of binder and wearing courses from samples taken for the field density test. The maximum allowable deficiency at any point shall not be more than 1/4 inch less than the thickness for the indicated course. Average thickness of course or of combined courses shall be not less than the indicated thickness. Where a deficiency exceeds the specified tolerances, correct each such representative area or areas by removing the deficient pavement and replacing with new pavement.

c. Smoothness: Straightedge test the compacted surface of leveling, binder, and wearing courses as work progresses. Apply straightedge parallel with and at right angles to the centerline after final rolling. Unevenness of binder courses shall not vary more than 1/4 inch in 10 feet; variations in the wearing course shall not vary more than 1/8 inch in 10 feet. Correct each portion of the pavement showing irregularities greater than that specified.

d. Finished Grades: Finish grades of each course placed shall not vary from the finish elevations, profiles, and cross sections indicated by more than 1/2 inch. Finished surface of the final wearing course will be tested by running lines of levels at intervals of 25 feet longitudinally and transversely to determine elevations of completed pavement. Within 45 days after completion of final placement. The Contracting Officer will inform the Contractor in writing of paved areas that fail to meet the final grades indicated within the specified tolerances. Correct deficient paved areas by removing existing work and replacing with new materials that meet the specifications. Skin patching for correcting low areas is prohibited.

e. Finish Surface Texture of Wearing Course: Visually check final surface texture for uniformity and reasonable compactness and tightness.Final wearing course with a surface texture having undesirable irregularities such as segregation, cavities, pulls or tears, checking, excessive exposure of coarse aggregates, sand streaks, indentations, ripples, or lack of uniformity shall be removed and replaced with new materials.

3.6 PROTECTION

Do not permit vehicular traffic, including heavy equipment, on pavement until surface temperature has cooled to at least 120 degrees F. Measure surface temperature by approved surface thermometers or other satisfactory methods.

-- End of Section --

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SECTION 32 13 13.06

PORTLAND CEMENT CONCRETE PAVEMENT FOR ROADS AND SITE FACILITIES
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.

ACI INTERNATIONAL (ACI)

ACI 211.1	(1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 301	(2005; Errata 2008) Specifications for Structural Concrete
ACI 305R	(1999; Errata 2006) Hot Weather Concreting
ACI 308R	(2001; R 2008) Guide to Curing Concrete

ASTM INTERNATIONAL (ASTM)

ASTM C 1077	(2008a) Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 1260	(2007) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C 150	(2007) Standard Specification for Portland Cement
ASTM C 231	(2008c) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(2006) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 309	(2007) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494/C 494M	(2008a) Standard Specification for Chemical Admixtures for Concrete
ASTM C 618	(2008a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

ASTM C 78	(2008) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C 94/C 94M	(2009) Standard Specification for Ready-Mixed Concrete
ASTM C 989	(2009) Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars

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. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Curing materials

Admixtures

Dowel

Reinforcement; G

Submit a complete list of materials including type, brand and applicable reference specifications.

SD-04 Samples

Field-Constructed Mockup; G

SD-05 Design Data

Concrete mix design; G

Thirty days minimum prior to concrete placement, submit a mix design, with applicable tests, for each strength and type of concrete for approval. Submit a complete list of materials including type; brand; source and amount of cement, fly ash, slag, and admixtures; and applicable reference specifications. Provide mix proportion data 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. Submittal shall clearly indicate where each mix design will be used when more than one mix design is submitted. Obtain acknowledgement of approvals prior to concrete placement. Submit a new mix design for each material source change.

SD-06 Test Reports

Aggregate tests; G

Concrete slump tests; G

Air content tests; G

Flexural strength tests; G

Cementitious materials; G

SD-07 Certificates

Ready-mixed concrete plant; G

Batch tickets; G

Cementitious materials; G

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.

Cementitious Materials; (LEED)

Aggregate; (LEED)

LEED documentation relative to recycled content credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Albedo; (LEED)

LEED documentation relative to heat island effect - non-roof credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.3 DELIVERY, STORAGE, AND HANDLING

ASTM C 94/C 94M.

1.4 QUALITY ASSURANCE

1.4.1 Ready-mixed Concrete Plant Certification

Provide documentation that the ready-mix plant is certified by the National Ready-Mix Concrete Association (NRMCA). If the Contractor elects to establish an on-site concrete batch plant, the facility must meet requirements of Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE.

1.4.2 Required Information

Submit copies of laboratory test reports showing that the mix has been successfully tested to produce concrete with the properties specified and that mix will be suitable for the job conditions. The laboratory test reports shall include mill test and all other test for cementitious materials, aggregates, and admixtures. Provide maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Test reports shall be submitted along with the concrete mix design. Sampling and testing of

materials, concrete mix design, sampling and testing in the field shall be performed by a commercial testing laboratory which conforms to ASTM C 1077. The laboratory shall be approved in writing by the Government.

1.4.3 Batch Tickets

ASTM C 94/C 94M. Submit mandatory batch ticket information for each load of ready-mixed concrete.

1.4.4 Field-Constructed Mockup

Install minimum 225 square feet to demonstrate typical joints, surface finish, texture, and standard of workmanship. If Contracting Officer determines that mockup does not meet requirements, demolish and remove it from the site and install another until the mockup is accepted. Keep accepted mockup undisturbed during construction as a standard for judging completed paving. Accepted mockup may be incorporated into final work when approved by Contracting Officer.

1.5 SUSTAINABLE DESIGN REQUIREMENTS

1.5.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Pavement materials may be locally available.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Cementitious Materials

Cementitious materials in concrete mix shall be maximum 50 percent non-portland cement pozzolanic materials by weight. Provide test data demonstrating compatibility and performance of concrete satisfactory to Contracting Officer.

2.1.1.1 Cement

ASTM C 150, Type I, II, or III, for high early concrete with maximum alkali content of 0.60%. Cement certificate shall include test results in accordance with ASTM C 150, including equivalent alkalies indicated in the Supplementary Optional Chemical Requirements.

2.1.1.2 Fly Ash and Pozzolan

ASTM C 618, Type F, except that the maximum allowable loss on ignition shall be 6%, maximum available alkalies content shall be 1.5%, and maximum calcium oxide (CaO) content 8%. Fly ash certificates shall include test results in accordance with ASTM C 618, including available alkalies indicated in the Supplementary Optional Chemical Requirements.

2.1.1.3 Slag

ASTM C 989, Ground Granulated Blast Furnace Slag (GGBFS), Grade 100 or 120. Certificates shall include test results in accordance with ASTM C 989.

2.1.2 Water

ASTM C 94/C 94M, fresh, clean, and potable.

2.1.3 Aggregate

See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Aggregate may contain post-consumer or post-industrial recycled content.

2.1.3.1 Alkali Reactivity Test

Aggregates to be used in all concrete shall be evaluated and tested by the Contractor for alkali-aggregate reactivity in accordance with ASTM C 1260. The types of aggregates shall be evaluated in a combination which matches the contractors' proposed mix design (including Class F fly ash or GGBF slag), utilizing the modified version of ASTM C 1260. Test results of the combination shall have a measured expansion of less than 0.08 percent at 16 days. Should the test data indicate an expansion of greater than 0.08%, the aggregate(s) shall be rejected and the contractor shall submit new aggregate sources for retesting or may submit additional test results incorporating Lithium Nitrate for consideration.

ASTM C 1260 shall be modified as follows to include one of the following options:

a. Utilize the contractor's proposed low alkali Portland cement and Class F fly ash in combination for the test proportioning. The laboratory shall use the contractor's proposed percentage of cement and fly ash.

b. Utilize the contractor's proposed low alkali Portland cement and ground granulated blast furnace (GGBF) slag in combination for the test proportioning. The laboratory shall use the contractor's proposed percentage of cement and GGBF.

c. Utilize the contractor's proposed low alkali Portland cement and Class F fly ash and ground granulated blast furnace (GGBF) slag in combination for the test proportioning. The laboratory shall use the contractor's proposed percentage of cement, fly ash and GGBF.

2.1.3.2 Fine Aggregates

ASTM C 33.

2.1.3.3 Coarse Aggregates

ASTM C 33.

2.1.4 Admixtures

ASTM C 494/C 494M: Type A, water reducing; Type B, retarding; Type C, accelerating; Type D, water-reducing and retarding; and Type E, water-reducing and accelerating admixture. Do not use calcium chloride admixtures. Where not shown or specified, the use of admixtures is subject to written approval of the Contracting Officer.

ASTM C 260: Air-entraining.

2.1.5 Reinforcement

2.1.5.1 Dowel Bars

Dowel bars shall be smooth dowels or plate dowels.

2.1.5.2 Tie Bars

Bars shall be billet or axle steel deformed bars and conform to ASTM A 615 or ASTM A 966 Grade 60. Epoxy coated in accordance with ASTM A 775.

2.1.5.3 Reinforcement

Deformed steel bar mats shall conform to ASTM A 184. Bar reinforcement shall conform to ASTM A 966, Grade 60.

2.1.6 Curing Materials

2.1.6.1 Liquid Membrane-Forming Compound

ASTM C 309, white pigmented, Type 2, Class B, free of paraffin or petroleum.

2.1.7 Joint Fillers and Sealants

Provide as specified in Section 32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS.

2.2 CONCRETE PAVEMENT

2.2.1 Albedo

Installed system must meet the requirements of LEED heat island effect non-roof credit.

2.3 CONTRACTOR-FURNISHED MIX DESIGN

Contractor-furnished mix design concrete shall be designed in accordance with ACI 211.1 except as modified herein, and the mix design shall be as specified herein under paragraph entitled "Submittals." The concrete shall have a minimum flexural strength of 650 pounds per square inch at 90 days. The concrete may be air entrained. If air entrainment is used the air content shall be 6.0 plus or minus 1.5 percent. Maximum size aggregate for slip forming shall be 1.5 inches. The minimum cementitious factor is 564 lbs per cubic yard and slump shall be 1 to 3 inches (or less when slip form is used).

If the cementitious material is not sufficient to produce concrete of the flexural strength required it shall be increased as necessary, without additional compensation under the contract. The cementitious factor shall be calculated using cement, Class F fly ash, and or GGBF slag. The mix shall use a cement replacement (by weight) of 25%-35% Class F fly ash, or 40%-50% GGBF slag, or a combination of the two. In the combination, each 5% of Class F fly ash shall be replaced by 8% GGBF slag.

PART 3 EXECUTION

3.1 FORMS

3.1.1 Construction

Construct forms to be removeable without damaging the concrete.

3.1.2 Grade and Alignment

Check and correct grade elevations and alignment of the forms immediately before placing the concrete.

3.2 REINFORCEMENT

3.2.1 Dowel Bars

Install bars accurately aligned, vertically and horizontally, at indicated locations and to the dimensions and tolerances indicated. Before installation thoroughly grease the sliding portion of each dowel. Dowels must remain in position during concrete placement and curing.

3.2.2 Tie Bars

Install bars, accurately aligned horizontally and vertically, at indicated locations. For slipform construction, insert bent tie bars by hand or other approved means.

3.2.3 Setting Slab Reinforcement

Reinforcement shall be positioned on suitable chairs prior to concrete placement. At expansion, contraction and construction joints, place the reinforcement as indicated. Reinforcement, when placed in concrete, shall be free of mud, oil, scale or other foreign materials. Place reinforcement accurately and wire securely. The laps at splices shall be 12 inches minimum and the distances from ends and sides of slabs and joints shall be as indicated.

3.3 MEASURING, MIXING, CONVEYING, AND PLACING CONCRETE

3.3.1 Measuring

ASTM C 94/C 94M.

3.3.2 Mixing

ASTM C 94, except as modified herein. Begin mixing within 30 minutes after cement has been added to aggregates. When the air temperature is greater than 85 degrees F, reduce mixing time and place concrete within 60 minutes. Additional water may be added to bring slump within required limits as specified in Section 11.7 of ASTM C 94, provided that the specified water-cement ratio is not exceeded.

3.3.3 Conveying

ASTM C 94.

3.3.4 Placing

Follow guidance of ACI 301, except as modified herein. Do not exceed a free vertical drop of 3 feet from the point of discharge. Place concrete continuously at a uniform rate, with minimum amount of segregation, without damage to the grade and without unscheduled stops except for equipment failure or other emergencies. If this occurs within 10 feet of a previously placed expansion joint, remove concrete back to joint, repair any damage to grade, install a construction joint and continue placing concrete only after cause of the stop has been corrected.

3.3.5 Vibration

Immediately after spreading concrete, consolidate concrete with internal type vibrating equipment along the boundaries of all slabs regardless of slab thickness, and interior of all concrete slabs 6 inches or more in thickness. Limit duration of vibration to that necessary to produce consolidation of concrete. Excessive vibration will not be permitted. Vibrators shall not be operated in concrete at one location for more than 15 seconds. At the option of the Contractor, vibrating equipment of a type approved by the Contracting Officer may be used to consolidate concrete in unreinforced pavement slabs less than 6 inches thick.

3.3.5.1 Vibrating Equipment

Operate equipment, except hand-manipulated equipment, ahead of the finishing machine. Select the number of vibrating units and power of each unit to properly consolidate the concrete. Mount units on a frame that is capable of vertical movement and, when necessary, radial movement, so vibrators may be operated at any desired depth within the slab or be completely withdrawn from the concrete. Clear distance between frame-mounted vibrating units that have spuds that extend into the slab at intervals across the paving lane shall not exceed 30 inches. Distance between end of vibrating tube and side form shall not exceed 2 inches. For pavements less than 10 inches thick, operate vibrators at mid-depth parallel with or at a slight angle to the subbase. For thicker pavements, angle vibrators toward the vertical, with vibrator tip preferably about 2 inches from subbase, and top of vibrator a few inches below pavement surface. Vibrators may be pneumatic, gas driven, or electric, and shall be operated at frequencies within the concrete of not less than 8,000 vibrations per minute. Amplitude of vibration shall be such that noticeable vibrations occur at 1.5 foot radius when the vibrator is inserted in the concrete to the depth specified.

3.3.6 Cold Weather

When air temperature falls below 40 degrees F, follow recommendations of ACI 308R (latest revision) "Recommended Practice for Cold Weather Concreting."

3.3.7 Hot Weather

When air temperature is around 90 degrees F, follow recommendations of ACI 305R(latest revision) "Recommended Practice for Hot Weather Concreting".

3.4 PAVING

Pavement shall be constructed with paving and finishing equipment utilizing either fixed forms or slipform.

3.4.1 Consolidation

The paver vibrators shall be inserted into the concrete not closer to the underlying material than 2 inches. The vibrators or any tamping units in front of the paver shall be automatically controlled so that they shall be stopped immediately as forward motion ceases. Excessive vibration shall not be permitted. Concrete in small, odd-shaped slabs or in locations inaccessible to the paver mounted vibration equipment shall be vibrated with a hand-operated immersion vibrator. Vibrators shall not be used to transport or spread the concrete.

3.4.2 Operation

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, including keeping the existing pavement surface free of any debris, and placing rubber mats beneath the paver tracks. Transversely oscillating screeds and extrusion plates shall overlap the existing pavement the minimum possible, but in no case more than 8 inches.

3.4.3 Required Results

The paver-finisher shall be operated 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. It shall produce only a very minimum of paste at the surface. Multiple passes of the paver-finisher shall 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. No water, other than true fog sprays (mist), shall be applied to the concrete surface during paving and finishing.

3.4.4 Fixed Form Paving

Forms shall be steel, except that wood forms may be used for curves having a radius of 150 feet or less, and for fillets. Forms may be built up with metal or wood, added only to the base, to provide an increase in depth of not more than 25 percent. The base width of the form shall be not less than eight-tenths of the vertical height of the form, except that forms 8 inches or less in vertical height shall have a base width not less than the vertical height of the form. Wood forms for curves and fillets shall be adequate in strength and rigidly braced. Forms shall be set on firm material cut true to grade so that each form section when placed will be firmly in contact with the underlying layer for its entire base. Forms shall not be set on blocks or on built-up spots of underlying material. Forms shall remain in place at least 12 hours after the concrete has been placed. Forms shall be removed without injuring the concrete.

3.4.5 Slipform Paving

The slipform paver shall shape the concrete to the specified and indicated cross section in one pass, and shall finish the surface and edges so that only a very minimum amount of hand finishing is required. Dowels shall not be installed by dowel inserters attached to the paver or by any other means of inserting the dowels into the plastic concrete.

3.4.6 Placing Reinforcing Steel

Reinforcement shall be positioned on suitable chairs securely fastened to the subgrade prior to concrete placement.

3.4.7 Placing Dowels and Tie Bars

Dowels shall be installed with alignment not greater than 1/8 inch per ft. Except as otherwise specified below, location of dowels shall be within a horizontal tolerance of plus or minus 5/8 inch and a vertical tolerance of plus or minus 3/16 inch. The portion of each dowel intended to move within the concrete or expansion cap shall be painted with one coat of rust inhibiting primer paint, and then oiled just prior to placement. Dowels and tie bars in joints shall be omitted when the center of the dowel tie bar is located within a horizontal distance from an intersecting joint equal to or less than one-fourth of the slab thickness.

3.4.7.1 Contraction Joints

Dowels and tie bars in joints within the paving lane shall be held securely in place by means of rigid metal basket assemblies. The dowels and tie bars shall be welded to the assembly or held firmly by mechanical locking arrangements that will prevent them from becoming distorted during paving operations. The basket assemblies shall be held securely in the proper location by means of suitable anchors.

3.4.7.2 Construction Joints-Fixed Form Paving

Installation of dowels and tie bars shall be by the bonded-in-place method, supported by means of devices fastened to the forms. Installation by removing and replacing in preformed holes will not be permitted.

3.4.7.3 Dowels Installed in Hardened Concrete

Installation shall be by bonding the dowels into holes drilled into the hardened concrete. Holes approximately 1/8 inch greater in diameter than the dowels shall be drilled into the hardened concrete. Dowels shall be bonded in the drilled holes using epoxy resin 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 shall 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 collar fitted around the dowel. The vertical alignment of the dowels shall be checked by placing the straightedge on the surface of the pavement over the top of the dowel and measuring the vertical distance between the straightedge and the beginning and ending point of the exposed part of the dowel.

3.4.7.4 Expansion Joints

Expansion joints shall be as shown.

3.5 FINISHING CONCRETE

Start finishing operations immediately after placement of concrete. Use finishing machine, except hand finishing may be used in emergencies and for concrete slabs in inaccessible locations or of such shapes or sizes that machine finishing is impracticable. Finish pavement surface on both sides

of a joint to the same grade. Finish formed joints from a securely supported transverse bridge. Provide hand finishing equipment for use at all times. Transverse and longitudinal surface tolerances shall be 1/4 inch in 10 feet.

3.5.1 Side Form Finishing

Strike off and screed concrete to the required slope and cross-section by a power-driven transverse finishing machine. Transverse rotating tube or pipe shall not be permitted unless approved by the Contracting Officer. Elevation of concrete shall be such that, when consolidated and finished, pavement surface will be adequately consolidated and at the required grade. Equip finishing machine with two screeds which are readily and accurately adjustable for changes in pavement slope and compensation for wear and other causes. Make as many passes over each area of pavement and at such intervals as necessary to give proper compaction, retention of coarse aggregate near the finished surface, and a surface of uniform texture, true to grade and slope. Do not permit excessive operation over an area, which will result in an excess of mortar and water being brought to the surface.

3.5.1.1 Equipment Operation

Maintain the travel of machine on the forms without lifting, wobbling, or other variation of the machine which tend to affect the precision of concrete finish. Keep the tops of the forms clean by a device attached to the machine. During the first pass of the finishing machine, maintain a uniform ridge of concrete ahead of the front screed for its entire length.

3.5.1.2 Joint Finish

Before concrete is hardened, correct edge slump of pavement, exclusive of edge rounding, in excess of 0.02 foot. Finish concrete surface on each side of construction joints to the same plane, and correct deviations before newly placed concrete has hardened.

3.5.1.3 Hand Finishing

Strike-off and screed surface of concrete to elevations slightly above finish grade so that when concrete is consolidated and finished pavement surface is at the indicated elevation. Vibrate entire surface until required compaction and reduction of surface voids is secured with a strike-off template.

3.5.1.4 Longitudinal Floating

After initial finishing, further smooth and consolidate concrete by means of hand-operated longitudinal floats. Use floats that are not less than 12 feet long and 6 inches wide and stiffened to prevent flexing and warping.

3.5.2 Texturing

3.5.2.1 Brooming

Finish the surface of the slab by brooming the surface with a broom at least 18 inches wide. Gently pull the broom over the surface of the pavement from edge to edge just before the concrete becomes non-plastic. Slightly overlap adjacent strokes of the broom. Broom perpendicular to centerline of pavement so that corrugations produced will be uniform in character and

width, and not more than 1/16 inch in depth. Broomed surface shall be free from porous spots, irregularities, depressions, and small pockets or rough spots such as may be caused by accidentally disturbing particles of coarse aggregate embedded near the surface.

3.5.3 Edging

At the time the concrete has attained a degree of hardness suitable for edging, carefully finish slab edges, including edges at formed joints, with an edge having a maximum radius of one-eighth inch. When brooming is selected for the final surface finish, edge transverse joints before starting brooming, then operate broom to obliterate as much as possible the mark left by the edging tool without disturbing the rounded corner left by the edger. Clean by removing loose fragments and soupy mortar from corners or edges of slabs which have crumbled and areas which lack sufficient mortar for proper finishing. Refill voids solidly with a mixture of suitable proportions and consistency and refinish. Remove unnecessary tool marks and edges. Remaining edges shall be smooth and true to line.

3.5.4 Repair of Surface Defects

Follow guidance of ACI 301.

3.6 CURING AND PROTECTION

Protect concrete adequately from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks and oil stains, and do not allow it to dry out from the time it is placed until the expiration of the minimum curing periods specified herein. Use liquid membrane-forming compound, except as specified otherwise herein. Do not use membrane-forming compound on surfaces where its appearance would be objectionable, on surfaces to be painted, where coverings are to be bonded to concrete, or on concrete to which other concrete is to be bonded. Maintain temperature of air next to concrete above 40 degrees F for the full curing periods.

3.6.1 Liquid Membrane-Forming Compound Curing

Apply compound immediately after surface loses its water sheen and has a dull appearance and before joints are sawed. Agitate curing compound thoroughly by mechanical means during use and apply uniformly in a two-coat continuous operation by suitable power-spraying equipment. Total coverage for the two coats shall be at least one gallon of undiluted compound per 200 square feet. Compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. Apply an additional coat of compound immediately to areas where film is defective. Respray concrete surfaces that are subject to heavy rainfall within 3 hours after curing compound has been applied in the same manner.

3.6.1.1 Protection of Treated Surfaces

Keep concrete surfaces to which liquid membrane-forming compounds have been applied free from vehicular traffic and other sources of abrasion for not less than 72 hours. Foot traffic is allowed after 24 hours for inspection purposes. Maintain continuity of coating for entire curing period and repair damage to coating immediately.

3.7 FIELD QUALITY CONTROL

3.7.1 Sampling

The Contractor's approved laboratory shall collect samples of fresh concrete in accordance with the following schedule:

a. Less than 50 cyds, two (2) samples
b. 50-150 cyds, three (3) samples
c. More than 150 cyds, one (1) sample every 150 cyds but not less than three(3) total

During each working day as required to perform tests specified herein. Test specimens to be taken from point of discharge.

3.7.2 Consistency Tests

The Contractor's approved laboratory shall perform concrete slump tests in accordance with ASTM C 143. Take samples for slump determination from concrete during placement. Perform tests at the beginning of a concrete placement operation and and for each batch (minimum) or every 20 cubic yards (maximum) of concrete to ensure that specification requirements are met. In addition, perform tests each time test beams and cylinders are made.

3.7.3 Flexural Strength Tests

The Contractor's approved laboratory shall test for flexural strength in accordance with ASTM C 78. Make four test specimens for each set of tests. Test two specimens at 7 days, and the other two at 28 days. Concrete strength will be considered satisfactory when the minimum of the 28-day test results equals or exceeds the specified 28-day flexural strength, and no individual strength test is less than 650 pounds per square inch. If the ratio of the 7-day strength test to the specified 28-day strength is less than 65 percent, make necessary adjustments for conformance. Frequency of flexural tests on concrete beams shall be not less than four test beams for each 50 cubic yards of concrete, or fraction thereof, placed. Concrete which is determined to be defective, based on the strength acceptance criteria therein, shall be removed and replaced with acceptable concrete.

3.7.4 Air Content Tests

Test air-entrained concrete for air content at the same frequency as specified for slump tests. Determine percentage of air in accordance with ASTM C 231 on samples taken during placement of concrete in forms.

3.7.5 Surface Testing

Surface testing for surface smoothness and plan grade shall be performed as indicated below by the Testing Laboratory. The measurements shall be properly referenced in accordance with paving lane identification and stationing, and a report given to the Government within 24 hours after measurement is made. A final report of surface testing, signed by a Registered Engineer, containing all surface measurements and a description of all actions taken to correct deficiencies, shall be provided to the Government upon conclusion of surface testing.

3.7.5.1 Surface Smoothness Requirements

The finished surfaces of the pavements shall have no abrupt change of 1/8 inch or more, and variations in final pervious surface shall not be more than 3/8 inch under a 10 foot straightedge.

3.7.5.2 Surface Smoothness Testing Method

Surfaces shall be tested for ponding water. Ponding shall not be allowed.

3.7.6 Plan Grade Testing and Conformance

The surfaces shall vary not more than 0.06 foot above or below the plan grade line or elevation indicated. Each pavement category shall be checked by the Contractor for conformance with plan grade requirements by running lines of levels at intervals to determine the elevation at each joint intersection.

3.7.7 Test for Pavement Thickness

Measure during concrete placement to determine in-place thickness of concrete pavement.

3.7.8 Reinforcement

Inspect reinforcement prior to installation to assure it is free of loose flaky rust, loose scale, oil, mud, or other objectionable material.

3.7.9 Dowels

Inspect dowel placement prior to placing concrete to assure that dowels are of the size indicated, and are spaced, aligned and painted and oiled as specified. Dowels shall not deviate from vertical or horizontal alignment after concrete has been placed by more than 1/8 inch per foot.

3.8 WASTE MANAGEMENT

In accordance with the Waste Management Plan.

-- 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.

ACI INTERNATIONAL (ACI)

ACI 305R	(1999; Errata 2006) Hot Weather Concreting
ACI 306.1	(1990; R 2002) Standard Specification for Cold Weather Concreting

ASTM INTERNATIONAL (ASTM)

ASTM A 185/A 185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A 615/A 615M	(2008) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM C 143/C 143M	(2008) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C 171	(2007) Standard Specification for Sheet Materials for Curing Concrete
ASTM C 172	(2008) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C 173/C 173M	(2008) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 231	(2008b) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 309	(2007) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2008a) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 920	(2008) Standard Specification for Elastomeric Joint Sealants
ASTM D 1751	(2004) Standard Specification for

	Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(2004a) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D 5893	(2004) 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 Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Concrete; G

Copies of certified delivery tickets for all concrete used in the construction.

SD-06 Test Reports

Field Quality Control; G

Copies of all test reports within 24 hours of completion of the test.

1.4 ENVIRONMENTAL REQUIREMENTS

1.4.1 Placing During Cold Weather

When air temperature falls below 40 degrees F, follow recommendations of

ACI 306.1 (latest revision) "Recommended Practice for Cold Weather Concreting".

1.4.2 Placing During Warm Weather

When air temperature is around 90 degrees F, follow recommendations of ACI 305R (latest revision) "Recommended Practice for Hot Weather Concreting".

PART 2 PRODUCTS

2.1 CONCRETE

Provide concrete conforming to the applicable requirements of Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL 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 4 to 5.5 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 A 615/A 615M. Wire mesh reinforcement shall conform to ASTM A 185/A 185M.

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 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 D 5893.

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 in conformance with Section 31 00 00 EARTHWORK.

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 of 1/4 inch per foot with the low side adjacent to the roadway or sloping away from buildings. 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 in the construction

drawings. 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 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 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 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 C 172. 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 C 231. ASTM C 231 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.

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SECTION 32 17 24.00 10

PAVEMENT MARKINGS
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 4505	(2005) Preformed Retroflective Pavement Marking Tape for Extended Service Life
ASTM D 792	(2008) Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM E 28	(1999; R 2009) Softening Point of Resins Derived from Naval Stores by Ring and Ball Apparatus

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-P-1952	(Rev E) Paint, Traffic and Airfield Markings, Waterborne

1.2 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.

1.2.1 Paint Application Equipment

1.2.1.1 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. Equipment used for marking streets and highways shall be capable of placing the prescribed number of lines at a single pass as solid lines, intermittent lines or a combination of solid and intermittent lines using a maximum of two different colors of paint as specified. . 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.

1.2.1.2 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.

1.2.2 Thermoplastic Application Equipment

1.2.2.1 Thermoplastic Material

Thermoplastic material shall be applied to the primed pavement surface by spray techniques or by the extrusion method, wherein one side of the shaping die is the pavement and the other three sides are contained by, or are part of, suitable equipment for heating and controlling the flow of material. By either method, the markings shall be applied with equipment that is capable of providing continuous uniformity in the dimensions of the stripe.

1.2.2.2 Application Equipment

a. Application equipment shall provide continuous mixing and agitation of the material. Conveying parts of the equipment between the main material reservoir and the extrusion shoe or spray gun shall prevent accumulation and clogging. All parts of the equipment which come into contact with the material shall be easily accessible and exposable for cleaning and maintenance. All mixing and conveying parts up to and including the extrusion shoes and spray guns shall maintain the material at the required temperature with heat-transfer oil or electrical-element-controlled heat.

b. The application equipment shall be constructed to ensure continuous uniformity in the dimensions of the stripe. The applicator shall provide a means for cleanly cutting off stripe ends squarely and shall provide a method of applying "skiplines". The equipment shall be capable of applying varying widths of traffic markings.

c. The applicator shall be equipped with a drop-on type bead dispenser capable of uniformly dispensing reflective glass spheres at controlled rates of flow. The bead dispenser shall be automatically operated and shall begin flow prior to the flow of composition to assure that the strip is fully reflectorized.

1.2.2.3 Mobile and Maneuverable

Application equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true

arc. The equipment used for the placement of thermoplastic pavement markings shall be of two general types: mobile applicator and portable applicator.

a. Mobile Application Equipment: The mobile applicator shall be defined as a truck-mounted, self-contained pavement marking machine that is capable of hot applying thermoplastic by either the extrusion or spray method. The unit shall be equipped to apply the thermoplastic marking material at temperatures exceeding 375 degrees F, at widths varying from 3 to 12 inches and in thicknesses varying from 0.020 to 0.190 inch and shall have an automatic drop-on bead system. The mobile unit shall be capable of operating continuously and of installing a minimum of 20,000 lineal feet of longitudinal markings in an 8-hour day.

(1) The mobile unit shall be equipped with a melting kettle which holds a minimum of 6000 pounds of molten thermoplastic material. The kettle shall be capable of heating the thermoplastic composition to temperatures of 375 to 425 degrees F. A thermostatically controlled heat transfer liquid shall be used. Heating of the composition by direct flame will not be allowed. Oil and material temperature gauges shall be visible at both ends of the kettle.

(2) The mobile unit shall be equipped with an electronic programmable line pattern control system. The control system shall be capable of applying skip or solid lines in any sequence, through any and all of the extrusion shoes, or the spray guns, and in programmable cycle lengths. In addition, the mobile unit shall be equipped with an automatic counting mechanism capable of recording the number of lineal feet of thermoplastic markings applied to the pavement surface with an accuracy of 0.5 percent.

b. Portable Application Equipment: The portable applicator shall be defined as hand-operated equipment, specifically designed for placing special markings such as crosswalks, stopbars, legends, arrows, and short lengths of lane, edge and centerlines. The portable applicator shall be capable of applying thermoplastic pavement markings by the extrusion method. The portable applicator shall be loaded with hot thermoplastic composition from the melting kettles on the mobile applicator. The portable applicator shall be equipped with all the necessary components, including a materials storage reservoir, bead dispenser, extrusion shoe, and heating accessories, so as to be capable of holding the molten thermoplastic at a temperature of 375 to 425 degrees F, of extruding a line of 3 to 12 inches in width, and in thicknesses of not less than 0.125 inch nor more than 0.190 inch and of generally uniform cross section.

1.2.3 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.

1.2.4 Preformed Tape Application Equipment

Mechanical application equipment shall be used for the placement of preformed marking tape. Mechanical application equipment shall be defined as a mobile pavement marking machine specifically designed for use in applying precoated, pressure-sensitive pavement marking tape of varying widths, up to 12 inches. The applicator shall be equipped with rollers, or other suitable compactive device, to provide initial adhesion of the preformed, pressure-sensitive marking tape with the pavement surface. Additional hand-operated rollers shall be used as required to properly seat the thermoplastic tape.

1.2.5 Surface Preparation Equipment

1.2.5.1 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.

1.2.5.2 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.

1.2.6 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.

1.2.6.1 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.

1.2.6.2 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.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. 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.

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

Submit documentation certifying that pertinent personnel are qualified for equipment operation and handling of chemicals.

1.4.2 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.

1.4.3 Maintenance of Traffic

1.4.3.1 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.

1.5 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.

1.6 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 selected. 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 THERMOPLASTIC COMPOUNDS

The thermoplastic reflectorized pavement marking compound shall be extruded or sprayed in a molten state onto a primed pavement surface. Following a surface application of glass beads and upon cooling to normal pavement temperatures, the marking shall be an adherent reflectorized strip of the specified thickness and width that is capable of resisting deformation by traffic.

2.2.1 Composition Requirements

The binder component shall be formulated as a hydrocarbon resin. The pigment, beads and filler shall be uniformly dispersed in the binder resin. The thermoplastic composition shall be free from all skins, dirt, and foreign objects and shall comply with the following requirements:

Component	Percent by Weight	
	White	Yellow
Binder	17 min.	17 min.
Titanium dioxide	10 min.	-
Glass beads	20 min.	20 min.
Calcium carbonate and inert fillers	49 max.	*
Yellow pigments	-	*
*Amount and type of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, providing the other composition requirements of this specification are met.		

2.2.2 Physical Properties

2.2.2.1 Color

The color shall be as indicated.

2.2.2.2 Drying Time

When installed at 70 degrees F and in thicknesses between 1/8 and 3/16 inch, after curing 15 minutes.

2.2.2.3 Softening Point

The composition shall have a softening point of not less than 194 degrees F when tested in accordance with ASTM E 28.

2.2.2.4 Specific Gravity

The specific gravity of the composition shall be between 1.9 and 2.2 as determined in accordance with ASTM D 792.

2.2.3 Asphalt Concrete Primer

The primer for asphalt concrete pavements shall be a thermosetting adhesive with a solids content of pigment reinforced synthetic rubber and synthetic plastic resin dissolved and/or dispersed in a volatile organic compound (VOC). Solids content shall not be less than 10 percent by weight at 70 degrees F and 60 percent relative humidity. A wet film thickness of 0.005 inch plus or minus 0.001 inch, shall dry to a tack-free condition in less than 5 minutes.

2.2.4 Portland Cement Concrete Primer

The primer for Portland cement concrete pavements shall be an epoxy resin primer. The primer shall be of the type recommended by the manufacturer of the thermoplastic composition. Epoxy primers recommended by the manufacturer shall be approved by the Contracting Officer prior to use. Requests for approval shall be accompanied with technical data, instructions for use, and a 1 quart sample of the primer material.

2.3 PREFORMED TAPE

The preformed tape shall be an adherent reflectorized strip in accordance with ASTM D 4505 Type I or IV, Class optional.

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. Materials will be sampled and tested by the Government. No material shall be used at the project prior to receipt by the Contractor of written notice that the materials meet the laboratory requirements. The cost of initial testing of samples from each lot of materials will be borne by the Government. If the sample fails to meet specification requirements, the material represented by the sample shall be replaced and the new material will be tested. Cost of sampling and testing the new material will be borne by the Contractor.

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 recleaned, when work has been stopped due to rain.

3.1.1 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.

3.1.2 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 road and street pavement at a rate of 6 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 Thermoplastic Compounds

Thermoplastic pavement markings shall be placed upon dry pavement; surface dry only will not be considered an acceptable condition. At the time of installation, the pavement surface temperature shall be a minimum of 40 degrees F and rising. Thermoplastics, as placed, shall be free from dirt or tint.

3.2.2.1 Longitudinal Markings

All centerline, skipline, edgeline, and other longitudinal type markings shall be applied with a mobile applicator. All special markings, crosswalks, stop bars, legends, arrows, and similar patterns shall be placed with a portable applicator, using the extrusion method.

3.2.2.2 Primer

After surface preparation has been completed the asphalt and/or concrete pavement surface shall be primed. The primer shall be applied with spray equipment. Primer materials shall be allowed to "set-up" prior to applying the thermoplastic composition. The asphalt concrete primer shall be allowed to dry to a tack-free condition, usually occurring in less than 10 minutes. The Portland cement concrete primer shall be allowed to dry in accordance with the thermoplastic manufacturer's recommendations. To shorten the curing time of the epoxy resins an infrared heating device may be used on the concrete primer.

a. Asphalt Concrete Primer: Primer shall be applied to all asphalt concrete pavements at a wet film thickness of 0.005 inch, plus or minus 0.001 inch (265-400 square feet/gallon).

b. Portland Cement Concrete Primer: Primer shall be applied to all concrete pavements (including concrete bridge decks) at a wet film thickness of between 0.04 to 0.05 inch (320-400 square feet/gallon).

3.2.2.3 Markings

After the primer has "set-up", the thermoplastic shall be applied at temperatures no lower than 375 degrees F nor higher than 425 degrees F at the point of deposition. Immediately after installation of the marking, drop-on glass spheres shall be mechanically applied so that the spheres are held by and imbedded in the surface of the molten material.

a. Extruded Markings: All extruded thermoplastic markings shall be applied at the specified width and at a thickness of not less than 0.125 inch nor more than 0.190 inch.

b. Sprayed Markings: All sprayed thermoplastic markings shall be applied at the specified width and the thicknesses designated in the contract plans. If the plans do not specify a thickness, centerline markings shall be applied at a wet thickness of 0.090 inch, plus or minus 0.005 inch, and edgeline markings at a wet thickness of 0.060 inch plus or minus 0.005 inch.

c. Reflective Glass Spheres: Immediately following application, reflective glass spheres shall be dropped onto the molten thermoplastic marking at the rate of 1 pound/20 square feet of compound.

3.2.3 Preformed Tape

The pavement surface temperature shall be a minimum of 60 degrees F and the ambient temperature shall be a minimum of 60 degrees F and rising. The preformed markings shall be placed in accordance with the manufacturer's written instructions.

3.2.4 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.

3.2.5 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, including plastic tape, 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.

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SECTION 32 31 13.53

HIGH-SECURITY CHAIN LINK FENCES AND GATES
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 A 116	(2005) Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric
ASTM A 121	(2007) Standard Specification for Metallic-Coated Carbon Steel Barbed Wire
ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 392	(2007) Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A 702	(1989; R 2006) Standard Specification for Steel Fence Posts and Assemblies, Hot Wrought
ASTM A 780	(2001; R 2006) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 824	(2001; R 2007) Standard Specification for Metallic-Coated Steel Marcelled Tension Wire for Use With Chain Link Fence
ASTM C 94/C 94M	(2009) Standard Specification for Ready-Mixed Concrete
ASTM F 1043	(2008) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F 1083	(2008) Standard Specification for Pipe, Steel, Hot-Dipped Zinc Coated (Galvanized) Welded, for Fence Structures
ASTM F 1184	(2005) Industrial and Commercial Horizontal Slide Gates
ASTM F 567	(2007) Standard Practice for Installation of Chain Link Fence
ASTM F 626	(2008) Standard Specification for Fence

	Fittings
ASTM F 900	(2005) Industrial and Commercial Swing Gates

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fence Installation
Installation Drawings
Location of gate, corner, end, and pull posts
Gate Assembly
Turnstiles
Gate Hardware and Accessories

Installation drawings in accordance with paragraph titled, "ASSEMBLY AND INSTALLATION DRAWINGS" of this section.

SD-03 Product Data

Fence Installation
Gate Assembly
Gate Hardware and Accessories

Manufacturer's catalog data.

SD-04 Samples

Fabric
Posts
Post Caps
Braces
Line Posts
Bottom Rail
Tension Wire
Barbed Wire
Barbed Wire Supporting Arms
Stretcher Bars
Gate Posts
Gate Hardware and Accessories
Turnstiles
Wire Ties

Samples as described within this section.

SD-06 Test Reports

Weight in ounces for zinc coating

Thickness of PVC coating

Chemical composition and thickness of aluminum alloy coating

SD-07 Certificates

Chain Link Fence

Submit reports, signed by an official authorized to certify on behalf of the manufacturer, attesting that the chain link fence and component materials meet the specified requirements.

Zinc Coating
PVC coating
aluminum alloy coating
Fabric
Barbed Wire
Stretcher Bars
Gate Hardware and Accessories
Concrete

SD-08 Manufacturer's Instructions

Submit Manufacturer's instructions for the following items:

Fence Installation
Accessories

1.3 QUALITY ASSURANCE

1.3.1 Required Report Data

Submit reports of chain-link fencing listing and accessories regarding weight in ounces for zinc coating, thickness of PVC coating, and chemical composition and thickness of aluminum alloy coating.

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.

PART 2 PRODUCTS

2.1 FENCE FABRIC

2.1.1 General

Provide ASTM A 392, Class 1 , zinc-coated steel wire with minimum coating weight of 1.2 ounces of zinc per square foot of coated surface. Fabricate fence fabric of 9 gauge wire woven in 2 inch mesh conforming to ASTM A 116. Set fabric height as shown. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage. Secure fabric to posts using stretcher bars or ties spaced 15 inches on center, or by integrally weaving to integral fastening loops of end, corner, pull, and gate posts for full length of each post. Install fabric on opposite side of posts from area being secured.

2.2 POSTS

2.2.1 Metal Posts for Chain Link Fence

a. Provide posts conforming to ASTM F 1083, zinc-coated. Group IA, with external coating Type A steel pipe. Group IC steel pipe,

zinc-coated with external coating Type A or Type B and Group II , roll-formed steel sections, meeting the strength and coating requirements of ASTM F 1043 and ASTM A 702. Group III, ASTM F 1043 steel H-section may be used for line posts in lieu of line post shapes specified for the other classes. Provide sizes as shown on the drawings. Line posts and terminal (corner, gate, and pull) posts selected shall be of the same designation throughout the fence. Provide gate post for the gate type specified subject to the limitation specified in ASTM F 900 and/or ASTM F 1184. Post spacing shall conform to the recommended guidelines as set forth in the CLFMI "Wind Load Guide for the Selection of Line Post Spacing and Size" unless specified to exceed those guidelines.

b.

2.2.2 Accessories

a. Provide accessories conforming to ASTM F 626. Ferrous accessories shall be zinc or aluminum coated.

b. Furnish truss rods for each terminal post. Provide truss rods with turnbuckles or other equivalent provisions for adjustment.

c. Provide Barbed wire supporting arms of the 45 degree outward angle 3-strand or V 6 strand arm type and of the design required for the post furnished. Secure arms by riveting.

d. Furnish post caps in accordance with manufacturer's standard accessories.

e. Provide 9 gauge steel tie wire for attaching fabric to rails, braces, and posts and match the coating of the fence fabric. Miscellaneous hardware coatings shall conform to ASTM A 153/A 153M unless modified.

2.3 BRACES AND RAILS

a. ASTM F 1083, zinc-coated, Group IA, steel pipe, size NPS 1-1/4. Group IC steel pipe, zinc-coated, shall meet the strength and coating requirements of ASTM F 1043. Group II, formed steel sections, size 1-21/32 inch and conforming to ASTM F 1043, may be used as braces and rails if Group II line posts are furnished.

b.

2.4 WIRE

2.4.1 Wire Ties

Provide wire ties constructed of the same material as the fencing fabric.

2.4.2 Barbed Wire

Provide barbed wire conforming to ASTM A 121 zinc-coated, Type Z, Class 3, or aluminum-coated, Type A, with 12.5 gauge wire with 14 gauge, round, 4-point barbs spaced no more than 5 inches apart.

2.4.3 Tension Wire

Provide Type I, Class 4 coating, in accordance with ASTM A 824.

2.5 CONCRETE

ASTM C 94/C 94M, using 3/4 inch maximum size aggregate, and having minimum compressive strength of 3000 psi at 28 days. Grout shall consist of one part portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

2.6 GATES

2.6.1 Gate Assembly

Provide gate assembly conforming to ASTM F 900 and/or ASTM F 1184 of the type and swing shown. Provide gate frames conforming to strength and coating requirements of ASTM F 1083 for Group IA, steel pipe, with external coating Type A, nominal pipe size (NPS) 1-1/2. Provide gate frames conforming to strength and coating requirements of ASTM F 1043, for Group IC, steel pipe with external coating Type A or Type B, nominal pipe size (NPS) 1-1/2. Gate fabric shall be as specified for chain link fabric.

2.6.2 Gate Leaves

For gate leaves, more than 8 feet wide, provide either intermediate members and diagonal truss rods or tubular members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 8 feet wide shall have truss rods or intermediate braces. Provide intermediate braces on all gate frames with an electro-mechanical lock. Attach fabric to the gate frame by method standard with the manufacturer except that welding will not be permitted.

2.6.3 Gate Hardware and Accessories

Furnish and install latches, hinges, stops, keepers, rollers, and other hardware items as required for the operation of the gate. Arrange latches for padlocking so that the padlock will be accessible from both sides of the gate. Provide stops for holding the gates in the open position. For high security applications, each end member of gate frames shall be extended sufficiently above the top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence.

PART 3 EXECUTION

3.1 FENCE INSTALLATION

Perform complete installation conforming to ASTM F 567.

3.1.1 Line and Grade

Install fence to the lines and grades indicated. Clear the area on either side of the fence line to the extent indicated. Space line posts equidistant at intervals not exceeding 10 feet. Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Provide fabric continuous between terminal posts; however, runs between terminal posts shall not exceed 500 feet. Repair any damage to galvanized surfaces, including welding, with paint containing zinc dust in accordance with ASTM A 780.

3.1.2 Excavation

Clear all post holes of loose material. Spread waste material where directed. Eliminate ground surface irregularities along the fence line to the extent necessary to maintain a 2 inch clearance between the bottom of the fabric and finish grade.

3.2 POST INSTALLATION

3.2.1 Earth and Bedrock

a. Set posts plumb and in alignment. Except where solid rock is encountered, set posts in concrete to the depth indicated on the drawings. Where solid rock is encountered with no overburden, set posts to a minimum depth of 18 inches in rock. Where solid rock is covered with an overburden of soil or loose rock, set posts to the minimum depth indicated on the drawing unless a penetration of 18 inches in solid rock is achieved before reaching the indicated depth, in which case terminate depth of penetration. Grout all portions of posts set in rock.

b. Portions of posts not set in rock shall be set in concrete from the rock to ground level. Posts set in concrete shall be set in holes not less than the diameter shown on the drawings. Make diameters of holes in solid rock at least 1 inch greater than the largest cross section of the post. Thoroughly consolidate concrete and grout around each post, free of voids and finished to form a dome. Allow concrete and grout to cure for 72 hours prior to attachment of any item to the posts. Group II line posts may be mechanically driven, for temporary fence construction only, if rock is not encountered. Set driven posts to a minimum depth of 3 feet and protect with drive caps when setting.

Test fence post rigidity by applying a 50 pound force on the post, perpendicular to the fabric, at 5 feet above ground. Post movement measured at the point where the force is applied shall be less than or equal to 3/4 inch from the relaxed position. Test every tenth post for rigidity. When a post fails this test, make further tests on the next four posts on either side of the failed post. All failed posts shall be removed, replaced, and retested at the Contractor's expense.

3.3 RAILS

Bolt bottom rail to double rail ends and securely fasten double rail ends to the posts. Peen bolts to prevent easy removal. Install bottom rail before chain link fabric.

3.4 FABRIC INSTALLATION

a. Install chain link fabric on the side of the post indicated. Attach fabric to terminal posts with stretcher bars and tension bands. Space bands at approximately 15 inch intervals. Install fabric and pull taut to provide a smooth and uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height. Fasten fabric to line posts at approximately 15 inch intervals and fastened to all rails and tension wires at approximately 12 inch intervals.

b. Cut fabric by untwisting and removing pickets. Accomplish splicing

by weaving a single picket into the ends of the rolls to be joined. The bottom of the installed fabric shall be 2 plus or minus 1/2 inch above the ground.

c. After the fabric installation is complete, exercise the fabric by applying a 50 pound push-pull force at the center of the fabric between posts; the use of a 30 pound pull at the center of the panel shall cause fabric deflection of not more than 2.5 inches when pulling fabric from the post side of the fence; every second fence panel shall meet this requirement; resecure and retest all failed panels at the Contractor's expense.

3.5 SUPPORTING ARMS

Install barbed wire supporting arms and barbed wire as indicated on the drawings and as recommended by the manufacturer. Anchor supporting arms with 3/8 inch diameter plain pin rivets or, at the Contractor's option, with studs driven by low-velocity explosive-actuated tools for steel, wrought iron, ductile iron, or malleable iron. Pull barbed wire taut and attach to the arms with clips or other means that will prevent easy removal.

3.6 GATE INSTALLATION

a. Install gates at the locations shown. Mount gates to slide as indicated. Install latches, stops, and keepers as required. Install Slide gates as recommended by the manufacturer.

b. Attach padlocks to gates or gate posts with chains. Weld or otherwise secure hinge pins, and hardware assembly to prevent removal.

c. Submit Six copies of operating and maintenance instructions, a minimum of 2 weeks prior to field training. Operating instructions shall outline the step-by-step procedures required for system startup, operation, and shutdown. Include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Include in the maintenance instructions routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. Also include the general gate layout, equipment layout and simplified wiring and control diagrams of the system as installed.

3.7 CLEANUP

Remove waste fencing materials and other debris from the work site each workday.

-- End of Section --

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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 93 00 EXTERIOR PLANTS, 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 Contractor Quality Control approval. 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; G

Include physical characteristics, and recommendations.

SD-06 Test Reports

Topsoil composition tests (reports and recommendations); G

SD-07 Certificates

State certification and approval for seed; G

SD-08 Manufacturer's Instructions

Erosion Control Materials; G

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 Gypsum and Lime 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 and lime may be furnished in bulk with certificate indicating the above information.

1.5.2 Storage

1.5.2.1 Seed, Fertilizer and Lime 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

Planting Season	Planting Dates
Season 1	February 15 - August 31
Temporary Seeding	September 1 - February 14

2.1.3 Seed Purity

Botanical Name	Common Name	Min. Percent Pure Seed	Min. Percent Germination and Hard Seed	Max. Percent Weed Seed
Cynodon Dactylon	Bermuda Grass	82	95	0.5
Iolium Multiflorum	Annual Rye Grass	88	95	0.5

2.1.4 Seed Mixture by Weight

Planting Season	Variety	Percent (by Weight)
Season 1	Commn Bermuda (Unhulled)	82
Temporary Seeding	Annual Rye Grass	88

Proportion seed mixtures by weight. Temporary seeding must later be replaced by Season 1 plantings for a permanent stand of grass. The same requirements of turf establishment for Season 1 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 furnished by the Contractor.

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	25-50 percent
Clay	10-30 percent
Sand	20-35 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 limestone containing a calcium carbonate equivalent (C.C.E.) as specified in ASTM C 602 of not less than 80 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 Granular Fertilizer

Organic, granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients:

12 percent available nitrogen
12 percent available phosphorus
12 percent available potassium

2.4.2 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.

12 percent available nitrogen
12 percent available phosphorus
12 percent available potassium

2.5 MULCH

Mulch shall be free from noxious weeds, mold, and other deleterious materials.

2.5.1 Straw

Stalks from oats, wheat, rye, barley, or rice. Furnish in air-dry condition and of proper consistency for placing with commercial mulch

blowing equipment. Straw shall contain no fertile seed.

2.5.2 Hay

Air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Hay shall be sterile, containing no fertile seed.

2.5.3 Wood Cellulose Fiber Mulch

Use recovered materials of either paper-based (100 percent) or wood-based (100 percent) hydraulic mulch. Processed to contain no growth or germination-inhibiting factors and dyed an appropriate color to facilitate visual metering of materials application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 5.5 to 8.2. Use with hydraulic application of grass seed and fertilizer.

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.

2.7 EROSION CONTROL MATERIALS

Erosion control material shall conform to the following:

2.7.1 Erosion Control Blanket

100 percent agricultural straw stitched with a degradable nettings, designed to degrade within 18 months.

2.7.2 Erosion Control Fabric

Fabric shall be knitted construction of polypropylene yarn with uniform mesh openings 3/4 to 1 inch square with strips of biodegradable paper. Filler paper strips shall have a minimum life of 6 months.

2.7.3 Erosion Control Net

Net shall be heavy, twisted jute mesh, weighing approximately 1.22 pounds per linear yard and 4 feet wide with mesh openings of approximately 1 inch square.

2.7.4 Hydrophilic Colloids

Hydrophilic colloids shall be physiologically harmless to plant and animal life without phytotoxic agents. Colloids shall be naturally occurring, silicate powder based, and shall form a water insoluble membrane after curing. Colloids shall resist mold growth.

2.7.5 Erosion Control Material Anchors

Erosion control anchors shall be as recommended by the manufacturer.

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 6 inches of off-site topsoil or on-site topsoil to meet indicated finish grade. After areas have been brought to indicated finish grade, incorporate fertilizer, pH adjusters, and soil conditioners into soil a minimum depth of 6 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 Soil Conditioner Application Rates

Apply soil conditioners 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:

Lime 50 pounds per 1000 square feet.

Peat or compost derivitives, 20 cubic yards per 1000 square feet

3.1.1.3 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 1200 pounds per acre

Hydroseeding Fertilizer 1200 pounds per acre

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 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 broadcasted and drop seeding or hydroseeding.

3.2.2.1 Broadcast and Drop Seeding

Seed shall be uniformly broadcast at the rate of 3 pounds per 1000 square feet for untilled Bermuda seed, and 2 pounds per 1000 square feet for annual rye. Use broadcast or drop seeders. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing. Cover seed uniformly to a maximum depth of 1/4 inch in clay soils and 1/2 inch in sandy soils by means of spike-tooth harrow, cultipacker, raking or other approved devices.

3.2.2.2 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 3 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.

3.2.3 Mulching

3.2.3.1 Hay or Straw Mulch

Hay or straw mulch shall be spread uniformly at the rate of 2 tons per acre. Mulch shall be spread by hand, blower-type mulch spreader, or other approved method. Mulching shall be started on the windward side of relatively flat areas or on the upper part of steep slopes, and continued uniformly until the area is covered. The mulch shall not be bunched or clumped. Sunlight shall not be completely excluded from penetrating to the ground surface. All areas installed with seed shall be mulched on the same day as the seeding. Mulch shall be anchored immediately following spreading.

3.2.3.2 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.

3.2.3.3 Asphalt Adhesive Tackifier

Asphalt adhesive tackifier shall be sprayed at a rate between 10 to 13 gallons per 1000 square feet. Sunlight shall not be completely excluded from penetrating to the ground surface.

3.2.3.4 Non-Asphaltic Tackifier

Hydrophilic colloid shall be applied at the rate recommended by the manufacturer, using hydraulic equipment suitable for thoroughly mixing with water. A uniform mixture shall be applied over the area.

3.2.3.5 Asphalt Adhesive Coated Mulch

Hay or straw mulch may be spread simultaneously with asphalt adhesive applied at a rate between 10 to 13 gallons per 1000 square feet, using power mulch equipment which shall be equipped with suitable asphalt pump

and nozzle. The adhesive-coated mulch shall be applied evenly over the surface. Sunlight shall not be completely excluded from penetrating to the ground surface.

3.2.4 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.

3.2.5 Erosion Control Material

Install in accordance with manufacturer's instructions, as directed by the Contracting Officer.

3.2.6 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 3 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 RENOVATION OF EXISTING TURF AREA

3.4.1 Aeration

Upon completion of weed eradication operations and Contracting Officer's approval to proceed, aerate turf areas by approved device. Core, by pulling soil plugs, to a minimum depth of 4 inches. Leave all soil plugs, that are produced, in the turf area.

Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean all soil plugs off of other paving when work is complete.

3.4.2 Vertical Mowing

Upon completion of aerating operation and Contracting Officer's approval to proceed, vertical mow turf areas by approved device, to a depth of 1/4 inch above existing soil level, to reduce thatch build-up, grain, and surface compaction. 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 is complete. Remove all debris generated during this operation off site.

3.4.3 Dethatching

Upon completion of aerating operation and Contracting Officer's approval to proceed, dethatch turf areas by approved device, to a depth of 1/4 inch below existing soil level, to reduce thatch build-up, grain, and surface compaction. 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 is complete. Remove all debris generated during this operation off site.

3.4.4 Overseeding

Apply seed in accordance with applicable portions of paragraph entitled "Seed Application Method" at rates in accordance with paragraph entitled "Seed Composition."

3.5 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 93 00

EXTERIOR PLANTS
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 NURSERY & LANDSCAPE ASSOCIATION (ANLA)

ANSI/ANLA Z60.1	(1996; R 2004) American Standard for Nursery Stock

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA P5	(2009) Standard for Waterborne Preservatives
AWPA T1	(2009) Use Category System: Processing and Treatment Standard
AWPA U1	(2009) Use Category System: User Specification for Treated Wood

ASTM INTERNATIONAL (ASTM)

ASTM A580/A580M	(2008) Standard Specification for Stainless Steel Wire
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
ASTM D 5268	(2007) Topsoil Used for Landscaping Purposes
ASTM D 6155	(2006) Nontraditional Coarse Aggregate for Bituminous Paving Mixtures

L.H. BAILEY HORTORIUM (LHBH)

LHBH	(1976) Hortus Third

TREE CARE INDUSTRY ASSOCIATION (TCIA)

TCIA A300P1	(2008) ANSI A300 Part1: Tree Care Operations - Trees, Shrubs and Other Woody Plant Maintenance Standard Practices - Pruning
TCIA Z133.1	(2006) American National Standard for

Arboricultural Operations - Pruning, Repairing, Maintaining, and Removing Trees, and Cutting Brush - Safety Requirements

U.S. DEPARTMENT OF AGRICULTURE (USDA)

DOA SSIR 42 (1996) Soil Survey Investigation Report No. 42, Soil Survey Laboratory Methods Manual, Version 3.0

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)

1.2 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.

1.3 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

State Landscape Contractor's License

Time Restrictions and Planting Conditions

Indicate anticipated dates and locations for each type of planting.

SD-03 Product Data

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.

Peat
Composted Derivatives
Rotted Manure
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.]

Gypsum; (LEED)
Drainage Pipe; (LEED)
Mulch; G
Ground Stakes
Recycled Plastic Edging; (LEED)
Hose; (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.

Fertilizer

Weed control fabric; G

Root control barrier; G

Staking Material

Metal anchors

Antidesiccants

Erosion control materials

Photographs; G

SD-06 Test Reports

Topsoil composition tests

Percolation Test

SD-07 Certificates

Nursery certifications

Indicate names of plants in accordance with the LHBH, including type, quality, and size.

SD-10 Operation and Maintenance Data

Plastic Identification

When not labeled, identify types in Operation and Maintenance Manual.

1.4 QUALITY ASSURANCE

1.4.1 Topsoil Composition Tests

Commercial test from an independent testing laboratory including basic soil groups (moisture and saturation percentages, Nitrogen-Phosphorus-Potassium (N-P-K) ratio, pH (ASTM D 4972), soil salinity), secondary nutrient groups (calcium, magnesium, sodium, Sodium Absorption Ratio (SAR)), micronutrients (zinc, manganese, iron, copper), toxic soil elements (boron, chloride, sulfate), cation exchange and base saturation percentages, and soil

amendment and fertilizer recommendations with quantities for plant material being transplanted. Soil required for each test shall include a maximum depth of 18 inches of approximately 1 quart volume for each test. Areas sampled should not be larger than 1 acre and should contain at least 6-8 cores for each sample area and be thoroughly mixed. Problem areas should be sampled separately and compared with samples taken from adjacent non-problem areas. The location of the sample areas should be noted and marked on a parcel or planting map for future reference.

1.4.2 Nursery Certifications

a. Indicate on nursery letterhead the name of plants in accordance with the LHBH, including botanical common names, quality, and size.

b. Inspection certificate.

1.4.3 State Landscape Contractor's License

Construction company shall hold a landscape contractors license in the state where the work is performed and have a minimum of five years landscape construction experience. Submit copy of license and three references for similar work completed in the last five years.

1.4.4 Plant Material Photographs

Contractor shall submit nursery photographs, for government approval prior to ordering, for each tree larger than 24-inch box/ 2-inch caliper size.

1.4.5 Percolation Test

Immediately following rough grading operation, identify a typical location for one of the largest trees and or shrubs and excavate a pit per the project details. Fill the pit with water to a depth of 12 inches. The length of time required for the water to percolate into the soil, leaving the pit empty, shall be measured by the project Landscape Architect and verified by the Contracting Officer. Within six hours of the time the water has drained from the pit, the Contractor, with the Contracting Officer and project Landscape Architect present, shall again fill the pit with water to a depth of 12 inches. If the water does not completely percolate into the soil within 9 hours, a determination shall be made whether a drainage system or a soil penetrant will be required for each tree and or shrub being transplanted.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

1.5.1.1 Branched Plant Delivery

Deliver with branches tied and exposed branches covered with material which allows air circulation. Prevent damage to branches, trunks, root systems, and root balls and desiccation of leaves.

1.5.1.2 Soil Amendment Delivery

Deliver to the site in original, unopened 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, sulfur, iron, and lime may be furnished in bulk with a certificate

indicating the above information. Store in dry locations away from contaminates.

1.5.1.3 Plant Labels

Deliver plants with durable waterproof labels in weather-resistant ink. Provide labels stating the correct botanical and common plant name and variety as applicable and size as specified in the list of required plants. Attach to plants, bundles, and containers of plants. Groups of plants may be labeled by tagging one plant. Labels shall be legible for a minimum of 60 days after delivery to the planting site.

1.5.2 Storage

1.5.2.1 Plant Storage and Protection

Store and protect plants not planted on the day of arrival at the site as follows:

a. Shade and protect plants in outside storage areas from the wind and direct sunlight until planted.

b. Heel-in bare root plants.

c. Protect balled and burlapped plants from freezing or drying out by covering the balls or roots with moist burlap, sawdust, wood chips, shredded bark, peat moss, or other approved material. Provide covering which allows air circulation.

d. Keep plants in a moist condition until planted by watering with a fine mist spray.

e. Do not store plant material directly on concrete or bituminous surfaces.

1.5.2.2 Fertilizer, Gypsum, pH Adjusters and Mulch Storage

Store in dry locations away from contaminants.

1.5.2.3 Topsoil

Prior to stockpiling topsoil, eradicate on site undesirable growing vegetation. Clear and grub existing vegetation three to four weeks prior to stockpiling existing topsoil.

1.5.2.4 Root Control Barrier and Weed Control Fabric

Store materials on site in enclosures or under protective covering in dry location. Store under cover out of direct sunlight. Do not store materials directly on ground.

1.5.3 Handling

Do not drop or dump plants from vehicles. Avoid damaging plants being moved from nursery or storage area to planting site. Handle plants carefully to avoid damaging or breaking the earth ball or root structure. Do not handle plants by the trunk or stem. Remove damaged plants from the site.

1.5.4 TIME LIMITATION

Except for container-grown plant material, the time limitation from digging to installing plant material shall be a maximum of 90 days. The time limitation between installing the plant material and placing the mulch shall be a maximum of 24 hours.

1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS

Not Used

1.7 GUARANTEE

All plants shall be guaranteed for one year beginning on the date of inspection by the Contracting Officer to commence the plant establishment period, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by the Government or by weather conditions unusual for the warranty period.]]

At end of warranty period, replace planting materials that die or have 25 percent or more of their branches that die during the construction operations or the guarantee period.

1.8 SUSTAINABLE DESIGN REQUIREMENTS

1.8.1 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 PLANTS

2.1.1 Regulations and Varieties

Furnish nursery stock in accordance with ANSI/ANLA Z60.1, except as otherwise specified or indicated. Each plant or group of planting shall have a "key" number indicated on the nursery certifications of the plant schedule. Furnish plants, including turf grass, grown under climatic conditions similar to those in the locality of the project. . Plants of the same specified size shall be of uniform size and character of growth. All plants shall comply with all Federal and State Laws requiring inspection for plant diseases and infestation.

2.1.2 Shape and Condition

Well-branched, well-formed, sound, vigorous, healthy planting stock free from disease, sunscald, windburn, abrasion, and harmful insects or insect eggs and having a healthy, normal, and undamaged root system.

2.1.2.1 Deciduous Trees and Shrubs

Symmetrically developed and of uniform habit of growth, with straight boles or stems, and free from objectionable disfigurements.

2.1.2.2 Evergreen Trees and Shrubs

Well developed symmetrical tops with typical spread of branches for each particular species or variety.

2.1.2.3 Ground Covers and Vines

Number and length of runners and clump sizes indicated, and of the proper age for the grade of plants indicated, furnished in removable containers, integral containers, or formed homogeneous soil section.

2.1.3 Plant Size

Minimum sizes measured after pruning and with branches in normal position, shall conform to measurements indicated, based on the average width or height of the plant for the species as specified in ANSI/ANLA Z60.1. Plants larger in size than specified may be provided with approval of the Contracting Officer. When larger plants are provided, increase the ball of earth or spread of roots in accordance with ANSI/ANLA Z60.1.

2.1.4 Root Ball Size

All box-grown, field potted, field boxed, collected, plantation grown, bare root, balled and burlapped, container grown, processed-balled, and in-ground fabric bag-grown root balls shall conform to ANSI/ANLA Z60.1. All wrappings and ties shall be biodegradable. Root growth in container grown plants shall be sufficient to hold earth intact when removed from containers. Root bound plants will not be accepted.

2.1.5 Growth of Trunk and Crown

2.1.5.1 Deciduous Trees

A height to caliper relationship shall be provided in accordance with ANSI/ANLA Z60.1. Height of branching shall bear a relationship to the size and species of tree specified and with the crown in good balance with the trunk. The trees shall not be "poled" or the leader removed.

a. Single stem: The trunk shall be reasonably straight and symmetrical with crown and have a persistent main leader.

b. Multi-stem: All countable stems, in aggregate, shall average the size specified. To be considered a stem, there shall be no division of the trunk which branches more than 6 inches from ground level.

2.1.5.2 Deciduous Shrubs

Deciduous shrubs shall have the height and number of primary stems recommended by ANSI/ANLA Z60.1. Acceptable plant material shall be well shaped, with sufficient well-spaced side branches, and recognized by the trade as typical for the species grown in the region of the project.

2.1.5.3 Coniferous Evergreen Plant Material

Coniferous Evergreen plant material shall have the height-to-spread ratio recommended by ANSI/ANLA Z60.1. The coniferous evergreen trees shall not be "poled" or the leader removed. Acceptable plant material shall be exceptionally heavy, well shaped and trimmed to form a symmetrical and tightly knit plant. The form of growth desired shall be as indicated.

2.1.5.4 Broadleaf Evergreen Plant Material

Broadleaf evergreen plant material shall have the height-to-spread ratio recommended by ANSI/ANLA Z60.1. Acceptable plant material shall be well shaped and recognized by the trade as typical for the variety grown in the region of the project.

2.1.5.5 Ground Cover and Vine Plant Material

Ground cover and vine plant material shall have the minimum number of runners and length of runner recommended by ANSI/ANLA Z60.1. Plant material shall have heavy, well developed and balanced crown with vigorous, well developed root system and shall be furnished in containers.

2.2 TOPSOIL

2.2.1 Existing Soil

Modify to conform to requirements specified in paragraph entitled "Composition."

2.2.2 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.

2.2.3 Off-Site Topsoil

Conform to requirements specified in paragraph entitled "Composition." Additional topsoil shall be obtain from topsoil borrow areas indicated.

2.2.4 Composition

Evaluate soil for use as topsoil in accordance with ASTM D 5268. 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, plants, and other debris and objectionable materials. Other components shall conform to the following limits:

Silt	25-50 percent
Clay	10-30 percent
Sand	20-35 percent
pH	5.5 to 7.0
Soluble Salts	600 ppm maximum

2.3 SOIL CONDITIONERS

Provide singly or in combination as required to meet specified requirements for topsoil. Soil conditioners shall be nontoxic to plants.

2.3.1 Lime

Commercial grade hydrated or burnt limestone containing a calcium carbonate equivalent (C.C.E.) as specified in ASTM C 602 of not less than 80 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 as modified herein. Shred and granulate peat to pass a 1/2 inch mesh screen and condition in storage pile for minimum 6 months after excavation. Biobased content shall be a minimum of 100 percent. Peat shall not contain invasive species, including seeds.

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, invasive species, including seeds, 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

2.3.8.3 Biobased Content

Minimum 100 percent.

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.

2.4 PLANTING SOIL MIXTURES

100 percent topsoil as specified herein.

2.5 FERTILIZER

2.5.1 Granular Fertilizer

Organic, granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients:

20 percent available nitrogen
20 percent available phosphorus
5 percent available potassium

2.5.2 Fertilizer Tablets

Organic, plant tablets composed of tightly compressed fertilizer chips forming a tablet that is insoluble in water, is designed to provide a continuous release of nutrients for at least 24 months and contains the following minimum percentages, by weight, of plant food nutrients:

20 percent available nitrogen
20 percent available phosphorus
5 percent available potassium

2.6 WEED CONTROL FABRIC

2.6.1 Roll Type Polypropylene or Polyester Mats

Fabric shall be woven, needle punched or non-woven and treated for protection against deterioration due to ultraviolet radiation. Fabric shall be minimum 99 percent opaque to prevent photosynthesis and seed germination from occurring, yet allowing air, water and nutrients to pass thru to the roots. Minimum weight shall be 5 ounces per square yard with a minimum thickness of 20 mils with a 20 year (minimum) guarantee.

2.7 DRAINAGE PIPE FOR PLANT PITS AND BEDS

Not Used

2.8 MULCH

Free from noxious weeds, mold, pesticides, or other deleterious materials.

2.8.1 Inert Mulch Materials

Recycled porcelain, concrete, stone, or other recycled material complying with ASTM D 6155. Provide materials from site and construction waste to

the greatest extent possible. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Mulch may contain post-consumer or post-industrial recycled content.

2.8.2 Organic Mulch Materials

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.

2.8.3 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 inchscreen. It shall be cleaned of all sticks a minimum 1 inch in diameter and plastic materials a minimum 3 inches length. The material shall be treated to retard the growth of mold and fungi.

2.9 STAKING AND GUYING MATERIAL

2.9.1 Staking Material

2.9.1.1 Tree Support Stakes

Rough sawn salvaged hard wood free of knots, rot, cross grain, bark, long slivers, or other defects that impair strength. Stakes shall be minimum 2 inches square or 2 1/2 inch diameter by 8 feet long, pointed at one end. Paint or stain wood stakes dark brown..

2.9.1.2 Ground Stakes

Salvaged wood or 100 percent post-consumer recycled content plastic, 2 inches square are by 3 feet long, pointed at one end.

2.9.2 Guying Material

2.9.2.1 Guying Wire

12 gauge annealed galvanized steel, ASTM A580/A580M.

2.9.2.2 Guying Cable

Minimum five-strand, 3/16 inch diameter galvanized steel cable plastic coated.

2.9.3 Hose Chafing Guards

New or used 2 ply 3/4 inch diameter reinforced rubber or plastic hose, black or dark green, all of same color.

2.9.4 Flags

White surveyor's plastic tape,, 12 inches long, fastened to guying wires or cables.

2.9.5 Turnbuckles

Galvanized or cadmium-plated steel with minimum 3 inch long openings fitted with screw eyes. Eye bolts shall be galvanized or cadmium-plated steel with one inch diameter eyes and screw length 1 1/2 inches, minimum.

2.9.6 Deadmen

4 by 8 inch rectangular or 8 inch diameter by 36 inch long, pine wood material.

2.9.7 Metal Anchors

2.9.7.1 Driven Anchors

Malleable iron, arrow shaped, galvanized, sized as follows:

Tree Caliper	Anchor Size
2 inches and under	3 inches
3 to 6 inches	4 inches
6 to 8 inches	6 inches
8 to 10 inches	8 inches
10 to 12 inches	10 inches

2.9.7.2 Screw Anchors

Steel, screw type with welded-on 3 inch round helical steel plate, minimum 3/8 inch diameter, 15 inches long.

2.10 EDGING MATERIAL

2.10.1 Wood Edging

Wood edging shall be free of solvent at time of delivery. Minimum 8 by 1/2 inch treated in accordance with AWPA U1 and AWPA T1 with preservatives conforming to AWPA P5 before installation. Anchoring stakes shall be the same material as wood edging, 1/2 by 2 inches, 12 inches long.

2.10.2 Recycled Plastic Edging

100 percent recycled polyethylene edging, resistant to insects, termites, boring worms, splintering and rotting, and shall not absorb moisture or promote bacterial growth. Minimum 1 by 6 inch, capable of bending a minimum 24 radius, integrally colored brown with slip joint connections. Anchors and stakes shall be of the same manufacturer and color as the edging.

2.10.3 Concrete Edging

Extruded concrete mowstrip. Provide saw cut contraction joints to a depth of 3/4 inch after the surface has been finished. Provide joints every 5 lineal feet. Provide 1/2 inch thick expansion joints at change of direction and where mowstrip abuts rigid pavement. Provide #4 reinforcement bar and other devices necessary to install and secure reinforcement. Provide a floated finish, then finish with a flexible bristle broom. 2500 psi compressive concrete strength at 28 days as specified under Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.11 ANTIDESICCANTS

Sprayable, water insoluble vinyl-vinledine complex which produce a moisture retarding barrier not removable by rain or snow. Film shall form at temperatures commonly encountered out of doors during planting season and have a moisture vapor transmission rate (MVT) of the resultant film of maximum 10 grams per 24 hours at 70 percent humidity.

2.12 EROSION CONTROL MATERIALS

Erosion control material shall conform to the following:

2.12.1 Erosion Control Blanket

100 percent agricultural straw stitched with a degradable nettings, designed to degrade within 12 months.

2.12.2 Erosion Control Material Anchors

Erosion control anchors shall be as recommended by the manufacturer.

2.13 ROOT CONTROL BARRIER

Flexible and permeable geotextile fabric with permanently attached time-released nodules. Color to be black.

2.14 WATER

Source of water to be approved by Contracting Officer and suitable quality for irrigation and shall not contain elements toxic to plant life.

2.14.1 Hose

Hoses used for watering shall be a minimum of 60 percent post-consumer rubber or plastic.

2.15 MYCORRHIZAL FUNGI INOCULUM

Mycorrhizal fungi inoculum shall be composed of multiple-fungus inoculum as recommended by the manufacturer for the plant material specified.

2.16 SOURCE QUALITY CONTROL

The Contracting Officer will inspect plant materials at the project site and approve them. Tag plant materials for size and quality.

PART 3 EXECUTION

3.1 EXTENT OF WORK

Provide soil preparation, fertilizing, tree, shrub, groundcover, and planting, edging, staking and guying, weed control fabric,, erosion control materialand root control barrier installation 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.

3.2 PREPARATION

3.2.1 Layout

Stake out approved plant material locations and planter bed outlines on the project site before digging plant pits or beds. The Contracting Officer reserves the right to adjust plant material locations to meet field conditions. Do not plant closer than 36 inches to a building wall, pavement edge, fence or wall edge and other similar structures.

3.2.2 Soil Preparation

3.2.2.1 pH Adjuster Application Rates

Apply pH adjuster at rates as determined by laboratory soil analysis of the soils at the job site. F

3.2.2.2 Soil Conditioner Application Rates

Apply soil conditioners at rates as determined by laboratory soil analysis of the soils at the job site.

3.2.2.3 Fertilizer Application Rates

Apply fertilizer at rates as determined by laboratory soil analysis of the soils at the job site.

3.2.3 Root Control Barrier

Install geotextile fabric in the soil in a horizontal application. Use appropriate holding device to assure fabric position. For vertical or horizontal application, a minimum 2 inch soil cover is required over the top surface. A minimum 18 inch extension of fabric beyond the structure area to be protected is required to prevent root growth from growing around fabric edges.

]3.2.4 Subsoil Drainage for Plant Pits and Beds

Provide as indicated. Lay perforated drain pipe with perforations down. Backfill trenches as specified in Section 31 00 00 EARTHWORK.

3.3 PLANT BED PREPARATION

Verify location of underground utilities prior to excavation. Protect existing adjacent turf before excavations are made. Where planting beds occur in existing turf areas, remove turf to a depth that will ensure removal of entire root system. Measure depth of plant pits from finished grade. Depth of plant pit excavation shall be as indicated and provide proper relation between top of root ball and finished grade. Install plant material as specified in paragraph entitled "Plant Installation." Do not install trees within 10 feet of any utility lines or building walls.

3.4 PLANT INSTALLATION

3.4.1 Individual Plant Pit Excavation

Excavate pits at least twice as large in diameter as the size of ball or container to depth shown.

3.4.2 Plant Beds with Multiple Plants

Excavate plant beds continuously throughout entire bed as outlined to depth shown.

3.4.3 Handling and Setting

Move plant materials only by supporting the root ball. Set plants on hand compacted layer of prepared backfill soil mixture 6 inches thick and hold plumb in the center of the pit until soil has been tamped firmly around root ball. Set plant materials, in relation to surrounding finish grade, one to 2 inches above depth at which they were grown in the nursery, collecting field or container. Replace plant material whose root balls are cracked or damaged either before or during the planting process.

Plant material shall be set in plant beds according to the drawings. Backfill soil mixture shall be placed on previously scarified subsoil to completely surround the root balls, and shall be brought to a smooth and even surface, blending to existing areas.

3.4.3.1 Balled and Burlapped Stock

Backfill with prepared soil mixture to approximately half the depth of ball and then tamp and water. Carefully remove or fold back excess burlap and tying materials from the top a minimum 1/3 depth from the top of the rootball. Tamp and complete backfill, place mulch topdressing, and water. Remove wires and non-biodegradable materials from plant pit prior to backfill operations.

3.4.3.2 Bare-Root Stock

Plant so roots are arranged in a natural position. Place roots in water a minimum of 30 minutes prior to planting. Carefully work prepared soil mixture among roots. Tamp remainder of backfill, place mulch topdressing and water.

3.4.3.3 Container Grown Stock

Remove from container and prevent damage to plant or root system.

3.4.3.4 Ground Covers and Vines

Smooth planting areas before planting to provide even, smooth finish. Plant after placing weed control fabric and mulch topdressing. Do not remove plant material from flats or containers until immediately before planting. Space at the intervals indicated. Plant at a depth to sufficiently cover all roots. Start watering areas planted as required by temperature and wind conditions. Apply water at a rate sufficient to ensure thorough wetting of soil to a depth of 6 inches without run off or puddling. Add mulch topdressing as needed.

3.4.4 Earth Mounded Watering Basin for Individual Plant Pits

Form with topsoil around each plant by placing a mound of topsoil around the edge of each plant pit. Watering basins shall be 6 inches deep for trees and 4 inches deep for shrubs. Construct watering basin in a 4 1/2 foot diameter circle around specimen (not planted in a close group) trees and shrubs.

3.4.5 Weed Control Fabric Installation

Remove grass and weed vegetation, including roots, from within the area enclosed by edging. Completely cover areas enclosed by edging with specified weed control fabric prior to placing mulch layer. Overlap cut edges 6 inches.

3.4.6 Erosion Control Material

Install in accordance with manufacturer's instructions.

3.4.7 Placement of Mulch Topdressing

Place specified mulch topdressing on top of weed control fabric covering total area enclosed by edging. Place mulch topdressing to a depth of 3 inches.

3.4.8 Mulch Topdressing

Provide mulch topdressing over entire planter bed surfaces and individual plant surfaces including earth mound watering basin around plants to a depth of 3 inches after completion of plant installation and before watering. Keep mulch out of the crowns of shrubs. Place mulch a minimum 2 to 3 inches away from trunk of shrub or tree. Place on top of any weed control fabric.

3.4.9 Installation of Edging

Uniformly edge beds of plants to provide a clear cut division line between planted area and adjacent lawn. Construct bed shapes as indicated. Install plastic edging material as indicated and as per manufacturer's instructions. Install edging material in a perfect 4 foot diameter circle inside the 4 1/2 foot watering basin, around individual specimen trees and shrubs not planted in a close group. Install edging with minimum one inch left above ground level.

3.4.10 Fertilization

3.4.10.1 Fertilizer Tablets

Place fertilizer planting tablets evenly spaced around the plant pits to the manufacturer's recommended depth.

3.4.10.2 Granular Fertilizer

Apply granular fertilizer as a top coat prior to placing mulch layer and water thoroughly.

3.4.11 Watering

Start watering areas planted as required by temperature and wind conditions. Apply water at a rate sufficient to ensure thorough wetting of soil to a depth of 12 inches without run off.

3.4.12 Staking and Guying

3.4.12.1 Staking

Stake plants with the number of stakes indicated complete with double strand of 12 gage guy wire as detailed. Attach guy wire half the tree height but not more than 5 feet high. Drive stakes to a depth of 2 1/2 to 3 feet into the ground outside the plant pit. Do not injure the root ball. Use hose chafer guards where guy wire comes in contact with tree trunk.

3.4.12.2 Guying

Guy plants as indicated. Attach two strands of guying wire around the tree trunk at an angle of 45 degrees at approximately 1/2 of the trunk height . Protect tree trunks with chafing guards where guying wire contacts the tree trunk. Anchor guys to wood ground stakes. Fasten flags to each guying wire approximately 2/3 of the distance up from ground level. Provide turnbuckles as indicated.

3.4.12.3 Chafing Guards

Use hose chafing guards, as specified where guy wire will contact the plant.

3.4.12.4 Deadmen

Place deadmen minimum 18 inches below ground surface. Place equal distance from tree trunk and around the plant pit.

3.4.12.5 Wood Ground Stakes

Drive wood ground stakes into firm ground outside of plant pit with top of stake flush with ground. Place equal distance from tree trunk and around the plant pit.

3.4.12.6 Iron Anchors

Drive malleable iron anchors into firm ground outside of plant pit a minimum 30 inches below finish grade. Place equal distance from tree trunk and around the plant pit.

3.4.12.7 Steel Screw Anchors

Insert steel screw anchors as recommended in manufacturer's data. Place equal distance from tree trunk and around the plant pit.

3.4.12.8 Flags

Securely fasten flags on each guy wire approximately two-thirds of the distance up from ground level.

3.4.13 Pruning

Prune in accordance with safety requirement of TCIA Z133.1.

3.4.13.1 Trees and Shrubs

Remove dead and broken branches. Prune to correct structural defects only. Retain typical growth shape of individual plants with as much height and

spread as practical. Do not cut central leader on trees. Make cuts with sharp instruments. Do not flush cut with trunk or adjacent branches. Collars shall remain in place. Pruning shall be accomplished by trained and experienced personnel and shall be accordance with TCIA A300P1.

3.4.13.2 Wound Dressing

Do not apply tree wound dressing to cuts.

3.5 RESTORATION AND CLEAN UP

3.5.1 Restoration

Turf areas, pavements and facilities that have been damaged from the planting operation shall be restored to original condition at the Contractor's expense.

3.5.2 Clean Up

Excess and waste material shall be removed from the installed area and shall be disposed offsite at an approved landfill, recycling center, or composting center. Separate and recycle or reuse the following landscape waste materials: nylon straps, wire, ball wrap, burlap, wood stakes,. Adjacent paved areas shall be cleared.

-- End of Section --

SECTION 33 11 00

WATER DISTRIBUTION
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.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(2008) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(2008) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151/A21.51	(2002; Errata 2002) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C153/A21.53	(2006) Ductile-Iron Compact Fittings for Water Service
AWWA C500	(2002; R 2003) Metal-Seated Gate Valves for Water Supply Service
AWWA C502	(2005) Dry-Barrel Fire Hydrants
AWWA C503	(2005) Wet-Barrel Fire Hydrants
AWWA C509	(2001) Resilient-Seated Gate Valves for Water Supply Service
AWWA C600	(2005) 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 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 C905	(1997) Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings 14 In. Through 48 In. (350 mm through 1,200 mm)

AWWA M23	(2002) Manual: PVC Pipe - Design and Installation

ASME INTERNATIONAL (ASME)

ASME B16.1	(2005) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME B18.2.2	(1987; R 2005) 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 A 307	(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 563	(2007a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM D 2774	(2008) Underground Installation of Thermoplastic Pressure Piping
ASTM D 3139	(1998; R 2005) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM F 477	(2008) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24	(2006) Standard for the Installation of Private Fire Service Mains and Their Appurtenances
NFPA 325	(1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 49	(2003) Hazardous Chemicals Data
NFPA 704	(2006) Identification of the Hazards of Materials for Emergency Response

UNDERWRITERS LABORATORIES (UL)

UL 246	(1993; Rev thru Dec 1998) Hydrants 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 DESIGN REQUIREMENTS

1.2.1 Water Distribution Mains

Provide water distribution mains indicated as Polyvinyl Chloride (PVCO) plastic. Provide water main accessories, gate valves and check valves as specified and where indicated.

1.2.2 Water Service Lines

Provide water service lines indicated from water distribution main to building service at a point approximately 5 feet from building. Water service lines shall be polyvinyl chloride (PVC) plastic pipe or High Density Polyethylene (HDPE). Provide water service line appurtenances.

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. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Piping Materials; G

Water distribution main piping, fittings, joints, valves, and coupling; G

Water service line piping, fittings, joints, valves, and coupling; G

Hydrants; G

Corporation stops; G

Submit manufacturer's standard drawings or catalog cuts, except submit both drawings and cuts for push-on joints. Include information concerning gaskets with submittal for joints and couplings.

SD-06 Test Reports

Bacteriological Disinfection; G

Test results from commercial laboratory verifying disinfection; G

SD-07 Certificates

Water distribution main piping, fittings, joints, valves, and coupling; G

Water service line piping, fittings, joints, valves, and coupling; G

Fire hydrants; G

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.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 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 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.

1.4.2 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.

1.4.2.1 Miscellaneous Plastic Pipe and Fittings

Handle Polyvinyl Chloride (PVC), pipe and fittings in accordance with the manufacturer's recommendations.

Storage facilities shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325.

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, except flanged pipe, AWWA C151/A21.51, Pressure Class 150. 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 have cement-mortar lining, AWWA C104/A21.4, standard thickness.

2.1.1.2 Polyvinyl Chloride (PVC) Plastic Piping

a. Pipe and Fittings: Pipe, AWWA C900 AND AWWA C905, shall be plain end or gasket bell end, Pressure Class 150 (DR 18) with cast-iron-pipe-equivalent OD.

b. Fittings for PVC pipe: Fittings shall be cast iron, ASME B16.1. 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.

c. 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 compression-type joints/mechanical joints, ASTM D 3139. 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. 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

AWWA C509. 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 mechanical-joint ends or push-on joint ends as appropriate for the pipe to which it is joined. Valves shall open by counterclockwise rotation of the valve stem. Stuffing boxes shall have 0-ring stem seals , except for those valves for which gearing is specified, in which case use conventional packing in place of 0-ring seal. 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 respectively for the joint or coupling. Valves shall be of one manufacturer and shall be UL listed and FM Global approved.

2.1.2.2 Gate Valves in Valve Pit(s) and Aboveground Location

AWWA C509. Unless otherwise specified, valves conforming to: (1) AWWA C509 shall be outside-screw-and-yoke rising-stem nonrising stem type with flanged ends. Provide valves with handwheels that open by counterclockwise rotation of the valve stem. Valves shall be UL listed and FM Global approved. Stuffing boxes shall be bolted and constructed so as to permit

easy removal of parts for repair.

2.1.2.3 Vacuum and Air Relief Valves

Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and stainless steel float.

2.1.2.4 Fire Hydrants

Hydrants shall be UL listed and FM Global approved. Dry-barrel type, shall be provided where indicated. Paint hydrants with at least one coat of primer and two coats of enamel paint. Paint color to be specified by the Government. Hydrants may be one color throughout or have a separate color top. Stencil hydrant number and main size on the hydrant barrel using black stencil paint.

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; 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 C502 or AWWA C503.

2.1.2.5 Valve Manholes

Valve manholes shall be constructed at locations indicated or as required above and in accordance with the details shown on the construction plans. All gate vales and air release valves shall be in a manhole.

2.1.2.6 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 PVC plastic pipe, the middle ring shall be of cast-iron or steel; and the follower rings shall be of malleable or ductile iron. Steel shall have a strength not less than that of the pipe. 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 A 307, Grade A, with nuts, ASTM A 563, 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.

2.1.2.7 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.

2.1.2.8 Water Meter

Meter vault shall be constructed of pre-cast concrete or cast in place. If cast in place, concrete shall have a minimum strength of 4000 psi at 28 days. Vault shall have minimum inside dimensions as shown on the details and wall thickness of 8". If pre-cast coordinate requirements with vendor. Contractor shall determine depth of pipe before ordering or fabrication of meter vault. Meter vaults shall be located in non-traffic areas. The meter settings shall be shown on the meter vault shop drawings.

The meter vault must be set on firm soil with a minimum bearing capacity of 2500 psf. The soil shall be compacted or replaced with pre-engineered soil as directed by an independent licensed soil laboratory to achieve an acceptable bearing capacity. The backfill around the pipe and behind the vault walls shall be placed on well compacted ground in one foot layers starting at 2 ft below the pipe and extending up to 6" below finished grade. Compaction is to be done by manual or mechanical tamping to a minimum density of 90% of the maximum unit weight of soil.

Meter pits shall be designed for full buoyant uplift. A safety factor of 1.5 against uplift shall be provided. Side friction shall not be considered as resisting force against uplift.

The meter shall be capable of wireless data transmission and have a continuous manual reading option. The meter shall be capable of at least hourly data logging and transmission and provide consumption data. The meter shall be configured to transmit at least daily. The metering shall be in accordance with the Public Service Commission (PSC) and Fort Knox standards.

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. See Section 33 30 00 SANITARY SEWERS. 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.

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 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: Use Megalug or equal for pipe joint restraint

d. Fittings: Install in accordance with AWWA C605.

3.1.2.2 Installation of Valves and Hydrants

a. Installation of Valves: 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 M17 for hydrant installation and as indicated. Make and assemble joints as specified for making and assembling the same type joints between pipe and fittings. 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 such water service lines shall be closed with plugs or caps.

3.1.4 Special Requirements for Installation of Water Service Piping

3.1.4.1 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, unless otherwise specified.

a. Jointing: 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.

3.1.4.2 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.

3.1.5 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.

Should any test of pipe laid disclose leakage greater than that specified, the contractor shall at his own expense locate and repair the defective joints until the leakage is within the specified allowance.

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 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 plastic pipe joints or 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 --

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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.

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2008) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM C 270	(2008a) Standard Specification for Mortar for Unit Masonry
ASTM C 443	(2005a) 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 923	(2008) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C 969	(2002) 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	(2008) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM D 2321	(2005) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2412	(2002; R 2008) Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D 3034	(2008) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

ASTM D 3212	(2007) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 412	(2006ae1e2) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D 624	(2000; R 2007) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM F 477	(2008) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 949	(2006a) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.27	Fixed Ladders

1.2 SYSTEM DESCRIPTION

1.2.1 Sanitary Sewer Gravity Pipeline

Provide mains and laterals of polyvinyl chloride (PVC) plastic pipe. Provide new and modify existing exterior sanitary gravity sewer piping and appurtenances. Provide each system complete and ready for operation. The exterior sanitary gravity sewer system includes equipment, materials, installation, and workmanship as specified herein more than 5 feet outside of building walls or as shown on the Contract Plans.

1.2.2 USACE Project

The construction required herein shall include appurtenant structures and building sewers to the location specified on the plans. 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 Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Drawings; G

Installation and As-Built drawings, as specified.

Precast concrete manhole; G
Metal items; G
Frames, covers, and gratings; G

Details, as specified.

SD-03 Product Data

Pipeline materials; G

Submit manufacturer's standard drawings or catalog cuts.

SD-06 Test Reports

Reports; G

Test and inspection reports, as specified.

SD-07 Certificates

Gaskets; G

Certificates of compliance stating that the fittings or gaskets used for waste drains or lines designated on the plans are per Project Specifications.

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 As-Built Drawings for the complete sanitary sewer system showing complete detail with all dimensions, both above and below grade, including invert elevation.

b. 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." The project has been constructed in accordance with the construction permit(s) and permitted Contract Plans. Any substantial deviations are listed below."

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 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 31 00.00 10 CAST-IN-PLACE STRUCTURAL 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. Carry, do not drag, pipe to trench.

PART 2 PRODUCTS

2.1 PIPELINE MATERIALS

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 PVC Plastic Gravity Sewer Piping

2.1.1.1 PVC Plastic Gravity Pipe and Fittings

ASTM D 3034, SDR 26, or ASTM F 949 with ends suitable for elastomeric gasket joints.

2.1.1.2 PVC Plastic Gravity Joints and Jointing Material

Joints shall conform to ASTM D 3212. Gaskets shall conform to ASTM F 477.

2.2 CONCRETE MATERIALS

2.2.1 Cement Mortar

Cement mortar shall conform to ASTM C 270, Type M with Type II cement.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Precast Concrete 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 be submitted with the shop drawings.

Buoyancy calculations for manholes shall be submitted with the shop drawings. The wall and/or base section shall be thickened to protect against uplift. Buoyancy calculations may be based on a minimum factor of safety of 1.1 if the groundwater elevation is assumed to be at ground surface and soil/structure interaction is ignored. If a lowered groundwater table is used per the geotechnical report and soil/structure interaction is taken into account, the minimum factor of safety shall be 1.5.

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 Di 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	-
Elogation 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

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" or "Sewer" shall be stamped or cast into covers so that it is plainly visible. All manhole frames, covers, and grate shall conform to the Project details.

2.3.4.2 Manhole Steps

Zinc-coated steel conforming to 29 CFR 1910.27. Aluminum steps or rungs will not be permitted. Steps are not required in manholes less 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 A 123/A 123M.

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 the location shown on the plans, 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. 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. An absolute minimum horizontal clearance of 6 feet is allowable, subject to the following conditions. 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:

(aa) The top (crown) of the sanitary piping shall be at least 18 inches below the bottom (invert) of the water main.

(bb) Where this vertical separation cannot be obtained, the sanitary piping shall be constructed of AWWA-approved cement mortar lined ductile iron water pipe pressure tested in place without leakage prior to backfilling.

(cc) 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:

(aa) 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.

(bb) 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 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 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.

3.1.3 Concrete Work

Cast-in-place concrete is included in Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE. The pipe shall be supported on a concrete cradle, or encased in concrete where indicated or directed.

3.1.4 Manhole Construction

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 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. 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 Metal Work

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.

3.1.6 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 by the Contractor 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 Televising

Section includes requirements to execute internal closed circuit television (CCTV) survey to inspect sewer mains and laterals.

a. CCTV: Color video camera shall be specifically designed and constructed for this application. Camera, Television monitor, and other components shall be capable of producing minimum 700-line resolution color video picture. The camera should be able to inspect lateral connections as small as 3 inches up to 70 feet from sewer mainline. Pan and tilt type, capable of turning at right angles to pipe's axis over an entire vertical circle (minimum pan of 270 degrees and rotation of 360 degrees. Lighting shall be suitable to allow clear picture of entire inner pipe wall extending at least 10 feet in front, including black High Density Polyethylene (HDPE) pipe. Camera should be operative in 100 percent humidity conditions. The image should be capable of self righting itself. The camera should be launched from within the mainline sewer. It should be mounted on tread tractor that moves through sewers and positions camera launcher opposite lateral line connection and the

attachment should be push cable with a fiberglass rod core. Camera, Television Monitor, and other components should be capable of producing a minimum 700-line resolution color video picture. The camera shall also include data view display feature capable of showing on tape the following information:

1. Lateral address

2. City and State

3. Date and Time

4. Project Name

5. Contractor's Name

6. Inside pipe diameter and type

7. Manhole identification (upstream manhole to downstream manhole)

8. On-going footage counter accurate within 0.2 feet

9. Include operator narration, in format approved by Engineer.

10. Recording of single section of sewer onto 2 DVD/CD-ROMs will not be acceptable.

11. Clearly label each DVD/CD-ROM as approved by Engineer.

b. Placement of Camera: The camera should be placed at the center of manhole and commence the video before entering the pipe. Start footage counter at center of manhole.

c. Operation of camera: Show inside of manhole walls, manhole channel, and pipe connection to wall at both upstream and downstream manhole lateral connections. Move through line at speed no greater than 30 feet per minute stopping for minimum 10 seconds to record lateral connections, defects, and features and points of interest. Maintain technical quality, sharp focus, and distortion free picture. Videotape a section of sewer in its entirety with no breaks or interruptions. Pan, tilt, and rotate as necessary to best view and evaluate lateral connections, defects, features, and points of interest. Use power winches, powered rewinds, tractors, and other devices that do not obstruct camera view or interfere with proper documentation of sewer conditions to move camera through sewer. Whenever remote-powered and controlled winches are used to set up telephones or other suitable means of communication between manholes to insure good communications. Use hydraulic jet nozzle if necessary to remove standing water from line. Eliminate steam in line for duration of inspection. Utilize blower as needed to defog the sewer line. Measurement for location of defects and service laterals are as follows:

1. At ground level by means of Engineer-approved footage counter or metering device.

2. Measurement Meters: Accurate to 0.2 foot over length of section being televised.

3. Use measuring target in front of television as exact

measurement reference point.

Movement of Television Camera: On the Mainline, stop camera at service connections and inspect lateral with pan and tilt camera. At active service connections where flow is discharging, identify building address and confirm that laterals are active by obtaining flush, with or without dye, of property owner's commode or by using outside cleanout, if available. If no flows are being discharged from building, consider observed flow as infiltration/inflow.

Identification of defects: If roots, sludge, or sediment material impedes inspection withdraw camera and re-clean mainline by hydraulic jet. Upon completion of re-cleaning operation resume internal inspection. Furnish media confirmation for heavy cleaning (more than 3 passes with jet cleaner) to Engineer. If protruding tap impedes inspection trim protruding tap 1/2 inch. If obstructions are not passable and cannot be removed by sewer cleaning or reaming, withdraw CCTV equipment and perform inspection from opposite end.

d. Field Documentation for Mainline: Submit original records, logs, DVD's, CD-ROM's and electronic data for sewer line inspection to Engineer within 5 working days. Include, but not limited to the following information:

1. Owner

2. Date, time (begin to end inspections)

3. Operator name

4. DVD/CD number and index

5. Address of uppermost lateral

6. Manhole number to manhole number

7. Length of pipe segment

8. Direction of CCTV

9. Pipe size

10. Pipe material

11. General physical conditions

12. Footage locations, clock positions, descriptions and estimated leakage rates for visible point sources of infiltration/inflow

13. Footage locations, clock positions, descriptions for lateral connections and estimated flow from laterals

14. Footage locations, clock position, and descriptions of defects such as obstructions, root intrusion, blockages in pipe, deteriorated joints, offset joints, holes, breaks, cracks, collapses, bends or sags in alignment, or protruding lateral connections.

15. Footage locations, clock position, and description of other defects, features and points of interest found.

16. Whether CCTV was complete or incomplete

DVD/CD-ROM recording/playback:

1. At the same speed that is was recorded.

2. Supply slow motion or stop motion playback features.

3. Have DVD/CD-ROM and necessary playback equipment readily accessible for review by Engineer during Project.

DVD/CD-ROM's displaying poor quality video refers to, but is not limited to grease or debris on lens, camera under water, image too dark, washed-out, distorted, or out-of-focus, lines improperly cleaned, and poor/no audio. Re-televise line if necessary and resubmit DVD/CD-ROM at no cost to the owner.

3.2.2.2 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.

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.

3.2.2.3 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.

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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 294	(2010) Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm Diameter

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 B26/B26M	(2009) Standard Specification for Aluminum-Alloy Sand Castings
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 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	(2011) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C231/C231M	(2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
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 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 1784	(2011) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2167	(2008) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2321	(2011) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2729	(2011) Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

ASTM D 3034	(2008) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3350	(2010a) Polyethylene Plastics Pipe and Fittings Materials
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 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

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. 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 III, or ASTM C 655.

2.1.1.1 Reinforced Arch Culvert and Storm Drainpipe

Manufactured in accordance with and conforming to ASTM C 506, Class A-III.

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-III. Vertical elliptical pipe shall be Class VE-III.

2.1.1.3 Nonreinforced Pipe

Manufactured in accordance with and conforming to ASTM C 14, Class 2.

2.1.2 Perforated Piping

2.1.2.1 PVC Pipe

ASTM D 2729.

2.1.3 PVC Pipe

Submit the pipe manufacturer's resin certification, indicating the cell classification of PVC used to manufacture the pipe, prior to installation of the pipe.

2.1.3.1 Type PSM PVC Pipe

ASTM D 3034, Type PSM, maximum SDR 35, produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.4 PE Pipe

Submit the pipe manufacturer's resin certification, indicating the cell classification of PE used to manufacture the pipe, prior to installation of the pipe. The minimum cell classification for polyethylene plastic shall apply to each of the seven primary properties of the cell classification limits in accordance with ASTM D 3350.

2.1.4.1 Smooth Wall PE Pipe

ASTM F 714, maximum DR of 21 for pipes 3 to 24 inches in diameter and maximum DR of 26 for pipes 26 to 48 inches in diameter. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 335434C.

2.1.4.2 Corrugated PE Pipe

AASHTO M 294, Type S or C. For slow crack growth resistance, acceptance of resins shall be determined by using the notched constant ligament-stress (NCLS) test meeting the requirements of AASHTO M 294. Pipe walls shall have the following properties:

Nominal Size (in.)	Minimum Wall Area (square in/ft)	Minimum Moment of Inertia of Wall Section (in to the 4th/in)
12	1.50	0.024
15	1.91	0.053
18	2.34	0.062
24	3.14	0.116
30	3.92	0.163
36	4.50	0.222
42	4.69	0.543
48	5.15	0.543
54	5.67	0.800
60	6.45	0.800

2.1.4.3 Profile Wall PE Pipe

ASTM F 894, RSC 160, produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 334433C. Pipe walls shall have the following properties:

		Minimum Moment Of Inertia of Wall Section (in to the 4th/in)	
Nominal Size (in.)	Minimum Wall Area (square in/ft)	Cell Class 334433C	Cell Class 335434C
18	2.96	0.052	0.038
21	4.15	0.070	0.051
24	4.66	0.081	0.059

Nominal Size (in.)	Minimum Wall Area (square in/ft)	Minimum Moment Of Inertia of Wall Section (in to the 4th/in) Cell Class 334433C	Cell Class 335434C
27	5.91	0.125	0.091
30	5.91	0.125	0.091
33	6.99	0.161	0.132
36	8.08	0.202	0.165
42	7.81	0.277	0.227
48	8.82	0.338	0.277

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. See plans for locations and sizes.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 4000 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 7 gallons 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 full-bedded in cement mortar and shall be smoothed to a uniform surface on both interior and exterior of the structure.

2.3.6 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 B26/B26M, 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.

2.3.7 Joints

2.3.7.1 PVC Plastic Pipes

Joints shall be solvent cement or elastomeric gasket type in accordance with the specification for the pipe and as recommended by the pipe manufacturer.

2.3.7.2 Smooth Wall PE Plastic Pipe

Pipe shall be joined using butt fusion method as recommended by the pipe manufacturer.

2.3.7.3 Corrugated PE Plastic Pipe

Pipe joints shall be water tight and shall conform to the requirements in AASHTO M 294. Water tight joints shall be made using a PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F 477.

2.3.7.4 Profile Wall PE Plastic Pipe

Joints shall be gasketed or thermal weld type with integral bell in accordance with ASTM F 894.

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 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 8 inches, 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 24 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting 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 sheeting, 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.

3.2.2 Plastic Pipe

Bedding for PVC and PE pipe shall meet the requirements of ASTM D 2321. Bedding, haunching, and initial backfill shall be either Class IB or II material.

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. Plastic pipe shall be protected from exposure to direct sunlight prior to laying, if necessary to maintain adequate pipe stiffness and meet installation deflection requirements. 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 (%)
Plastic (PVC & HDPE)	5

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, PVC, Ribbed PVC

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 Corrugated PE Pipe

Laying shall be with the separate sections joined firmly on a bed shaped to line and grade and shall follow manufacturer's recommendations.

3.3.4 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.

3.3.5 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 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.

3.4.1.4 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.

3.4.1.5 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, complete with frames and covers or gratings; and with fixed galvanized steel ladders where indicated.

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 8 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 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 finial 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.).

-- End of Section --

SECTION 33 51 15

NATURAL-GAS / LIQUID PETROLEUM GAS DISTRIBUTION
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.

AMERICAN GAS ASSOCIATION (AGA)

AGA ANSI B109.2	(2000) Diaphragm-Type Gas Displacement Meters (500 cubic ft./hour Capacity and Over)
AGA XR0603	(2006; 8th Ed) AGA Plastic Pipe Manual for Gas Service

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 5L	(2007; Errata 2009; Addenda 1 2009; Addenda 2 2010; 44th Ed) Specification for Line Pipe
API Spec 6D	(2008; Errata 2008; Errata 2008; Errata 2009; Addendum 2009; Errata 2010) Specification for Pipeline Valves
API Std 1104	(2005; Errata/Adden 2007; Errata 2008; R 2010) Welding of Pipeline and Related Facilities

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 25-06	(2008) Earthquake-Activated Automatic Gas Shutoff Devices

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C203	(2008) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C213	(2007) Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 2006) Pipe Threads, General Purpose (Inch)
ASME B16.11	(2009) Forged Fittings, Socket-Welding and

Threaded

ASME B16.21 (2011) Nonmetallic Flat Gaskets for Pipe Flanges

ASME B16.34 (2009; Supp 2010) Valves - Flanged, Threaded and Welding End

ASME B16.40 (2008) Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems

ASME B16.5 (2009) Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard

ASME B16.9 (2007) Standard for Factory-Made Wrought Steel Buttwelding Fittings

ASME B31.8 (2010; Supplement 2010) Gas Transmission and Distribution Piping Systems

ASME BPVC SEC VIII D1 (2007; Addenda 2008; Addenda 2009) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASME PTC 25 (2008) Pressure Relief Devices

ASTM INTERNATIONAL (ASTM)

ASTM A135/A135M (2009) Standard Specification for Electric-Resistance-Welded Steel Pipe

ASTM A139/A139M (2004; R 2010) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)

ASTM A181/A181M (2006) Standard Specification for Carbon Steel Forgings, for General-Purpose Piping

ASTM A53/A53M (2010) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM D 1598 (2002; R 2009) Time-to-Failure of Plastic Pipe Under Constant Internal Pressure

ASTM D 1599 (1999; R 2005) Resistance to Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings

ASTM D 2513 (2011) Thermoplastic Gas Pressure Pipe, Tubing, and Fittings

ASTM D 2683 (2010) Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing

ASTM D 3261 (2010a) Standard Specification for Butt

	Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D 3308	(2006) PTFE Resin Skived Tape
ASTM D 3350	(2010a) Polyethylene Plastics Pipe and Fittings Materials

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(2008) Standard Marking System for Valves, Fittings, Flanges and Unions

MASTER PAINTERS INSTITUTE (MPI)

MPI 9	(Oct 2009) Exterior Alkyd, Gloss, MPI Gloss Level 6

NACE INTERNATIONAL (NACE)

NACE RP0274	(1974; R 2004) High Voltage Electrical Inspection of Pipeline Coatings
NACE SP0185	(2007) Extruded Polyolefin Resin Coating Systems with Soft Adhesives for Underground or Submerged Pipe

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 25	(1997; E 2004) Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II
SSPC SP 1	(1982; E 2004) Solvent Cleaning
SSPC SP 3	(1982; E 2004) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning
SSPC SP 7/NACE No.4	(2007) Brush-Off Blast Cleaning

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

49 CFR 192	Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards

UNDERWRITERS LABORATORIES (UL)

UL Gas&Oil Dir	(2009) Flammable and Combustible Liquids and Gases Equipment Directory

1.2 SYSTEM DESCRIPTION

The gas distribution system includes natural gas piping and appurtenances from point of connection with existing system, as indicated, to a point approximately 5 feet from the facility. Section 31 10 00 CLEARING FOR CIVIL WORKS, applies to this section unless otherwise specified. Submit

operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA, in three separate packages.

1.2.1 Gas Distribution System and Equipment Operation

Include maps showing piping layout, locations of system valves, gas line markers and cathodic protection system test stations; step-by-step procedures for system start up, operation and shutdown (index system components and equipment to the system maps); isolation procedures including valve operation to shutdown or isolate each section of the system (index valves to the system maps and provide separate procedures for normal operation and emergency shutdown if required to be different). Submit Data Package No. 4.

1.2.2 Gas Distribution System Maintenance

Include maintenance procedures and frequency for system and equipment; identification of pipe materials and manufacturer by locations, pipe repair procedures, and jointing procedures at transitions to other piping material or material from a different manufacturer. Submit Data Package No. 4.

1.2.3 Gas Distribution Equipment Maintenance

Include identification of valves and other equipment by materials, manufacturer, vendor identification and location; maintenance procedures and recommended tool kits for valves and equipment; recommended repair methods (i.e., field repair, factory repair, or replacement) for each valve and piece of equipment; and preventive maintenance procedures, possible failure modes and troubleshooting guide. Submit Data Package No. 3.

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-02 Shop Drawings

Pipe, Fittings, and Associated Materials; G

SD-03 Product Data

Materials and Equipment; G
Spare Parts; G
Pipe and Accessory Coatings; G

SD-05 Design Data

Connections to Existing Lines; G
Connection and Abandonment Plan; G
Jointing of Polyethylene and Fiberglass Piping; G

SD-06 Test Reports

Pressure and Leak Tests; G

Data in booklet form from all pressure tests of the distribution system.

SD-07 Certificates

Welder's training, qualifications and procedures; G
Utility Work; G

Certification from the Operating Agency/Utility Company that work for which the Utility is responsible has been completed.

SD-10 Operation and Maintenance Data

Gas distribution system and equipment operation; G
Gas distribution system maintenance; G
Gas distribution equipment maintenance; G

Data packages, as specified.

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

1.4.1.1 Welding General

a. Submit a certificate of Welder's training, qualifications and procedures, in conformance with API Std 1104, for metal along with a list of names and identification symbols of performance qualified welders and welding operators.

b. Welding and nondestructive testing procedures for pressure piping are specified in Section 40 05 13.96 WELDING PROCESS PIPING.

c. Weld structural members in accordance with Section 05 05 23 WELDING, STRUCTURAL.

1.4.1.2 Jointing of Polyethylene and Fiberglass Piping

a. Join piping by performance qualified PE joiners, qualified by a person who has been trained and certified by the manufacturer of the pipe, using manufacturer's pre-qualified joining procedures in accordance with AGA XR0603. Inspect joints by an inspector qualified in the joining procedures being used and in accordance with AGA XR0603. Welders training, qualifications and procedures,(metal and PE) includes use of equipment, explanation of the procedure, and successfully making joints which pass tests specified in AGA XR0603.

b. Submit a certificate of qualified jointing procedures, training procedures, qualifications of trainer, and training test results for joiners and inspectors. Notify the Contracting Officer at least 24 hours in advance of the date to qualify joiners and inspectors.

1.4.2 Pre-Installation Conference

1.4.2.1 Shop Drawings

Submit shop drawings, within 30 days of contract award, containing complete schematic and piping diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Show on the drawings proposed layout and anchorage of the system and appurtenances, and equipment relationship to other parts of the work

including clearances for maintenance and operation.

1.4.2.2 Connecting and Abandonment Plan

Submit written notification of the method and schedule for making connections to existing gas lines, to the Contracting Officer at least 10 days in advance. Include gas line tie in, hot taps, abandonment/removal or demolition, purging, and plugging as applicable in conformance with ASME B31.8 Include in submittal connections to existing lines and connection and abandonment plan.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

Inspect materials delivered to the site for damage, and store with a minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping 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.

1.5.2 Handling

Handle pipe and components carefully to ensure a sound, undamaged condition. Take particular care not to damage pipe coating. Repair damaged coatings to original finish. Do not place pipe or material of any kind inside another pipe or fitting after the coating has been applied, except as specified in paragraph INSTALLATION. Handle steel piping with coal-tar enamel coating in accordance with AWWA C203, and fusion-bonded epoxy coatings per AWWA C213. Handle plastic pipe in conformance with AGA XR0603.

1.6 EXTRA MATERIALS

Submit spare parts data for each different item of equipment and material specified, after approval of the detail shop drawings and not later than one month prior to the date of beneficial occupancy. Include in the data a complete list of parts and supplies, with current unit prices and source of supply.

PART 2 PRODUCTS

2.1 PIPE, FITTINGS, AND ASSOCIATED MATERIALS

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Asbestos or products containing asbestos are not allowed. Provide written verification and point of contact for a supporting service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site. Mark all valves, flanges, and fittings in accordance with MSS SP-25. Submit a complete list of materials and equipment, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions, including, but not limited to the following:

a. Dielectric Waterways and Flange Kits.
b. Emergency Gas Supply Connection.
c. Fittings

d. Piping
e. Pipe and Accessory coatings
f. Pressure Reducing Valves.
g. Meters
h. Regulators.
i. Shut-off Valves
j. Earthquake Actuated Automatic Gas Shut-off System conforming to ASCE 25-06.

2.1.1 Steel Pipe

API Spec 5L, Grade A, B, or X42, ASTM A53/A53M, Grade A or B, ASTM A135/A135M, or ASTM A139/A139M, Grade A or B, Schedule 40. Do not coat pipe and fittings for aboveground lines. Provide butt weld wrought steel fittings, conforming to ASME B16.9, Schedule 40. Provide forged steel socket weld and threaded fittings , conforming to ASME B16.11. Verify that pipe wall thickness conforms to ASME B31.8 for larger sizes and high pressures.

2.1.2 Small Fittings

For sizes 1-1/2 inches and smaller, provide fittings conforming to ASME B16.11.

2.1.3 Fittings, 2 inches and Larger

Provide pipe flanges and flanged fittings, including bolts, nuts, and bolt patterns in accordance with ASME B16.5. Provide buttweld fittings in accordance with ASME B16.9. Use weld neck flanges.

2.1.4 Steel Forged Branch Connections

Provide steel forged branch connections conforming to ASTM A181/A181M, Class 60, carbon steel.

2.1.5 Flange Gaskets

Provide non-asbestos compressed material gaskets in accordance with ASME B16.21, 1/16 inch minimum thickness, full face or self-centering flat ring type, containing aramid fibers bonded with nitrile butadiene rubber (NBR), or glass fibers bonded with polytetrafluoroethylene, suitable for maximum 600 degrees F service and meeting applicable requirements of ASME B31.8.

2.1.6 Pipe Threads

Provide threaded pipe conforming to ASME B1.20.1.

2.1.7 Polyethylene Pipe, Tubing, Fittings and Joints

Provide polyethylene pipe, tubing, fittings and joints conforming to ASTM D 3350 and ASTM D 2513, pipe designations PE 2406 and PE 3408, rated SDR or less, as specified in ASME B31.8. Mark pipe sections as required by ASTM D 2513. Provide butt fittings conforming to ASTM D 3261 and socket fittings conforming to ASTM D 2683. Match fittings to the service rating of the pipe.

2.1.8 Sealants for Steel Pipe Threaded Joints

2.1.8.1 Sealing Compound

Provide joint sealing compound as listed in UL Gas&Oil Dir, Class 20 or less.

2.1.8.2 Tape

Provide polyetrafluoroethylene tape conforming to ASTM D 3308.

2.1.9 Identification

Provide pipe flow markings and metal tags for each valve, meter, and regulator as required by the Contracting Officer.

2.1.10 Insulating Joint Materials

Provide insulating joint materials between flanged or threaded metallic pipe systems where shown to isolate galvanic or electrolytic action.

2.1.10.1 Threaded Joints

For threaded pipe joints, provide steel body nut type, dielectric waterways with insulating gaskets.

2.1.10.2 Flanged Joints

For flanged pipe joints, provide full face sandwich-type flange insulating gasket of the dielectric type, insulating sleeves for flange bolts and insulating washers for flange nuts.

2.1.10.3 Dielectric Waterways and Flanges

Provide dielectric waterways with temperature and pressure rating equal to or greater than that specified for the connecting piping, with metal connections on both ends suited to match connecting piping. Provide internally lined dielectric waterways, lined with an insulator specifically designed to prevent current flow between dissimilar metals, meeting the performance requirements described herein for dielectric waterways.

2.1.11 Gas Transition Fittings

Provide manufactured steel gas transition fittings approved for jointing steel and polyethylene or fiberglass pipe, conforming to AGA XR0603 requirements for transition fittings.

2.2 VALVES

Provide valves suitable for shutoff or isolation service and conforming to the following:

2.2.1 Steel Valves

Provide steel valves 1-1/2 inches and smaller installed underground conforming to ASME B16.34, carbon steel, socket weld ends, with square wrench operator adaptor. Provide steel valves 1-1/2 inches and smaller installed aboveground conforming to ASME B16.34, carbon steel, socket weld or threaded ends with handwheel or wrench operator. Provide steel valves 2

inches and larger installed underground conforming to API Spec 6D, carbon steel, buttweld ends, with square wrench operator adaptor. Provide steel valves 2 inches and larger installed aboveground conforming to API Spec 6D, carbon steel, buttweld or flanged ends, with handwheel or wrench operator.

2.2.2 Steel Valve Operators

Provide valves 8 inches and larger with worm or spur gear operators, totally enclosed, grease packed, and sealed, with operators having Open and Closed stops and position indicators. Provide locking feature where indicated. Wherever the lubricant connections are not conveniently accessible, provide extensions for the application of lubricant. Provide valves with lubricant compatible with gas service.

2.2.3 Polyethylene Valves

Provide polyethylene valves conforming to ASME B16.40. Polyethylene valves, in sizes 1/2 inch to 6 inches, may be used with polyethylene distribution and service lines, in lieu of steel valves, for underground installation only.

2.3 PRESSURE REGULATORS

Provide ferrous bodied regulators with backflow protection, designed to meet the pressure, load and other service conditions.

2.3.1 Gas Main Regulators

Equip pressure regulators for main distribution lines, supplied from a source of gas which is at a higher pressure than the maximum allowable operating pressure for the system, with pressure regulating devices of adequate capacity. In addition to the pressure regulating devices, provide a protective method to prevent overpressuring of the system in accordance with ASME B31.8. Suitable protective devices are as follows:

a. Spring-loaded relief valve meeting the provisions of ASME BPVC SEC VIII D1.

b. Pilot-loaded back pressure regulator used as relief valve, so designed that failure of the pilot system will cause the regulator to open.

c. Weight-loaded relief valves conforming to ASME PTC 25.

d. Monitoring regulator installed in series with the primary pressure regulator.

e. Series regulator installed upstream from the primary regulator, set to limit the pressure on the inlet of the primary regulator continuously to the maximum allowable operating pressure of the system, or less.

f. Automatic shutoff device installed in series with the primary regulator, set to shut off when the pressure on the distribution system reaches the maximum allowable operating pressure of the system, or less, which remains closed until manually reset.

g. Spring-loaded, diaphragm type relief valves.

2.3.2 Service Line Regulators

a. Provide ferrous bodied pressure regulators for individual service lines, capable of reducing distribution line pressure to pressures required for users. Provide regulators where gas will be distributed at pressures in excess of 10 inches of water column, with pressure relief set at a lower pressure than would cause unsafe operation of any connected user.

b. Provide regulator(s) having a single port with orifice diameter no greater than that recommended by the manufacturer for the maximum gas pressure at the regulator inlet. Provide regulator valve vent of resilient materials designed to withstand flow conditions when pressed against the valve port, capable of regulating downstream pressure within limits of accuracy and limiting the buildup of pressure under no-flow conditions to 50 percent or less of the discharge pressure maintained under flow conditions. Provide a self contained service regulator, and pipe not exceeding exceed2 inch size.

2.4 METERS

Provide meters conforming to AGA ANSI B109.2, pedestal mounted and be provided with a strainer immediately upstream. Provide meters with over-pressure protection as specified in ASME B31.8, tamper-proof protection, and frost protection, suitable for accurately measuring and handling gas at pressures, temperatures, and flow rates indicated. Provide meters with a pulse switch initiator capable of operating up to speeds of 500 maximum pulses per minute with no false pulses and requiring no field adjustments. Provide not less than one pulse per 100 cubic feet of gas.

2.5 EARTHQUAKE ACTUATED AUTOMATIC GAS SHUTOFF SYSTEM

Provide Earthquake Actuated Automatic Gas Shutoff devices conforming to ASCE 25-06, UL or AGA listed requirements and furnished by the Contracting Officer as being tested and in conformance with specified requirements. The valve may be either pendulum or ball construction with actuator.

2.6 EMERGENCY GAS SUPPLY CONNECTION

Provide an emergency gas supply connection consisting of piping (same size as service line) and accessories that will enable a portable, commercial-sized gas cylinder system to be connected to the gas piping system. Cap this connection to prevent gas leakage with a lockable manual valve located to allow shutting off flow. Provide the entire assembly in a weatherproof, lockable box, with permanently installed written instructions stating the type and pressure of the gas allowed to be connected to the line, and providing specific instruction for testing of the integrity of the building's gas system with an inert gas before the fuel gas connection is made. Provide a subplate in the box that is required to be unbolted to gain access to the connection, and containing a warning regarding the potential consequences of using gas other than that specified or of failing to test system integrity before hooking up emergency fuel supply.

2.7 PROTECTIVE COVERING MATERIALS

Provide a continuously extruded polyethylene and adhesive coating system material conforming to NACE SP0185, Type A.

2.8 TELEMETERING OR RECORDING GAUGES

Equip each distribution system supplied by more than one district pressure regulating station with telemetering or recording pressure gauges to indicate the gas pressure in the district line.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 EXCAVATION AND BACKFILLING

Earthwork is as specified in Section 31 00 00 EARTHWORK.

3.3 GAS MAINS

Provide steel, polyethylene, or fiberglass, pipe for gas mains. Coat steel pipe and fittings with protective covering as specified. Do not install polyethylene or fiberglass mains aboveground.

3.4 SERVICE LINES AND EMERGENCY GAS SUPPLY CONNECTION

3.4.1 General

Construct service lines of materials specified for gas mains and extend from a gas main to and including the point of delivery within 5 feet of the building. The point of delivery is the shutoff valve. Connect the service lines to the gas mains as indicated. Where indicated, provide service line with an isolation valve of the same size as the service line. Make the service lines as short and as straight as practicable between the point of delivery and the gas main, without bends or lateral curves unless necessary to avoid obstructions or otherwise permitted. Lay service lines with as few joints as practicable using standard lengths of pipe, use shorter lengths only for closures. Do not install polyethylene or fiberglass service lines aboveground except as permitted in ASME B31.8.

3.4.2 Emergency Gas Supply Connection

Provide an aboveground locked, valved and capped emergency gas supply connection upstream of the pressure regulator, located outside of the building within12 inches of the exterior wall and installed in a weatherproof box which is mounted on the exterior wall and clearly marked with an appropriate metal sign mounted on wall above.

3.5 WORKMANSHIP AND DEFECTS

Make pipe, tubing, and fittings clear and free of cutting burrs and defects in structure or threading, and thoroughly brushed and blown free of chips and scale. Do not repair, but replace defective pipe, tubing, or fittings.

3.6 PROTECTIVE COVERING

3.6.1 Protective Covering for Underground Steel Pipe

Except as otherwise specified, apply protective coverings mechanically in a

factory or field plant especially equipped for the purpose. Hand apply protective covering to valves and fittings that cannot be coated and wrapped mechanically, preferably at the plant that applies the covering to the pipe. Coat and wrap joints by hand, in a manner and with materials that will produce a covering equal in thickness to that of the covering applied mechanically.

3.6.1.1 Thermoplastic Resin Coating System

Provide a thermoplastic coating system conforming to NACE SP0185, Type A. Clean the exterior of the pipe to a commercial grade blast cleaning finish in accordance with SSPC SP 6/NACE No.3, and apply adhesive compound to the pipe. Immediately after the adhesive is applied, extrude a seamless tube of polyethylene over the adhesive to produce a bonded seamless coating, with a nominal thickness of 10 mils (plus or minus 10 percent) of adhesive and 40 mils (plus or minus 10 percent) of polyethylene for pipes up to 16 inches in diameter. For pipes 18 inches and larger in diameter, apply a minimum thickness to the pipe of 10 mils (plus or minus 10 percent) adhesive and 60 mils (plus or minus 10 percent) polyethylene. Apply joint coating and field repair material as recommended by the coating manufacturer, consisting of one the following:

a. Heat shrinkable polyethylene sleeves.

b. Polyvinyl chloride pressure-sensitive adhesive tape.

c. High density polyethylene/bituminous rubber compound tape.

Inspect the coating system for holes, voids, cracks, and other damage during installation.

3.6.1.2 Inspection of Pipe Coatings

Repair any damage to the protective covering during transit and handling before installation. After field coating and wrapping has been applied, inspect the entire pipe using an electric holiday detector with impressed current set at a value in accordance with NACE RP0274 using a full-ring, spring-type coil electrode. Equip the holiday detector with a bell, buzzer, or other type of audible signal which sounds when a holiday is detected. Immediately repair all holidays in the protective covering upon detection. The Contracting Officer reserves the right to inspect and determine the suitability of the detector. Furnish labor, materials, and equipment necessary for conducting the inspection.

3.6.2 Protective Covering for Aboveground Piping Systems

Apply finish painting conforming to the applicable paragraphs of Section 09 90 00 PAINTS AND COATINGS and as follows:

3.6.2.1 Ferrous Surfaces

Touch up shop primed surfaces with ferrous metal primer of the same type paint as the shop primer. Solvent-clean surfaces that have not been shop primed in accordance with SSPC SP 1. Mechanically clean surfaces that contain loose rust, loose mill scale, and other foreign substances by power wire brushing in accordance with SSPC SP 3 or brush-off blast clean in accordance with SSPC SP 7/NACE No.4 and primed with ferrous metal primer in accordance with SSPC Paint 25. Finish primed surfaces with two coats of exterior alkyd paint conforming to MPI 9.

3.6.2.2 Nonferrous Surfaces

Do not paint nonferrous surfaces.

3.6.3 Protective Covering for Piping in Valve Boxes and Manholes

Apply protective coating to piping in valve boxes or manholes as specified for underground steel pipe.

3.7 INSTALLATION

Install gas distribution system and equipment in conformance with the manufacturer's recommendations and applicable sections of ASME B31.8, AGA XR0603 and 49 CFR 192. Perform abandonment of existing gas piping in accordance with ASME B31.8. Cut the pipe without damaging the pipe; unless otherwise authorized, use an approved type of mechanical cutter. Use wheel cutters where practicable. On steel pipe6 inches and larger, an approved gas-cutting-and-beveling machine may be used. Cut plastic pipe in accordance with AGA XR0603. Design valve installation in plastic pipe to protect the plastic pipe against excessive torsional or shearing loads when the valve is operated and from other stresses which may be exerted through the valve or valve box.

3.7.1 Installing Pipe Underground

Grade gas mains and service lines as indicated. Weld joints in steel pipe except as otherwise permitted for installation of valves. Provide mains with 24 inch minimum cover; service lines with 18 inch minimum cover; and place both mains and service lines on firmly compacted select material for the full length. Where indicated, encase, bridge, or design the main to withstand any anticipated external loads as specified in ASME B31.8. Provide standard weight black steel pipe encasement material with a protective coating as specified. Separate the pipe from the casing by insulating spacers and seal the ends with casing bushings. Excavate the trench below pipe grade, bed with bank sand, and compact to provide full-length bearing. Laying pipe on blocks to produce uniform grade is not permitted. Ensure that the pipe is clean inside before it is lowered into the trench and keep free of water, soil, and all other foreign matter that might damage or obstruct the operation of the valves, regulators, meters, or other equipment. When work is not in progress, securely close open ends of pipe or fittings with expandable plugs or other suitable means. Minor changes in line or gradient of pipe that can be accomplished through the natural flexibility of the pipe material without producing permanent deformation and without overstressing joints may be made when approved. Make changes in line or gradient that exceed the limitations specified with fittings. When cathodic protection is furnished, provide electrically insulated joints or flanges. When polyethylene or fiberglass piping is installed underground, place foil backed magnetic tape above the pipe to permit locating with a magnetic detector. After laying of pipe and testing, backfill the trench in accordance with Section 31 00 00 EARTHWORK.

3.7.2 Installing Pipe Aboveground

Protect aboveground piping against dirt and other foreign matter, as specified for underground piping. Weld joints in steel pipe ; however, joints in pipe 1-1/2 inches in diameter and smaller may be threaded; joints may also be threaded to accommodate the installation of valves. Provide flanges of the weld neck type to match wall thickness of pipe.

3.8 PIPE JOINTS

Design and install pipe joints to effectively sustain the longitudinal pullout forces caused by the contraction of piping or superimposed loads.

3.8.1 Threaded Steel Joints

Provide threaded joints in steel pipe with tapered threads evenly cut, made with UL approved graphite joint sealing compound for gas service or polytetrafluoroethylene tape applied to the male threads only. Caulking of threaded joints to stop or prevent leaks is not permitted.

3.8.2 Welded Steel Joints

Perform gas pipe weldments as indicated. Make changes in direction of piping by welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction is not permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Use forged or flared branch outlet fittings for improvement of flow where attached to the run, and reinforced against external strains. Perform all beveling, alignment, heat treatment, and inspection of welds conforming to ASME B31.8. Remove weld defects and repair the weld, or remove the weld joints entirely and reweld. After filler metal has been removed from its original package, protect it or store so that its characteristics or welding properties are not affected adversely. Do not use electrodes that have been wetted or have lost any of their coating.

3.8.3 Polyethylene and Fiberglass Pipe Jointing Procedures

Use jointing procedures conforming to AGA XR0603. Avoid making indiscriminate heat fusion joining of plastic pipe or fittings made from different polyethylene resins by classification or by manufacturer if other alternative joining procedures are available. If heat fusion joining of dissimilar polyethylene is required, special procedures are required. Test the method of heat fusion joining dissimilar polyethylene resins in accordance with paragraph TESTS, subparagraph Destructive Tests of Plastic Pipe Joints.

3.8.4 Connections Between Metallic and Plastic Piping

Only make metallic to plastic connections outside, underground, and with approved transition fittings.

3.9 VALVE BOXES

Provide valve boxes of cast iron not less than 3/16 inch thick at each underground valve except where concrete or other type of housing is indicated. Provide valve boxes with locking covers that require a special wrench for removal, and furnish the correctly marked wrench for each box. Cast the word "gas" in the box cover. When the valve is located in a roadway, protect the valve box by a suitable concrete slab at least 3 square feet. When in a sidewalk, provide the top of the box as a removable concrete slab 2 feet square and set flush with the sidewalk. Make the boxes adjustable extension type with screw or slide-type adjustments. Separately support valve boxes to not rest on the pipe, so that no traffic loads can be transmitted to the pipe. Only locate valves valve boxes or inside of buildings.

3.10 DRIPS

Install drips at locations where indicated, conforming to the details shown, or provide commercial units of approved type and capacity. Connect a blow off pipe 1-1/4 inches or larger to each drip at its lowest point and extend to or near the ground surface at a convenient location away from traffic. Provide a reducing fitting for each discharge at each drip terminal (outlet), a plug valve, and a 1/2 inch nipple turned down. Locate the discharge terminal (outlet) inside a length of 12 inches or larger vitrified clay pipe, concrete sewer pipe or concrete terminal box set vertically on a bed of coarse gravel 1 foot thick and3 feet square, and closed at the ground surface with a suitable replacement cover.

3.11 PRESSURE REGULATOR INSTALLATION

3.11.1 Main Distribution Line Regulators

Install pressure regulators where shown. Install a valve on each side of the regulator for isolating the regulator for maintenance. Provide a bypass line with bypass valves or 3 way valves and an over-pressurization pressure regulating device. Install regulators and valves in rectangular reinforced concrete boxes, large enough so that all required equipment can be properly installed, operated, and maintained, with box sidewalls extending above ground line. Provide the boxes with cast iron manhole covers with locking provisions and 4 inch diameter vents. Furnish one key or other unlocking device with each cover. Locate discharge stacks, vents, or outlet ports of all pressure relief devices where gas can be discharged into the atmosphere without undue hazard. Provide stacks and vents with fittings to preclude entry of water.

3.11.2 Service Line Regulators

Install a shutoff valve, meter set assembly, and service regulator on the service line outside the building, 18 inches above the ground on the riser. Install an insulating joint on the inlet side of the meter set assembly and service regulator and construct to prevent flow of electrical current. Provide a 3/8 inch tapped fitting equipped with a plug on both sides of the service regulator for installation of pressure gauges for adjusting the regulator. Terminate all service regulator vents and relief vents in the outside air in rain and insect resistant fittings. Locate the open end of the vent where gas can escape freely into the atmosphere, away from any openings into the building and above areas subject to flooding.

3.12 METER INSTALLATION

Install meters in accordance with ASME B31.8. Install permanent gas meters with provisions for isolation and removal for calibration and maintenance, and suitable for operation in conjunction with an energy monitoring and control system.

3.13 CONNECTIONS TO EXISTING LINES

Make connections between new work and existing gas lines, where required, in accordance with ASME B31.8, using proper fittings to suit the actual conditions. When connections are made by tapping into a gas main, provide the same size connecting fittings as the pipe being connected.

3.13.1 Connections to Publicly or Privately Operated Gas Utility Lines

Provide materials for the connections to the existing gas lines. The Utility is to make final connections and turn on the gas. The Utility is to also disconnect, purge and cap, plug or otherwise effectively seal existing lines that are to be a abandoned or taken out of service. Notify the Contracting Officer, in writing, 10 days before final connections and turning on of gas lines. Make necessary arrangements with the Utility for tie in and activation of new gas lines. Only the Operating Agency/Utility Company may reactivate the system after tie in. Furnish a certification by the Operating Agency/Utility Company that all Utility work has been satisfactorily completed.

3.13.2 Connection to Government Owned/Operated Gas Lines

Provide connections to the existing gas lines in accordance with approved procedures. Only perform deactivation of any portion of the existing system at the valve location shown on the drawings. Reactivation of any existing gas lines will only be done by the Government. Submit the approved Contractor's Connection and Abandonment Plan prior to making any connections to existing gas lines. Notify the Contracting Officer, in writing, 10 days before connections to existing lines are to be made.

a. Physically disconnect from the pipeline system if facilities are abandoned in place. Purge, cap, plug or otherwise effectively seal the open ends of all abandoned facilities. Do not complete abandonment until it has been determined that the volume of gas or liquid hydrocarbons contained within the abandoned section poses no potential hazard. Use air or inert gas for purging, or fill the facility with water or other inert material. If air is used for purging, ensure that a combustible mixture is not present after purging.

b. When a main is abandoned, together with the service lines connected to it, only the customer's end of such service lines is required to be sealed as stipulated above.

c. Disconnect abandoned service lines from the active mains as close to the main as practicable.

d. Close all valves left in the abandoned segment.

e. Remove all above grade valves, risers, and vault and valve box covers. Fill vault and valve box voids with suitable compacted backfill material.

3.14 CATHODIC PROTECTION

Provide cathodic protection for all metallic gas piping installed underground.

3.15 TESTS

3.15.1 Destructive Tests of Plastic Pipe Joints

Each day, prior to making polyethylene heat fusion joints or fiberglass adhesive joints, make a joint of each size and type to be installed that day by each person performing joining of plastic pipe that day and destructively test. Cut at least 3 longitudinal straps from each joint. Visually examine each strap for voids or discontinuities on the cut

surfaces of the joint area, deformations by bending, torque, or impact. If failure occurs, it must not initiate in the joint area. If a joint fails the visual or deformation test, the qualified joiner who made that joint is not allowed to make further field joints in plastic pipe on this job until that joiner has been retrained and re-qualified. Record the results of the destructive tests including the date and time of the tests, size and type of the joints, ambient conditions, fusion iron temperature and names of inspectors and joiners.

3.15.2 Pressure and Leak Tests

Test the system of gas mains and service lines after construction and before being placed in service, using air as the test medium. Conform testing to ASTM D 1598 and ASTM D 1599 for plastic piping.

a. Prior to testing the system, blow-out, clean, and clear the interior of all foreign materials. Remove all meters, regulators, and controls before blowing out and cleaning,and reinstall after clearing of all foreign materials.

b. Perform testing of gas mains and service lines with due regard for the safety of employees and the public during the test. Keep persons not working on the test operations out of the testing area while testing is proceeding. Perform the test on the system as a whole or on sections that can be isolated.

c. Test joints in sections prior to backfilling when trenches will be backfilled before the completion of other pipeline sections. Continue the test for at least 24 hours from the time of the initial readings to the final readings of pressure and temperature. Do not take the initial test readings of the instrument for at least 1 hour after the pipe has been subjected to the full test pressure. Do not take initial or final readings at times of rapid changes in atmospheric conditions, and temperatures are representative of the actual trench conditions. No indication of reduction of pressure is allowed during the test after corrections have been made for changes in atmospheric conditions in conformity with the relationship $T(1)P(2)=T(2)P(1)$, in which T and P denote absolute temperature and pressure, respectively, and the numbers denote initial and final readings.

d. During the test, completely isolate the entire system from all compressors and other sources of air pressure. Test each joint by means of soap and water or an equivalent nonflammable solution prior to backfilling or concealing any work. Secure approval of testing instruments from the Contracting Officer. Furnish all labor, materials and equipment for conducting the tests subject to inspection at all times during the tests. Maintain safety precautions for air pressure testing at all times during the tests.

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SECTION 33 70 02.00 10

ELECTRICAL DISTRIBUTION SYSTEM, 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 A48/A48M	(2003; R 2008) Standard Specification for Gray Iron Castings
ASTM B117	(2009) Standing Practice for Operating Salt Spray (Fog) Apparatus
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)

ASTM D 1654 (2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

ASTM D 4059 (2000; R 2010) Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography

ASTM D 923 (2007) Standard Practice for Sampling Electrical Insulating Liquids

FM GLOBAL (FM)

FM APP GUIDE (updated on-line) Approval Guide http://www.approvalguide.com/

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 386 (2006) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V

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 C37.13 (2008; INT 1 2009) Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures

IEEE C37.16 (2009) Standard for Preferred Ratings, Related Requirements, and Application Recommendations for Low-Voltage AC (635 V and below) and DC 3200 V and below) Power Circuit Breakers

IEEE C37.46 (2010) Standard for High Voltage Expulsion and Current-Limiting Type Power Class

	Fuses and Fuse Disconnecting Switches
IEEE C57.12.00	(2010) Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.21	(1992) Pad-Mounted, Compartmental-Type Self-Cooled, Single-Phase Distribution Transformers With High Voltage Bushings; High-voltage, 34,500 GRYD/19,920 Volts
IEEE C57.12.26	(1992) Pad-Mounted Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors
IEEE C57.13	(2008) Standard Requirements for Instrument Transformers
IEEE C57.98	(1993; Errata 1998; R 1999) Guide for Transformer Impulse Tests
IEEE C62.11	(2005; Amd 1 2008) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C119.1	(2011) Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI C12.4	(1984; R 2002) Registers - Mechanical Demand
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
NEMA/ANSI C12.10	(2004) Physical Aspects of Watthour Meters - Safety Standards
NEMA/ANSI C12.11	(2007) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; TIA 11-1; Errata 2011) National

Electrical Code

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04	(2007; Change 1) Seismic Design for Buildings

UNDERWRITERS LABORATORIES (UL)

UL 1072	(2006; Reprint Mar 2011) Medium-Voltage Power Cables
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 489	(2009) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
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; 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
UL 854	(2004; Reprint Oct 2007) Standard for Service-Entrance Cables

1.2 SYSTEM DESCRIPTION

Items provided under this section shall be specifically suitable for the following service conditions. Seismic details shall conform to UFC 3-310-04 and Sections 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 26 05 48.00 10 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT .

a. Altitude 750 feet.

b. Ambient Temperature 110 degrees F.

c. Frequency 60 Hz

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

Drawings, as specified.

SD-03 Product Data

Protective Device; G

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.

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.

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.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

Six copies of operation and maintenance manuals, within 30 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.

1.4 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) Switchgear.

(d) Pad-mounted loadbreak switches.

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.

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.

2.2.2 Liquid-Filled Transformer Nameplates

Power transformers shall be provided with nameplate information in accordance with IEEE C57.12.00. Nameplates shall indicate the number of gallons and composition of liquid-dielectric, and shall be permanently marked with a statement that the transformer dielectric to be supplied is non-polychlorinated biphenyl. If transformer nameplate is not so marked, furnish manufacturer's certification for each transformer that the dielectric is non-PCB classified, with less than 2 ppm PCB content in accordance with paragraph LIQUID DIELECTRICS. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the 2 ppm PCB content or transformers without certification will be considered as PCB insulated and will not be accepted.

2.3 CORROSION PROTECTION

2.3.1 Aluminum Materials

Aluminum shall not 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.

2.3.2.2 Equipment

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaries 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 B117 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 a zinc rich paint conforming to the manufacturer's standard.

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 Type MV, conforming to NFPA 70 and UL 1072. Cables shall be manufactured for use in duct applications.

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 AEIC 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 conductor shield, a semiconducting insulation shield, and an overall copper tape shield for each phase.

2.4.1.6 Jackets

Cables shall be provided with a PVC jacket.

2.4.2 Low-Voltage Cables

Cables shall be rated 600 volts and shall conform to the requirements of NFPA 70, and must be UL listed for the application or meet the applicable section of either ICEA or NEMA standards.

2.4.2.1 Conductor Material

Underground cables shall be annealed copper complying with ASTM B3 and ASTM B8. Intermixing of copper and aluminum conductors is not permitted.

2.4.2.2 Insulation

Insulation must be in accordance with NFPA 70, and must be UL listed for the application or meet the applicable sections of either ICEA, or NEMA standards.

2.4.2.3 Direct Buried

Single and multi-conductor cables shall of a type identified for direct burial. Service entrance cables shall conform to UL 854 for Type USE service entrance cable.

2.4.2.4 In Duct

Cables shall be single-conductor cable, in accordance with NFPA 70.

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 Low-Voltage Cable Splices

Low-voltage cable splices and terminations shall be rated at not less than 600 Volts. Splices in conductors 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 conductors No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A-486B. Splices shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket. 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.

2.5.4 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.

2.5.4.1 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

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 40 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. Cast

iron shall comply with ASTM A48/A48M, Class 30B, minimum. Handholes for low voltage cables installed in parking lots, sidewalks, and turfed areas shall be fabricated from an aggregate consisting of sand and with continuous woven glass strands having an overall compressive strength of at least 10,000 psi and a flexural strength of at least 5,000 psi. Pullbox and handhole covers in sidewalks, and turfed areas shall be of the same material as the box. Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers.

2.8 TRANSFORMERS, SUBSTATIONS, AND SWITCHGEAR

Transformers, substations, and switchgear shall be of the outdoor type having the ratings and arrangements indicated. Medium-voltage ratings of cable terminations shall be 15 kV between phases for 133 percent insulation level.

2.8.1 Pad-Mounted Transformers

Pad-mounted transformers shall comply with IEEE C57.12.26 and shall be of the loop feed type. Pad-mounted transformer stations shall be assembled and coordinated by one manufacturer and each transformer station shall be shipped as a complete unit so that field installation requirements are limited to mounting each unit on a concrete pad and connecting it to primary and secondary lines. Stainless steel pins and hinges shall be provided. Barriers shall be provided between high- and low-voltage compartments. High-voltage compartment doors shall be interlocked with low-voltage compartment doors to prevent access to any high-voltage section unless its associated low-voltage section door has first been opened. Compartments shall be sized to meet the specific dimensional requirements of IEEE C57.12.26. Pentahead locking bolts shall be provided with provisions for a padlock.

2.8.1.1 High-Voltage Compartments

The high-voltage compartment shall be dead-front construction. Primary switching and protective devices shall include loadbreak switching, oil-immersed, current-limiting, bayonet-type fuses, medium-voltage separable loadbreak connectors, universal bushing wells and inserts or integral one piece bushings and surge arresters. Fuses shall comply with the requirements of paragraph METERING AND PROTECTIVE DEVICES. The switch shall be mounted inside transformer tank with switch operating handle located in high-voltage compartment and equipped with metal loop for hook stick operation. Fuses shall be interlocked with switches so that fuses can be removed only when the associated switch is in the "OPEN" position. Adjacent to medium-voltage cable connections, a nameplate or equivalent stenciled inscription shall be provided inscribed "DO NOT OPEN CABLE CONNECTORS UNLESS SWITCH IS OPEN." Surge arresters shall be fully insulated and configured to terminate on a second set of high voltage bushings.

2.8.1.2 Load-Break Switch

a. Radial-feed oil-immersed type rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 200 ampere, and a make-and-latch rating of 10,000 rms amperes symmetrical. Locate the switch handle in the high-voltage compartment.

2.8.1.3 Transformer Tank Sections

Transformers shall comply with IEEE C57.12.00 and IEEE C57.12.21 and shall be of the less-flammable, liquid-insulated type with biodegradable vegetable oil. Transformers shall be suitable for outdoor use and shall have 2 separate windings per phase. Standard NEMA primary taps shall be provided. Where primary taps are not specified, 4, 2-1/2 percent rated kVA high-voltage taps shall be provided 2 above and 2 below rated, primary voltage. Operating handles for primary tap changers for de-energized operation shall be located within high-voltage compartments, externally to transformer tanks. Adjacent to the tap changer operating handle, a nameplate or equivalent stenciled inscription shall be provided and inscribed "DO NOT OPERATE UNDER LOAD." Transformer ratings at 60 Hz shall be as follows:

Three-phase capacity	As indicated on the drawings.
Impedance	5.75 percent
Temperature Rise	149 degrees F
High-voltage winding	12,470/7,200 volts
High-voltage winding connections	Wye
Low-voltage winding	480/277 volts
Low-voltage winding connections	Wye

2.8.1.4 Low-Voltage Cable Compartments

Neutrals shall be provided with fully-insulated bushings. Clamp type cable terminations, suitable for copper conductors entering from below, shall be provided as necessary.

2.8.1.5 Accessories

High-voltage warning signs shall be permanently attached to each side of transformer stations. Voltage warning signs shall comply with IEEE C2. Copper-faced steel or stainless steel ground connection pads shall be provided in both the high- and low-voltage compartments. Dial-type thermometer, liquid-level gauge, and drain valve with built-in sampling device shall be provided for each transformer station. Insulated-bushing-type parking stands shall be provided adjacent to each separable load-break elbow to provide for cable isolation during sectionalizing operations.

2.9 METERING AND PROTECTIVE DEVICES

2.9.1 Circuit Breakers, Low-Voltage

2.9.1.1 Low-Voltage Power Circuit Breakers

a. Construction. Low-voltage power circuit breakers shall conform to IEEE C37.13 and IEEE C37.16, and shall be three-pole, single-throw, stored energy, manually operated, with drawout mounting. Solid-state trip elements which require no external power connections shall be provided. Circuit breakers shall have an open/close contact indicator,

primary disconnect devices, and a mechanical interlock to prevent making or breaking contact of primary disconnections when the circuit breaker is closed. Control voltage shall be 24 V dc. The circuit breaker enclosure shall be suitable for its intended location.

b. Ratings. Voltage ratings shall be not less than the applicable circuit voltage. Circuit breakers shall be rated for 100 percent continuous duty and shall have trip current ratings and frame sizes as shown. Nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings shall be in accordance with IEEE C37.16. Tripping features shall be as follows:

(1) Long-time current pick-up, adjustable from 50 percent to 100 percent of sensor current rating.

(2) Adjustable long-time delay.

(3) Short-time current pick-up, adjustable from 1.5 to 9 times long-time current setting.

(4) Adjustable short-time delay.

(5) Instantaneous current pick-up, adjustable from 1.5 to 9 times long-time current setting.

(6) Ground-fault pick-up, adjustable from 20 percent to 60 percent of sensor rating, but in no case greater than 1200 amperes. Sensing of ground-fault current at the main bonding jumper or ground strap shall not be permitted.

(7) Fixed ground-fault delay.

(8) Overload and short-circuit trip indicators shall be provided.

2.9.1.2 Molded-Case Circuit Breakers

UL 489 and UL 489.

2.9.2 Fuses, Medium-Voltage, Including Current-Limiting

2.9.2.1 Construction

Units shall be suitable for outdoor use. Fuses shall have integral blown-fuse indicators. All ratings shall be clearly visible.

2.9.2.2 Ratings

Current-limiting power fuses shall have ratings in accordance with IEEE C37.46 and as follows:

Nominal voltage (kV)	12.47/7.2
Rated maximum voltage (kV	15.5
Rated continuous current (A)	As indicated
Maximum symmetrical interrupting capacity (kA)	12.2

BIL (kV)	110

2.9.2.3 E-Rated, Current-Limiting Power Fuses

E-rated, current-limiting, power fuses shall conform to IEEE C37.46.

2.9.3 Instrument Transformers

2.9.3.1 General

Instrument transformers shall comply with NEMA/ANSI C12.11 and IEEE C57.13. Instrument transformers shall be configured for mounting in/on the device to which they are applied. Polarity marks on instrument transformers shall be visually evident and shown on drawings.

2.9.3.2 Current Transformers

Unless otherwise indicated, bar, wound, or window-type transformers are acceptable; and except for window-type units installed over insulated buses, transformers shall have a BIL rating consistent with the rated BIL of the associated switchgear or electric power apparatus bushings, buses or conductors. Current transformers shall have the indicated ratios. The continuous thermal-current rating factor shall not be less than 2.0. Other thermal and mechanical ratings of current transformers and their primary leads shall be coordinated with the design of the circuit breaker and shall be not less than the momentary rating of the associated circuit breaker. Circuit protectors shall be provided across secondary leads of the current transformers to prevent the accident open-circuiting of the transformers while energized. Each terminal of each current transformer shall be connected to a short-circuiting terminal block in the circuit interrupting mechanism cabinet, power transformer terminal cabinet, and in the associated instrument and relay cabinets.

2.9.3.3 Current Transformers for Kwh and Demand Metering (Low-Voltage)

Current transformers shall conform to IEEE C57.13. Provide current transformers with a metering accuracy Class of 0.3 through B-1.8, with a minimum RF of 1.5 at 30 degrees C, with 600-volt insulations, and 10 kV BIL. Provide butyl-molded, window-type current transformers mounted on the transformer low-voltage bushings. Route current transformer leads in a location as remote as possible from the power transformer secondary cables to permit current measurements to be taken with hook-on-ammeters.

2.9.4 Watthour Meters

Watthour meters shall conform to NEMA/ANSI C12.10, except numbered terminal wiring sequence and case size may be the manufacturer's standard. Watthour meters shall be of the socket mounted outdoor type having a 15 minute, cumulative form, demand register meeting ANSI C12.4 and provided with not less than 2-1/2 stators. Watthour demand meters shall have factory-installed electronic pulse initiators. Pulse initiators shall be solid-state devices incorporating light-emitting diodes, phototransistors, and power transistors, except that mercury-wetted output contacts are acceptable. Initiators shall be totally contained within watthour demand meter enclosures, shall be capable of operating up to speeds of 500 pulses per minute with no false pulses, and shall require no field adjustments. Initiators shall be calibrated for a pulse rate output of 1 pulse per 1/4 disc revolution of the associated meter and shall be compatible with the

indicated equipment.

2.10 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.

2.11 GROUNDING AND BONDING

2.11.1 Driven Ground Rods

Ground rods shall be copper-clad steel conforming to UL 467 not less than 3/4 inch in diameter by 10 feet in length. Sectional type rods may be used.

2.11.2 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.

2.12 CONCRETE AND REINFORCEMENT

Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.13 PADLOCKS

Padlocks shall comply with Fort Knox standards.

2.14 CABLE FIREPROOFING SYSTEMS

Cable fireproofing systems shall be listed in FM APP GUIDE as a fire-protective coating or tape approved for grouped electrical conductors and shall be suitable for application on the type of medium-voltage cables provided. After being fully cured, materials shall be suitable for use where exposed to oil, water, gases, salt water, sewage, and fungus and shall not damage cable jackets or insulation. Asbestos materials are not acceptable.

2.14.1 Fireproof Coating

Cable fireproofing coatings shall be compounded of water-based thermoplastic resins, flame-retardant chemicals, and inorganic noncombustible fibers and shall be suitable for the application methods used. Coatings applied on bundled cables shall have a derating factor of less than 5 percent, and a dielectric strength of 95 volts per mil minimum after curing.

2.14.2 Fireproofing Tape

Fireproofing tape shall be at least 2 inches wide and shall be a flexible, conformable, polymeric, elastomer tape designed specifically for fireproofing cables.

2.14.3 Plastic Tape

Preapplication plastic tape shall be pressure sensitive, 10 mil thick, conforming to UL 510.

2.15 LIQUID DIELECTRICS

Liquid dielectrics for transformers, capacitors, reclosers, and other liquid-filled electrical equipment shall be non-polychlorinated biphenyl (PCB) mineral-oil or less-flammable liquid as specified. Nonflammable fluids shall not be used. Tetrachloroethylene (perchloroethylene) and 1, 2, 4 trichlorobenzene fluids shall not be used. Liquid dielectrics in retrofitted equipment shall be certified by the manufacturer as having less than 2 parts per million (ppm) PCB content. In lieu of the manufacturer's certification, the Contractor may submit a test sample of the dielectric in accordance with ASTM D 923 and have tests performed in accordance with ASTM D 4059 at a testing facility approved by the Contracting Officer. Equipment with test results indicating PCB level exceeding 2 ppm shall be replaced.

2.16 FACTORY TESTS

Factory tests shall be performed, as follows, in accordance with the applicable publications and with other requirements of these specifications. The Contracting Officer shall be notified at least 10 days before the equipment is ready for testing. The Contracting Officer reserves the right to witness the tests.

a. Transformers: Manufacturer's standard routine tests in accordance with IEEE C57.12.00.

b. Transformers rated 200 kVA and above: Reduced full-wave, chopped-wave, and full-wave impulse test on each line and neutral terminal, in accordance with IEEE C57.98.

c. Instrument Current Transformers: Manufacturer's standard tests in accordance with IEEE C57.13.

d. Factory Preformed Terminations: Wet withstand voltage tests in accordance with IEEE 48 for the next higher BIL level.

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. 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 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 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.

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.

3.3.2 Duct Line

Cables shall be installed in duct lines where indicated. Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

3.3.3 Insect and Rodent Damage

Animal guards shall be installed as shown.

3.3.4 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 DUCT LINES

3.5.1 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.

3.5.2 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.

3.5.3 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.

3.5.4 Nonencased Direct-Burial

Top of duct lines shall be below the frost line depth of 32 inches, but not less than 36 inches below finished grade 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, a 3 inch layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil before installing ducts. Joints in adjacent tiers of duct shall be vertically staggered at least 6 inches. The first 6 inch layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in 3 to 6 inch layers. 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.

3.5.5 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.

3.5.6 Duct Line Markers

Duct line markers shall be provided as indicated. 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.

3.6 MANHOLES, HANDHOLES, AND PULLBOXES

3.6.1 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.

3.6.2 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 indicated 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.

3.6.3 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.

3.6.4 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.

3.6.5 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.

3.6.6 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.

3.7 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. Three-phase transformers shall be installed with clockwise phase sequence. Primary taps shall be set to provide +2%/-1/2% at the service switchboard.

3.7.1 Concrete Pads

3.7.1.1 Construction

Concrete pads for pad-mounted electrical equipment shall be 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.

3.7.1.2 Concrete and Reinforcement

Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.7.1.3 Sealing

When the installation is complete, seal all conduit and other entries into

the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.7.2 Padlocks

Padlocks shall be provided for pad-mounted equipment and for each fence gate. Padlocks shall be keyed as directed by the Contracting Officer.

3.8 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.

3.9 CONNECTIONS TO BUILDINGS

Cables shall be extended into the various buildings as indicated, and shall be 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. After installation of cables, conduits shall be sealed with caulking compound to prevent entrance of moisture or gases into buildings.

3.10 GROUNDING

A ground ring consisting of the indicated configuration of bare copper conductors and driven ground rods shall be installed around pad-mounted equipment as shown. Equipment frames of metal-enclosed equipment, and other noncurrent-carrying metal parts, such as cable shields, cable sheaths and armor, and metallic conduit shall be grounded.

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. Ground ring - A ground ring shall be installed as shown consisting of bare copper conductors installed not less than 30 inches below finished top of soil grade. Ground ring conductors shall be sized as shown.

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 as shown, 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 transformer 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. 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 system 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.

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 Low-Voltage Cable Test

Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet

Each cable failing this test shall be repaired or replaced. The repaired cable shall be retested until failures have been eliminated.

3.11.6 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. Pad-mounted transformers

b. Switches

-- End of Section --

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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 HB-17	(2002; Errata 2003; Errata 2005, 17th Edition) Standard Specifications for Highway Bridges
AASHTO M 198	(2010) Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 318M	(2008; Errata 2011) Building Code Requirements for Structural Concrete & Commentary
ACI SP-66	(2004) ACI Detailing Manual

ASTM INTERNATIONAL (ASTM)

ASTM B1	(2001; R 2007) Standard Specification for Hard-Drawn Copper Wire
ASTM B3	(2001; R 2007) Standard Specification for Soft or Annealed Copper Wire
ASTM B8	(2011) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C32	(2011) Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C478	(2009) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C857	(2011) Standard Practice for Minimum Structural Design Loading for Underground

	Precast Concrete Utility Structures
ASTM F 512	(2006) Smooth-Wall Poly (Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE C2	(2012) National Electrical Safety Code

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 C119.1	(2011) Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts
NEMA TC 6 & 8	(2003) Standard for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations
NEMA TC 9	(2004) Standard for Fittings for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; TIA 11-1; Errata 2011) National Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-758	(2004a) Customer-Owned Outside Plant Telecommunications Infrastructure Standard

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS Bull 1751F-644	(2002) Underground Plant Construction

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-60005	(Basic; Notice 2) Frames, Covers, Gratings, Steps, Sump And Catch Basin, Manhole

UNDERWRITERS LABORATORIES (UL)

UL 44	(2010) Thermoset-Insulated Wires and Cables
UL 467	(2007) Grounding and Bonding Equipment
UL 486A-486B	(2003; Reprint Feb 2010) Wire Connectors
UL 510	(2005; Reprint Apr 2008) Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 514B	(2004; Reprint Nov 2009) Conduit, Tubing and Cable Fittings
UL 651	(2005; Reprint Mar 2010) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings
UL 83	(2008) Thermoplastic-Insulated Wires and Cables
UL 854	(2004; Reprint Oct 2007) Standard for Service-Entrance Cables

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. In the text of this section, the words conduit and duct are used interchangeably and have the same meaning.

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. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Precast underground structures; G

SD-03 Product Data

Precast concrete structures; G

Sealing Material

Pulling-In Irons

Manhole frames and covers; G

SD-06 Test Reports

Arc-proofing test for cable fireproofing materials; G

Field Acceptance Checks and Tests; G

Arc-proofing test for cable fireproofing tape; G

Cable Installation Plan and Procedure

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

Cable splicer/terminator; G

Cable Installer Qualifications

1.4 QUALITY ASSURANCE

1.4.1 Precast Underground Structures

Submittal required for each type used. Provide calculations and drawings for precast manholes and handholes bearing the seal of a registered professional engineer including:

a. Material description (i.e., f'c and Fy)

b. Manufacturer's printed assembly and installation instructions

c. Design calculations

d. Reinforcing shop drawings in accordance with ACI SP-66

e. Plans and elevations showing opening and pulling-in iron locations and details

1.4.2 Certificate of Competency for Cable Splicer/Terminator

Certification of the qualification of the cable splicer/terminator shall be submitted, for approval, 30 days before splices or terminations are to be made. The certification shall include the training, and experience of the individual on the specific type and classification of cable to be provided under this contract. The certification shall indicate that the individual has had three or more years recent experience splicing and terminating

cables. The certification shall also list a minimum of three splices/terminations that have been in operation for more than one year. In addition, the individual may be required to perform a dummy or practice splice/termination in the presence of the Contracting Officer, before being approved as a qualified cable splicer. If that additional requirement is imposed, the Contractor shall provide short sections of the approved types of cables along with the approved type of splice/termination kit, and detailed manufacturer's instructions for the cable to be spliced. The Contracting Officer reserves the right to require additional proof of competency or to reject the individual and call for certification of an alternate cable splicer.

1.4.3 Cable Installer Qualifications

Provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. Provide a resume showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers.

1.4.4 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.

1.4.5 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.

1.4.5.1 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.

1.4.5.2 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.

PART 2 PRODUCTS

2.1 CONDUIT, DUCTS, AND FITTINGS

2.1.1 Plastic Duct for Concrete Encasement

NEMA TC 6 & 8 and ASTM F 512, UL 651, EPC-40-PVC or as indicated.

2.1.2 Innerduct

Provide corrugated or solid wall polyethylene (PE) or PVC innerducts with pullwire. Size as indicated.

2.1.3 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. Inflatable bladders may be used as an option.

2.1.4 Fittings

2.1.4.1 PVC Conduit Fittings

UL 514B, UL 651.

2.1.4.2 PVC Duct Fittings

NEMA TC 9.

2.2 LOW VOLTAGE INSULATED CONDUCTORS AND CABLES

Insulated conductors shall be rated 600 volts and conform to the requirements of NFPA 70, including listing requirements. Wires and cables manufactured more than 24 months prior to date of delivery to the site shall not be accepted. Service entrance conductors shall conform to UL 854, type USE.

2.2.1 Conductor Types

Cable and duct sizes indicated are for copper conductors and THHN/THWN unless otherwise noted. Conductors No. 10 AWG and smaller shall be solid copper. Conductors No. 8 AWG and larger shall be stranded copper. All conductors shall be copper.

2.2.2 Conductor Material

Unless specified or indicated otherwise or required by NFPA 70, wires in conduit, other than service entrance, shall be 600-volt, Type THWN/THHN conforming to UL 83 or Type XHHW or RHW conforming to UL 44. Copper conductors shall be annealed copper complying with ASTM B3 and ASTM B8.

2.2.3 Jackets

Multiconductor cables shall have an overall PVC outer jacket.

2.2.4 In Duct

Cables shall be single-conductor cable.

2.2.5 Cable Marking

Insulated conductors shall have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout the cable length.

Each cable 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.

Conductors shall be color coded. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Conductor identification shall be by color-coded insulated conductors, plastic-coated self-sticking printed markers, colored nylon cable ties and plates, heat shrink type sleeves,or colored electrical tape. Control circuit terminations shall be properly identified. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutrals shall be white with a different colored (not green) stripe for each. Color of ungrounded conductors in different voltage systems shall be as follows

a. 480/277 volt, three-phase

(1) Phase A - brown

(2) Phase B - orange

(3) Phase C - yellow

2.3 LOW VOLTAGE WIRE CONNECTORS AND TERMINALS

Shall provide a uniform compression over the entire conductor contact surface. Use solderless terminal lugs on stranded conductors.

a. For use with copper conductors: UL 486A-486B.

2.4 LOW VOLTAGE SPLICES

Provide splices in conductors with a compression connector on the conductor and by insulating and waterproofing using one of the following methods which are suitable for continuous submersion in water and complying with ANSI C119.1.

2.4.1 Heat Shrinkable Splice

Provide heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material which shall be applied in accordance with the manufacturer's written instructions.

2.4.2 Cold Shrink Rubber Splice

Provide a cold-shrink rubber splice which consists of EPDM rubber tube which has been factory stretched onto a spiraled core which is removed during splice installation. The installation shall not require heat or flame, or any additional materials such as covering or adhesive. It shall be designed for use with inline compression type connectors, or indoor, outdoor, direct-burial or submerged locations.

2.5 TELECOMMUNICATIONS CABLING

Provide telecommunications cabling in accordance with Section 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP).

2.6 TAPE

2.6.1 Insulating Tape

UL 510, plastic insulating tape, capable of performing in a continuous temperature environment of 80 degrees C.

2.6.2 Buried Warning and Identification Tape

Provide detectable tape in accordance with Section 31 00 00 EARTHWORK.

2.6.3 Fireproofing Tape

Provide tape composed of a flexible conformable unsupported intumescent elastomer. Tape shall be not less than .030 inch thick, noncorrosive to cable sheath, self-extinguishing, noncombustible, and shall not deteriorate when subjected to oil, water, gases, salt water, sewage, and fungus.

2.7 PULL ROPE

Shall be plastic or flat pull line (bull line) having a minimum tensile strength of 200 pounds.

2.8 GROUNDING AND BONDING

2.8.1 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.

2.8.2 Grounding Conductors

Stranded-bare copper conductors shall conform to ASTM B8, Class B, soft-drawn unless otherwise indicated. Solid-bare copper conductors shall conform to ASTM B1 for sizes No. 8 and smaller. 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. Aluminum is not acceptable.

2.9 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section 03 30 00 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.

2.10 UNDERGROUND STRUCTURES

Provide precast concrete underground structures or standard type cast-in-place manhole types as indicated, conforming to ASTM C857 and ASTM C478. 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.

2.10.1 Cast-In-Place Concrete Structures

Concrete shall conform to Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.10.2 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.

2.10.2.1 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.

2.10.2.2 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 (phi) = 30 degrees

b. Unit Weight of Soil (Dry) = 110 pcf, (Saturated) = 130 pcf

c. Coefficient of Lateral Earth Pressure (Ka) = 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.

2.10.2.3 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.

2.10.2.4 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.

2.10.3 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.

2.10.4 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.

2.10.5 Brick for Manhole Collar

Brick shall be sewer and manhole brick conforming to ASTM C32, Grade MS.

2.11 CABLE SUPPORTS (RACKS, ARMS, AND INSULATORS)

The metal portion of racks and arms shall be zinc-coated after fabrication.

2.11.1 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.

2.11.2 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.

2.11.3 Insulators

Insulators for metal rack arms shall be dry-process glazed porcelain. Insulators are not required for nylon arms.

2.12 CABLE TAGS IN MANHOLES

Provide tags for each power cable located in manholes. The tags shall be polyethylene. Do not provide handwritten letters. The first position on the power cable tag shall denote the voltage. The second through sixth positions on the tag shall identify the circuit. The next to last position shall denote the phase of the circuit and shall include the Greek "phi" symbol. The last position shall denote the cable size. As an example, a tag could have the following designation: "11.5 NAS 1-8(Phase A)500," denoting that the tagged cable is on the 11.5kV system circuit number NAS 1-8, underground, Phase A, sized at 500 kcmil.

2.12.1 Polyethylene Cable Tags

Provide tags of polyethylene that have an average tensile strength of 3250 pounds per square inch; and that are 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 170 degrees F. Provide 0.05 inch (minimum) thick black polyethylene tag holder. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties shall

have a minimum loop tensile strength of 175 pounds. The cable tags shall have black block letters, numbers, and symbols one inch high on a yellow background. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.

2.13 SOURCE QUALITY CONTROL

2.13.1 Arc-Proofing Test for Cable Fireproofing Tape

Manufacturer shall test one sample assembly consisting of a straight lead tube 12 inches long with a 2 1/2 inch outside diameter, and a 1/8 inch thick wall, and covered with one-half lap layer of arc and fireproofing material per manufacturer's instructions. The arc and fireproofing tape shall withstand extreme temperature of a high-current fault arc 13,000 degrees K for 70 cycles as determined by using an argon directed plasma jet capable of constantly producing and maintaining an arc temperature of 13,000 degrees K. Temperature (13,000 degrees K) of the ignited arc between the cathode and anode shall be obtained from a dc power source of 305 (plus or minus 5) amperes and 20 (plus or minus 1) volts. The arc shall be directed toward the sample assembly accurately positioned 5 (plus or minus 1) millimeters downstream in the plasma from the anode orifice by fixed flow rate of argon gas (0.18 g per second). Each sample assembly shall be tested at three unrelated points. Start time for tests shall be taken from recorded peak current when the specimen is exposed to the full test temperature. Surface heat on the specimen prior to that time shall be minimal. The end point is established when the plasma or conductive arc penetrates the protective tape and strikes the lead tube. Submittals for arc-proofing tape shall indicate that the test has been performed and passed by the manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment and devices in accordance with the manufacturer's published instructions and with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable. In addition to these requirements, install telecommunications in accordance with TIA-758 and RUS Bull 1751F-644.

3.2 CABLE INSPECTION

Prior to installation, each 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 prior to installation in accordance with the cable manufacturer's recommendations.

3.3 CABLE INSTALLATION PLAN AND PROCEDURE

The Contractor shall 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 limits for installation, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, maximum allowable pulling tension, and maximum allowable sidewall bearing pressure. The Contractor shall then perform pulling calculations and prepare a pulling plan which shall be submitted along with the manufacturers instructions in accordance with SUBMITTALS. Cable shall be installed strictly in accordance with the cable manufacturer's recommendations and the approved installation plan.

Calculations and pulling 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 bearing 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.

3.4 UNDERGROUND FEEDERS SUPPLYING BUILDINGS

Terminate underground feeders supplying building at a point 5 feet outside the building and projections thereof, except that conductors shall be continuous to the terminating point indicated. Conduit shall be PVC, Type EPC-40 from the supply equipment to a point 5 feet outside the building and projections thereof. Protect ends of underground conduit with plastic plugs until connections are made.

Encase the underground portion of the conduit in a concrete envelope and bury as specified for underground duct with concrete encasement.

3.5 UNDERGROUND STRUCTURE CONSTRUCTION

Provide standard type cast-in-place construction as specified herein and as indicated, or precast construction as specified herein. Horizontal concrete surfaces of floors shall have a smooth trowel finish. Cure concrete by applying two coats of white pigmented membrane forming-curing compound in strict accordance with the manufacturer's printed instructions, except that precast concrete may be steam cured. Curing compound shall conform to ASTM C309. Locate duct entrances and windows in the center of end walls (shorter) and near the corners of sidewalls (longer) to facilitate cable racking and splicing. Covers for underground structures shall fit the frames without undue play. Steel and iron shall be formed 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.

3.5.1 Cast-In-Place Concrete Structures

Construct walls on a footing of cast-in-place concrete except that precast concrete base sections may be used for precast concrete manhole risers.

3.5.2 Precast Concrete Construction

Set commercial precast structures on 6 inches of level, 90 percent compacted granular fill, 3/4 inch to 1 inch size, extending 12 inches beyond the structure on each side. Compact granular fill by a minimum of four passes with a plate type vibrator. Installation shall additionally conform to the manufacturer's instructions.

3.5.3 Pulling-In Irons

Provide steel bars bent as indicated, and cast in the walls and floors. Alternatively, pipe sleeves may be precast into the walls and floors where required to accept U-bolts or other types of pulling-in devices possessing the strengths and clearances stated herein. The final installation of pulling-in devices shall be made permanent. Cover and seal exterior projections of thru-wall type pulling-in devices with an appropriate protective coating. In the floor the irons shall be a minimum of 6 inches from the edge of the sump, and in the walls the irons shall be located within 6 inches of the projected center of the duct bank pattern or precast window in the opposite wall. However, the pulling-in iron shall not be located within 6 inches of an adjacent interior surface, or duct or precast window located within the same wall as the iron. If a pulling-in iron cannot be located directly opposite the corresponding duct bank or precast window due to this clearance limitation, locate the iron directly above or below the projected center of the duct bank pattern or precast window the minimum distance required to preserve the 6 inch clearance previously stated. In the case of directly opposing precast windows, pulling-in irons consisting of a 3 foot length of No. 5 reinforcing bar, formed into a hairpin, may be cast-in-place within the precast windows simultaneously with the end of the corresponding duct bank envelope. Irons installed in this manner shall be positioned directly in line with, or when not possible, directly above or below the projected center of the duct bank pattern entering the opposite wall, while maintaining a minimum clear distance of 3 inches from any edge of the cast-in-place duct bank envelope or any individual duct. Pulling-in irons shall have a clear projection into the structure of approximately 4 inches and shall be designed to withstand a minimum pulling-in load of 6000 pounds. Irons shall be hot-dipped galvanized after fabrication.

3.5.4 Cable Racks, Arms and Insulators

Cable racks, arms and insulators shall be sufficient to accommodate the cables. Racks in power manholes shall be spaced not more than 3 feet apart, and each manhole wall shall be provided with a minimum of two racks. Racks in signal manholes shall be spaced not more than 16 1/2 inches apart with the end rack being no further than 12 inches from the adjacent wall. Methods of anchoring cable racks shall be as follows:

a. Provide a 5/8 inch diameter by 5 inch long anchor bolt with 3 inch foot cast in structure wall with 2 inch protrusion of threaded portion of bolt into structure. Provide 5/8 inch steel square head nut on each anchor bolt. Coat threads of anchor bolts with suitable coating immediately prior to installing nuts.

b. Provide concrete channel insert with a minimum load rating of 800 pounds per foot. Insert channel shall be steel of the same length as "vertical rack channel;" channel insert shall be cast flush in structure wall. Provide 5/8 inch steel nuts in channel insert to receive 5/8 inch diameter by 3 inch long steel, square head anchor bolts.

c. Provide concrete "spot insert" at each anchor bolt location, cast flush in structure wall. Each insert shall have minimum 800 pound load rating. Provide 5/8 inch diameter by 3 inch long steel, square head anchor bolt at each anchor point. Coat threads of anchor bolts with suitable coating immediately prior to installing bolts.

3.5.5 Field Painting

Cast-iron frames and covers not buried in concrete or masonry shall be cleaned of mortar, rust, grease, dirt and other deleterious materials, and given a coat of bituminous paint.

3.6 UNDERGROUND CONDUIT AND DUCT SYSTEMS

3.6.1 Requirements

Depths to top of the conduit shall be in accordance with NFPA 70. Run conduit in straight lines except where a change of direction is necessary. Numbers and sizes of ducts shall be as indicated. Ducts shall have a continuous slope downward toward underground structures and away from buildings, laid with a minimum slope of 3 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 structures.

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 Conduit Cleaning

As each conduit run is completed, for conduit sizes 3 inches and larger, draw a flexible testing mandrel approximately 12 inches long with a diameter less than the inside diameter of the conduit through the conduit. After which, draw a stiff bristle brush through until conduit is clear of

particles of earth, sand and gravel; then immediately install conduit plugs. For conduit sizes less than 3 inches, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs.

3.6.4 Jacking and Drilling Under Roads and Structures

Conduits to be installed under existing paved areas which are not to be disturbed, and under roads and railroad tracks, shall be zinc-coated, rigid steel, jacked into place.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.

3.6.5 Multiple Conduits

Separate multiple conduits by a minimum distance of 3 inches, except that light and power conduits shall be separated from control, signal, and telephone conduits by a minimum distance of 12 inches. Stagger the joints of the conduits by rows (horizontally) and layers (vertically) to strengthen the conduit assembly. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers, ties, and locking device on top to provide a completely enclosed and locked-in conduit assembly. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 10 feet of conduit assembly.

3.6.6 Conduit Plugs and Pull Rope

New conduit indicated as being unused or empty shall be provided with plugs on each end. Plugs shall contain a weephole or screen to allow water drainage. Provide a plastic pull rope having 3 feet of slack at each end of unused or empty conduits.

3.6.7 Conduit and Duct Without Concrete Encasement

Provide not less than 3 inches clearance from the conduit to each side of the trench. Grade bottom of trench smooth; where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 3 inches, fill and tamp level with original bottom with sand or earth free from particles, that would be retained on a 1/4 inch sieve. The first 6 inch layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in 3 to 6 inch layers. Provide color, type and depth of warning tape as specified in Section 31 00 00 EARTHWORK.

3.6.7.1 Encasement Under Roads and Structures

Under roads, paved areas, and railroad tracks, install conduits in concrete encasement of rectangular cross-section providing a minimum of 3 inch concrete cover around ducts. Concrete encasement shall extend at least 5 feet beyond the edges of paved areas and roads, and 12 feet beyond the rails on each side of railroad tracks.

3.6.8 Duct Encased in Concrete

Construct underground duct lines of individual conduits encased in concrete. Do not mix different kinds of conduit in any one duct bank. Concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover for ducts. Separate conduits by a minimum concrete thickness of 2 1/2 inches, except separate light and power conduits from control, signal, and telecommunications conduits by a minimum concrete thickness of 3 inches. Before pouring concrete, anchor duct bank assemblies to prevent the assemblies from floating during concrete pouring. Anchoring shall be done by driving reinforcing rods adjacent to duct spacer assemblies and attaching the rods to the spacer assembly. Provide color, type and depth of warning tape as specified in Section 31 00 00 EARTHWORK.

3.6.8.1 Connections to Manholes

Duct bank envelopes connecting to underground structures shall be flared to have enlarged cross-section at the manhole entrance to provide additional shear strength. Dimensions of the flared cross-section shall be larger than the corresponding manhole opening dimensions by no less than 12 inches in each direction. Perimeter of the duct bank opening in the underground structure shall be flared toward the inside or keyed to provide a positive interlock between the duct bank and the wall of the structure. Use vibrators when this portion of the encasement is poured to assure a seal between the envelope and the wall of the structure.

3.6.8.2 Connections to Existing Underground Structures

For duct bank connections to existing structures, break the structure wall out to the dimensions required and preserve steel in the structure wall. Cut steel and extend into the duct bank envelope. Chip the perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with the duct bank envelope.

3.7 CABLE PULLING

Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation. Use flexible cable feeds to convey cables through manhole opening and into duct runs. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into transformers and other enclosures. Cable with tape or wire shield shall have a bending radius not less than 12 times the overall diameter of the completed cable. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

3.7.1 Cable Lubricants

Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables.

3.8 CABLES IN UNDERGROUND STRUCTURES

Do not install cables utilizing the shortest path between penetrations, 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 on brackets and cable insulators. Support cable splices in underground structures by racks on each side of the

splice. Locate splices to prevent cyclic bending in the spliced sheath. Install cables at middle and bottom of cable racks, leaving top space open for future cables, except as otherwise indicated for existing installations. Provide one spare three-insulator rack arm for each cable rack in each underground structure.

3.8.1 Cable Tag Installation

Install cable tags in each manhole as specified, including each splice. Tag wire and cable provided by this contract. Install cable tags over the fireproofing, if any, and locate the tags so that they are clearly visible without disturbing any cabling or wiring in the manholes.

3.9 CONDUCTORS INSTALLED IN PARALLEL

Conductors shall be grouped such that each conduit of a parallel run contains 1 Phase A conductor, 1 Phase B conductor, 1 Phase C conductor, and 1 neutral conductor.

3.10 LOW VOLTAGE CABLE SPLICING AND TERMINATING

Make terminations and splices with materials and methods as indicated or specified herein and as designated by the written instructions of the manufacturer. Do not allow the cables to be moved until after the splicing material has completely set. Make splices in underground distribution systems only in accessible locations such as manholes,handholes, or aboveground termination cabinets.

3.11 CABLE END CAPS

Cable ends shall be sealed at all times with coated heat shrinkable end caps. Cables ends shall be sealed when the cable is delivered to the job site, while the cable is stored and during installation of the cable. The caps shall remain in place until the cable is spliced or terminated. Sealing compounds and tape are not acceptable substitutes for heat shrinkable end caps. Cable which is not sealed in the specified manner at all times will be rejected.

3.12 GROUNDING SYSTEMS

Provide grounding system as indicated, in accordance with NFPA 70 and IEEE C2, and as specified herein.

Noncurrent-carrying metallic parts associated with electrical equipment shall have a maximum resistance to solid earth ground not exceeding the following values:

Pad-mounted transformers without protective fences	5 ohms
Ground in manholes	5 ohms
Grounding other metal enclosures of primary voltage electrical and electrically-operated equipment	5 ohms

3.12.1 Grounding Electrodes

Provide cone pointed driven ground rods driven full depth plus 6 inches, installed to provide an earth ground of the appropriate value for the particular equipment being grounded.
If the specified ground resistance is not met, an additional ground rod shall be provided in accordance with the requirements of NFPA 70 (placed not less than 6 feet from the first rod). Should the resultant (combined) resistance exceed the specified resistance, measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately.

3.12.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, by exothermic weld or compression connector.

a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

b. Make compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

3.12.3 Grounding Conductors

Provide bare grounding conductors, except where installed in conduit with associated phase conductors. Ground cable sheaths, cable shields, conduit, and equipment with No. 6 AWG. Ground other noncurrent-carrying metal parts and equipment frames of metal-enclosed equipment. Ground metallic frames and covers of handholes and pull boxes with a braided, copper ground strap with equivalent ampacity of No. 6 AWG. Provide direct connections to the grounding conductor with 600 v insulated, full-size conductor for each grounded neutral of each feeder circuit, which is spliced within the manhole.

3.12.4 Ground Cable Crossing Expansion Joints

Protect ground cables crossing expansion joints or similar separations in structures and pavements by use of approved devices or methods of installation which provide the necessary slack in the cable across the joint to permit movement. Use stranded or other approved flexible copper cable across such separations.

3.12.5 Manhole Grounding

Loop a 4/0 AWG grounding conductor around the interior perimeter, approximately 12 inches above finished floor. Secure the conductor to the manhole walls at intervals not exceeding 36 inches. Connect the conductor to the manhole grounding electrode with 4/0 AWG conductor. Connect all incoming 4/0 grounding conductors to the ground loop adjacent to the point of entry into the manhole. Bond the ground loop to all cable shields, metal cable racks, and other metal equipment with a minimum 6 AWG conductor.

3.13 EXCAVATING, BACKFILLING, AND COMPACTING

Provide in accordance with NFPA 70 and Section 31 00 00 EARTHWORK.

3.13.1 Reconditioning of Surfaces

3.13.1.1 Unpaved Surfaces

Restore to their original elevation and condition unpaved surfaces disturbed during installation of duct. Preserve sod and topsoil removed during excavation and reinstall after backfilling is completed. Replace sod that is damaged by sod of quality equal to that removed. When the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in the original seeding, and provide topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching.

3.13.1.2 Paving Repairs

Where trenches, pits, or other excavations are made in existing roadways and other areas of pavement where surface treatment of any kind exists, restore such surface treatment or pavement the same thickness and in the same kind as previously existed, except as otherwise specified, and to match and tie into the adjacent and surrounding existing surfaces.

3.14 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.14.1 Concrete Slabs for Equipment

Unless otherwise indicated, the slab shall be at least 8 inches thick, reinforced with a 6 by 6 - W2.9 by W2.9 mesh, placed uniformly 4 inches from the top of the slab. Slab shall be placed on a 6 inch thick, well-compacted gravel base. Top of concrete slab shall be approximately 4 inches above finished grade with gradual slope for drainage. Edges above grade shall have 1/2 inch chamfer. Slab shall be of adequate size to project at least 8 inches beyond the equipment.

Stub up conduits, with bushings, 2 inches into cable wells in the concrete pad. Coordinate dimensions of cable wells with transformer cable training areas.

3.14.2 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.15 FIELD QUALITY CONTROL

3.15.1 Performance of Field 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.

3.15.1.1 Grounding System

a. Visual and mechanical inspection

Inspect ground system for compliance with contract plans and specifications

b. Electrical tests

Perform ground-impedance measurements utilizing the fall-of-potential method in accordance with IEEE 81. 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 megohmmeter tester 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.

3.15.2 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 --

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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 B1	(2001; R 2007) Standard Specification for Hard-Drawn Copper Wire
ASTM B8	(2011) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
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 FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; TIA 11-1; Errata 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

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 345-50	(1979) Trunk Carrier Systems (PE-60)
RUS Bull 345-65	(1985) Shield Bonding Connectors (PE-65)
RUS Bull 345-72	(1985) Filled Splice Closures (PE-74)

UNDERWRITERS LABORATORIES (UL)

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 33 71 02.00 20, UNDERGROUND, ELECTRICAL DISTRIBUTION applies 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, poles, 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.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. 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

Telecommunications Entrance Facility Drawings

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

Cable splices, and connectors

Closures

Building protector assemblies

Protector modules

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

Outside Plant Test Plan

SD-07 Certificates

Telecommunications Contractor Qualifications

Key Personnel Qualifications

Minimum Manufacturer's Qualifications

SD-08 Manufacturer's Instructions

Building protector assembly installation

Fiber Optic Splices

Submit instructions prior to installation.

SD-09 Manufacturer's Field Reports

Factory Reel Test Data

SD-10 Operation and Maintenance Data

Telecommunications outside plant (OSP), Data Package 5

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

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. 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 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 CLOSURES

2.2.1 Copper Conductor Closures

2.2.1.1 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.

2.2.2 Fiber Optic Closures

2.2.2.1 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.

2.3 CABLE SPLICES, AND CONNECTORS

2.3.1 Copper Cable Splices

Provide multipair, splices of a moisture resistant, two-wire 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.

2.3.2 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.

2.3.3 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.

2.3.4 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.

2.3.5 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.

2.4 CONDUIT

Provide conduit as specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION SYSTEM.

2.5 PLASTIC INSULATING TAPE

UL 510.

2.6 WIRE AND CABLE

2.6.1 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:

2.6.1.1 Underground

Provide filled cable meeting the requirements of ICEA S-99-689 and RUS 1755.390.

2.6.1.2 Screen

Provide screen-compartmental core cable filled cable meeting the requirements of ICEA S-99-689 and RUS 1755.390.

2.6.2 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.

2.6.2.1 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.

2.6.2.2 Performance Requirements

Provide fiber optic cable with optical and mechanical performance requirements in accordance with ICEA S-87-640.

2.6.3 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 B1 for sizes No. 8 AWG and smaller and stranded bare copper wire meeting the requirements of ASTM B8, for sizes No. 6 AWG and larger. Insulated conductors shall have 600-volt, Type TW insulation meeting the requirements of UL 83.

2.7 T-SPAN LINE TREATMENT REPEATERS

Provide as indicated. Repeaters shall be pedestal mounted with non-pressurized housings, sized as indicated and shall meet the requirements of RUS Bull 345-50.

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 or polyethylene and labeled as indicated in accordance with TIA/EIA-606. Handwritten labeling is unacceptable.

2.8.1 Stainless Steel

Provide stainless steel, cable tags 1 5/8 inches in diameter 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.

2.8.2 Polyethylene Cable Tags

Provide tags of polyethylene that have an average tensile strength of 3250

pounds per square inch; and that are 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 170 degrees F. Provide 0.05 inch (minimum) thick black polyethylene tag holder. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties shall have a minimum loop tensile strength of 175 pounds. The cable tags shall have black block letters, numbers, and symbols one inch high on a yellow background. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.

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 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.

3.1.4 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.

3.1.4.1 Cable Tensions

Obtain from the cable manufacturer and provide to the Contracting Officer,

the maximum allowable pulling tension. This tension shall not be exceeded.

3.1.4.2 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.

3.1.4.3 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.

3.1.5 Cable Splicing

3.1.5.1 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.

3.1.5.2 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.

3.1.6 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 meets the requirements of RUS Bull 1751F-815.

3.1.7 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.

3.1.8 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 only new wire and cable 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 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

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.

3.4.1 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.

3.4.1.1 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

3.4.1.2 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 or 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.

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.

-- End of Section --

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APPENDIX BB
Engineering & Construction Bulletin (ECB) 2011-1

US Army Corps of Engineers

ENGINEERING AND CONSTRUCTION BULLETIN

No. 2011-1 **Issuing Office:** CECW-CE **Issued:** 19 Jan 2011 **Expires:** 19 Jan 2013

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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Subject: High Performance Building Energy and Sustainability Policy

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
VIABLE 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 climatic 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 *x*B)

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/m^2 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.)

APPENDIX CC
Geophysical Survey

BWSC | BARGE WAGGONER SUMNER & CANNON, INC.®

September 23, 2011
File 3473460

Tom Kamphake
BWSC
Project Manager, Architect
8280 Yankee Street
Dayton, OH 45458

RE: Report of August 2011 Geophysical Survey-*Revised*
Future Location of the 19th Battalion Headquarters
Ft. Knox, Kentucky

Dear Mr. Kamphake,

Barge Waggoner Sumner and Cannon, Inc (BWSC) subcontracted Forrest Environmental Services (FES) to perform a geophysical survey at the future location of the 19th Battalion Headquarters at Ft. Knox, Kentucky. The survey consisted of an electromagnetic (EM) survey, a time-domain electromagnetic (TDEM) survey, and a ground penetrating radar (GPR) survey to locate suspected underground storage tanks (USTs) and oil-water separators. A copy of the Geophysical Survey Report prepared by Forrest Environmental Services, Inc, is attached.

The EM survey was performed using an EM-31 induction meter to measure the apparent conductivity of the subsurface. The TDEM survey was performed using an EM-61 meter to which also measures the apparent conductivity of the subsurface. However, the EM-61 is a high sensitivity, high resolution metal detector that can detect ferrous metallic objects. The GPR survey was performed using a Noggin Smart Cart with a shielded 250 megahertz (MHz) antenna. GPR is an EM method that detects interfaces between subsurface materials with contrasting dielectric constants.

The survey area was walked by BWSC and FES personnel prior to commencement of survey activities. Limits of the surveyed area were verified using Figure 1, Site Map. Data was collected within the survey area at either 5-foot or 10-foot intervals based on proximity of buildings and vehicles. Smaller intervals are used when aboveground objects with large amounts of metal are located within the survey area to help reduce the amount of interference from the object. However, despite the smaller intervals, data from portions of the site are inconclusive due to the large volume of vehicles and buildings within the area. Information on conductivity and magnetic susceptibility collected during the survey is shown on Figure 2 and 3 of the attached report.

Analysis of the survey information indicated the presence of five anomalies within the survey area. Locations of each anomaly are presented in Figure 7 of the attached report. . The anomalies were grouped in the southeast corner of the survey area and appear to be consistent with the presence of underground storage tanks (UST) and/or excavation pits. Note that the Anomalies identified as 'E' and 'F' are known Oil Water Separators.

Based on the results of the geophysical surveys, BWSC recommends removal of the USTs prior to commencement of other demolition work.

Sincerely,

Barge Waggoner Sumner and Cannon, Inc.

KB Evetts

Kent B. Evetts, P.G.
VP, Energy & Environment

From: McGar, James D Mr CIV USA IMCOM
To: Tom Kamphake
Subject: FW: (UNCLASSIFIED)
Date: Friday, October 21, 2011 8:22:08 AM
Attachments: 2786 digging.doc

Classification: UNCLASSIFIED
Caveats: NONE

FYI

Donnie McGar
Chief, Compliance Branch
Environmental Management Division
(502) 624-8186
donnie.mcgar@us.army.mil

-----Original Message-----
From: Tibbitts, Rick [mailto:Rick.Tibbitts@icisrvcs.com]
Sent: Thursday, October 20, 2011 4:45 PM
To: McGar, James D Mr CIV USA IMCOM
Cc: Albright, James E CTR US USA; Pollock, Linda G Mrs CIV USA IMCOM; Ousley, Craig
Subject: RE: (UNCLASSIFIED)

ICI Services Corporation has reviewed the geophysical report prepared by BWSC. On October 19, 2011, ICI Services with the services of H.F. McClure Maintenance, performed two exploratory excavations of Anomaly E and Anomaly G. Although verbal results have been provided, this email documents our observations.

Anomaly E (OWS Separator); located southwest corner of Building 2786. Since the OWS is located approximately 100 feet west of the location identified in Figure 7, ICI Services dug two exploratory trenches with a backhoe to a depth of approximately 4 feet below grade. The soil profile was, in general, topsoil, clay (yellowish-brown/gray mottled), clay (red/gray mottled). This profile is consist with native soil disposition. ICI Services believes Anomaly E is not from an OWS Separator or underground storage tank, but instead interference from two water lines in the area. One water line has a north-south orientation and the second water line has an east-west orientation. A fire hydrant is located near the intersection of the two water lines.

Anomaly G; (two location identified) located north of Building 2786. At the western location identified, an underground storage tank used to stored used oil was removed from this location in the mid-1990s. The UST was removed by H.F. McClure Maintenance and the representative on site yesterday remembered removing the UST in the mid-1990s. Yesterday, a 1-1/2 inch pipe was visible at the surface (see attached, top photo, circled in red). The UST was located east of that pipe. The exploratory excavation was west of that pipe. At a depth of 4 to 4-1/2 feet below grade surface, a 2-1/2 inch horizontal pipe was uncovered (see attached, bottom photo, circled in blue; continuation of surface pipe is circled in red). The original or purpose of the pipe is unknown. In addition, a metal box is poor condition (top missing) (see attached, bottom photo, circled in yellow) was also uncovered at a similar depth. The size or purpose of the metal box is unknown.

At the eastern location identified, a grit trap is identified in several drawings. ICI believes this grit trap is the cause of the anomaly.

Rick L. Tibbitts | Operations Center Manager ICI Services Corporation | 1332 Woodman Drive | Suite 200 | Dayton, OH 45432
Office: (937) 252-6008 | Mobile: (937) 608-7587

-----Original Message-----
From: McGar, James D Mr CIV USA IMCOM [mailto:donnie.mcgar@us.army.mil]
Sent: Monday, October 17, 2011 9:13 AM
To: Tibbitts, Rick
Cc: Albright, James E CTR US USA; Pollock, Linda G Mrs CIV USA IMCOM
Subject: FW: (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Rick, attached is the geophysical report for the 19th Engr Battalion Complex. See note below. UST 2786 was registered and is on the 18 regulated USTs that ned closure reports. No registration exists for 2789. We may have 2 more UOL USTs in the ground. Call me when you have had a chance to review. May need Tim to scratch around to see what he can find.

Donnie McGar
Chief, Compliance Branch
Environmental Management Division
(502) 624-8186
donnie.mcgar@us.army.mil

-----Original Message-----
From: Tom Kamphake [mailto:Tom.Kamphake@bwsc.net]
Sent: Friday, October 14, 2011 2:08 PM
To: McGar, James D Mr CIV USA IMCOM
Cc: Michael Moore; Steve Skaggs; Brackett, Matthew J CIV US USA; Graham, Lewis H CIV USA USACE; Scott DeGaro
Subject:

Donnie,

Attached is a copy of the Final Geophysical report for the 19th Eng Bn project. Please review especially with respect to the Anomalies E, H and G. We believe that Anomaly E is actually in the grass area immediately to the west of where it is indicated, but we need to confirm with the geophysical surveyor. You may need to get these included with your demolition contract. We have the ability to get test pits dug to determine the cause of the anomaly, with authorization by USACE.

Thomas F. Kamphake, AIA, PMP, CBO, LEED AP BD+C

Project Manager, Architect

Barge Waggoner Sumner & Cannon, Inc.

2786

From: McGar, James D Mr CIV USA IMCOM
To: Tom Kamphake
Subject: FW: (UNCLASSIFIED)
Date: Friday, October 21, 2011 8:21:37 AM

Classification: UNCLASSIFIED
Caveats: NONE

Tom, FYI

Donnie McGar
Chief, Compliance Branch
Environmental Management Division
(502) 624-8186
donnie.mcgar@us.army.mil

-----Original Message-----
From: Tibbitts, Rick [mailto:Rick.Tibbitts@icisrvcs.com]
Sent: Thursday, October 20, 2011 5:03 PM
To: McGar, James D Mr CIV USA IMCOM
Cc: Albright, James E CTR US USA; Pollock, Linda G Mrs CIV USA IMCOM; Ousley, Craig
Subject: RE: (UNCLASSIFIED)

In addition to the exploratory excavation work at 2786, ICI Services reviewed the UST files for that area.

Building 2789 - had a used oil underground storage tank removed in the mid-1990s. It was located on the northeast corner of the building. Fort Knox received a "No Further Action" letter for this site.

Building 2788 - had three used oil underground storage tanks associated with this building plus a fourth UST containing heating oil.

- Used oil UST located northwest corner of building was removed within the past 5 years. Fort Knox received a "No Further Action" letter for this site.
- Used oil UST located east of the building/parking area was removed in the mid-1990s. Information in the file indicates laboratory results of TPH up to 835 mg/kg. The state has never requested additional information and Fort Knox has not received a "No Further Action" letter. Therefore, Fort Knox may consider additional data gathering to determine the extent of impacted soil.
- Used oil UST located southeast of building (east of Building 2789; just north of new storage building). This site was over-excavated within the past 5 years. Fort Knox received a "No Further Action" letter for this site, however, a portion of the UST area was located under the existing structure. During the demolition phase, the contractor should be aware of the potential contaminated soil in this area.
- Heating oil UST located northeast of the building was removed within the past 5 years and met all regulatory requirements.

Building 2789 - had two used oil USTs associated with this building.

- Used oil UST located northeast corner of the building was removed and overexcavated in the mid-1990s. While Fort Knox did not receive a "No Further Action" letter, the laboratory results from the overexcavation are non-detects.
- Used oil UST located west of the building/west of the storage pad was removed in the mid-1990s by H.F. McClure Maintenance. ICI

Services was not able to obtain any information regarding the closure of this tank. Therefore, Fort Knox may consider additional data gathering to determine the extent of impacted soil.

Building 2786 - had two used oil USTs associated with this building.

- Used oil UST located north of the building was removed in the mid-1990s. At the request of the state, ICI Services obtained soil samples via geoprobe to determine the condition of the soil and attempt to obtain a "No Further Action" letter.
- Used oil UST located west of the building/west of the storage pad was removed in the mid-1990s by H.F. McClure Maintenance. ICI Services was not able to obtain any information regarding the closure of this tank. Therefore, Fort Knox may consider additional data gathering to determine the extent of impacted soil.

Rick L. Tibbitts | Operations Center Manager
ICI Services Corporation | 1332 Woodman Drive | Suite 200 | Dayton, OH 45432
Office: (937) 252-6008 | Mobile: (937) 608-7587

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Subject: FW: (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

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west of where it is indicated, but we need to confirm with the geophysical surveyor. You may need to get these included with your demolition contract. We have the ability to get test pits dug to determine the cause of the anomaly, with authorization by USACE.

Thomas F. Kamphake, AIA, PMP, CBO, LEED AP BD+C

Project Manager, Architect

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www.bargewaggoner.com <blockedhttp://www.bargewaggoner.com/>

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Classification: UNCLASSIFIED
Caveats: NONE

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Geophysical Survey
New Battalion HQ Buildings
Fort Knox, Kentucky

Prepared For:

Barge Waggoner Sumner & Cannon, Inc.

211 Commerce Street, Suite 600
Nashville, Tennessee 37201

Prepared By:

Forrest Environmental Services, Inc.
3057 Crosen Court
Oak Hill, Virginia 20171
(703) 648-9090

August 2011

FES Project No. 11178

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1.0 Introduction

Forrest Environmental Services, Inc. (FES) performed a geophysical survey at the New Battalion HQ Building site located in Fort Knox, Kentucky from 2nd through the 5th August 2011. The investigation consisted of an electromagnetic (EM) survey, a time-domain electromagnetic (TDEM) survey, and a ground penetrating radar (GPR) survey to locate suspected underground storage tanks (USTs) and oil-water separators.

The EM survey was conducted northern section of the property that included the parking lot. Data was collected along linear 10-foot traverses having stations at 5 readings per second using an Archer data logger connected to a GPS within a sub-meter accuracy that covered approximately 12 acres. The northings and eastings values were in UTM feet coordinates. The survey boundaries were selected by a Barge Waggoner Sumner & Cannon, Inc. representative.

The EM, TDEM, and GPR survey was also conducted by reconnaissance at a tighter spacing adjacent to the buildings within the site. The Data was collected along 5-foot lines having stations collected continuously adjacent to the buildings.

Topographically, the site slopes to the west. The site consists of reinforced concrete roads and parking lot with grass areas. Numerous military vehicles were parking in the parking lots during the survey. The site is considered very noisy due the numerous park military vehicles and reinforced concrete parking lots and roads. The geophysical survey did not include areas of parked military vehicles and an overgrown vegetated section between the parking lots. The geophysical survey also did not include areas within the buildings. Areas adjacent or underneath the parked military vehicles could masked the present of USTs. Survey locations and physical features are shown in Figure 1.

Details of the geophysical survey are described in the following sections.

2.0 Equipment and Procedures

EM

The EM survey was performed using an EM-31 induction meter to measure the apparent conductivity of the subsurface. The EM-31 consists of two horizontal coplanar loops, one acting as a transmitter and the other as a receiver. The transmitter induces electrical eddy currents in the earth, which in turn produce a secondary magnetic field. The receiver intercepts the secondary field, and the meter measures the terrain conductivity by comparing the strength of the secondary field to that of the primary field.

The depth of investigation by EM is a function of the intercoil spacing and the orientation of the antenna dipoles. The EM-31 has an intercoil spacing of 12 feet, and used in the vertical dipole mode, has an effective penetration depth of approximately 18 feet.

Two readings were obtained from the EM-31 at each measurement station. The EM was connected to a data logger that simultaneously recorded both the quadrature-phase component and the in-phase component. The quadrature-phase component measures the apparent terrain conductivity of the subsurface, and will detect metallic and nonmetallic objects or features with conductivities that deviate from their surroundings. The background apparent terrain conductivity value at the site was approximately 40 millimhos per meter (mmhos/m).

The in-phase component measurements are proportional to an effective, average magnetic susceptibility of the surrounding earth; this mode is sensitive to large metallic objects. The readings do not indicate true magnetic susceptibility because there is an unknown additive constant and multiplying factor that would be required to convert the measured values to magnetic susceptibility.

Generally, negative EM values can indicate the areal extent of large, shallow buried metal objects. The EM displays moderate-sized metal objects that are buried deep as areas of high conductivity; therefore, both high and negative readings of apparent conductivity can indicate metal. However, high conductivity materials can also be caused by conductive chemical

compounds such as acids, sulfates, fly ash, and salts in the subsurface and by conductive soils such as clay. Low conductivity materials such as wood and oil are generally not detectable by the EM.

Contours of the EM data were generated by computer using Golden Software's SURFER®. Data gridding was performed using 1-foot spacing, and the Kriging algorithm was used for grid interpolation. The contour maps of the data results are discussed in the following section.

TDEM

The EM-61 survey was performed using an EM-61 meter to measure the apparent conductivity of the subsurface. The EM-61 is a high sensitivity, high resolution metal detector that can detect ferrous metallic objects. The EM-61 consists of a powerful transmitter that generates a pulsed primary magnetic field, which induces eddy currents in nearby metallic objects. The decay of these currents is measured by two receiver coils.

The EM-61 consists of a portable, coincident time-domain transmitter and a receiver coil. The transmitter generates electromagnetic pulses 150 times per second, and measures during the off-times between pulses. After each pulse, secondary electromagnetic fields are induced briefly in the moderately conductive earth, and for a longer time for metallic sources. Between each pulse, the EM-61 waits until the response from the earth dissipates, and then measures the prolonged buried response. By sensing only the response from the buried metal, the EM-61 detects metal targets that might otherwise be missed.

The depth of investigation by EM is a function of the intercoil spacing and the orientation of the antenna dipoles. The receiver consists of a main coil and a focusing coil. The EM-61 has an effective penetration depth of approximately 8 feet.

Three readings were obtained from the EM-61 at each measurement station, including the main coil, the focusing coil, and the difference in measurement (gradient) between the coils. This difference can be used to calculate the depth of a metal body. The EM-61 was connected

to a data logger that simultaneously records both the upper and lower receiver coils and the difference measurements.

Ground Penetrating Radar Survey

The GPR survey was performed using a Noggin Smart Cart with a shielded 250 megahertz (MHz) antenna. GPR is an EM method that detects interfaces between subsurface materials with contrasting dielectric constants. The GPR system consists of an antenna that consists of a transmitter and receiver that were connected to a computer that processes the received signal and locates the position of data collection.

The transmitter radiates repetitive short-duration EM waves into the earth from the antenna as it is moved across the ground surface. These radar waves are reflected back to the receiver by interfaces between materials with different dielectric constants. The intensity of the reflected signal is a function of the dielectric constant contrast at the interface, the conductivity of the material the wave is traveling through, and the frequency of the signal. Subsurface features that cause reflections are: 1) natural geologic conditions such as changes in sediment composition, bedding and cementation horizons, voids, and water content and 2) fill materials or changes in the subsurface such as soil backfill, buried debris, USTs, pipelines, and utilities. The controlling unit receives the signal from the antenna and produces a continuous cross-section of the subsurface interface reflections.

Depth of GPR signals is highly site-specific and is limited by signal attenuation or absorption of the subsurface. Signal attenuation is dependent on the electrical conductivity of subsurface materials. Signal attenuation is greatest in materials with high conductivity, such as clays or brackish groundwater, and lowest in low conductivity material, such as unsaturated sands or rock. GPR depth penetration is dependent on antenna frequency. Depth penetration increases with decreasing frequency; however, identification diminishes proportionally with smaller features. The depth penetration of this GPR survey was approximately 2.5 meters (8 feet) below surface.

The GPR survey used a 250 MHz antenna that was internally shielded from above ground and adjacent anthropogenic sources. The GPR survey was performed by a project geophysicist

pulling the antenna adjacent to the vents. The location of the antenna along the transects lines were marked electronically from a survey wheel. Recorded data were collected at 0.1-foot intervals and stored on the laptop computer.

The GPR data were converted into a GPR depth model using Sensor's and Software pulse EKKO software. The GPR data was gained, migrated, and a low frequency response filter was included to the raw data.

3.0 Survey Results and Conclusions

The objective of the geophysical survey was to determine the presence of suspected USTs and other buried metal and non-metal objects.

The EM apparent terrain conductivity contour map (Figure 2) exhibited five anomalies that are not from surface anthropogenic interferences such as reinforced concrete and fences. The EM average magnetic susceptibility contour map (Figure 3) confirms the presence of the anomalies of Figure 2.

One negative anomaly is centered at 1941980 feet East 13769300 feet North. The Anomaly A appears to be from surface anthropogenic interferences such as reinforced concrete and a fence.

One negative anomaly is centered at 1942180 feet East 13769500 feet North. The Anomaly B appears to be from surface anthropogenic interferences such as reinforced concrete and the building.

The mostly linear negative anomalies such as the anomaly centered at 1942050 feet East 13769450 feet North. The Anomaly C appears to be from reinforced concrete and an underground utility such as a sewer line.

One high linear northwest-southeast anomaly is centered at 1941640 feet East 1377000 feet North. The Anomaly D appears to be from the fence.

One negative anomaly is centered at 1942320 feet East 13769380 feet North. The Anomaly E appears to be to be a large mass of buried metal such as an oil water separator.

One negative anomaly is centered at 1942660 feet East 13769430 feet North. The Anomaly F appears to be to be a large mass of buried metal such as an oil water separator.

Two negative anomalies centered at 1942340 feet East 13769480 feet North. Anomalies G appear to be to be large masses of buried metal such as buried USTs.

One negative anomaly is centered at 1942500 feet East 13769540 feet North. The Anomaly H appears to be to be a large mass of buried metal such as a UST.

The EM, TDEM, and GPR survey also included a tighter grid adjacent to the buildings by reconnaissance.

GPR Line 1 was conducted at Anomaly H north of Building 2789 (Figure 1). GPR Line 1 indicates one anomaly centered at approximately 4 feet East about 2 feet below ground surface (Figure 4). The TDEM survey indicates the anomaly is metal. The anomaly appears to be a large mass of metal such as a UST.

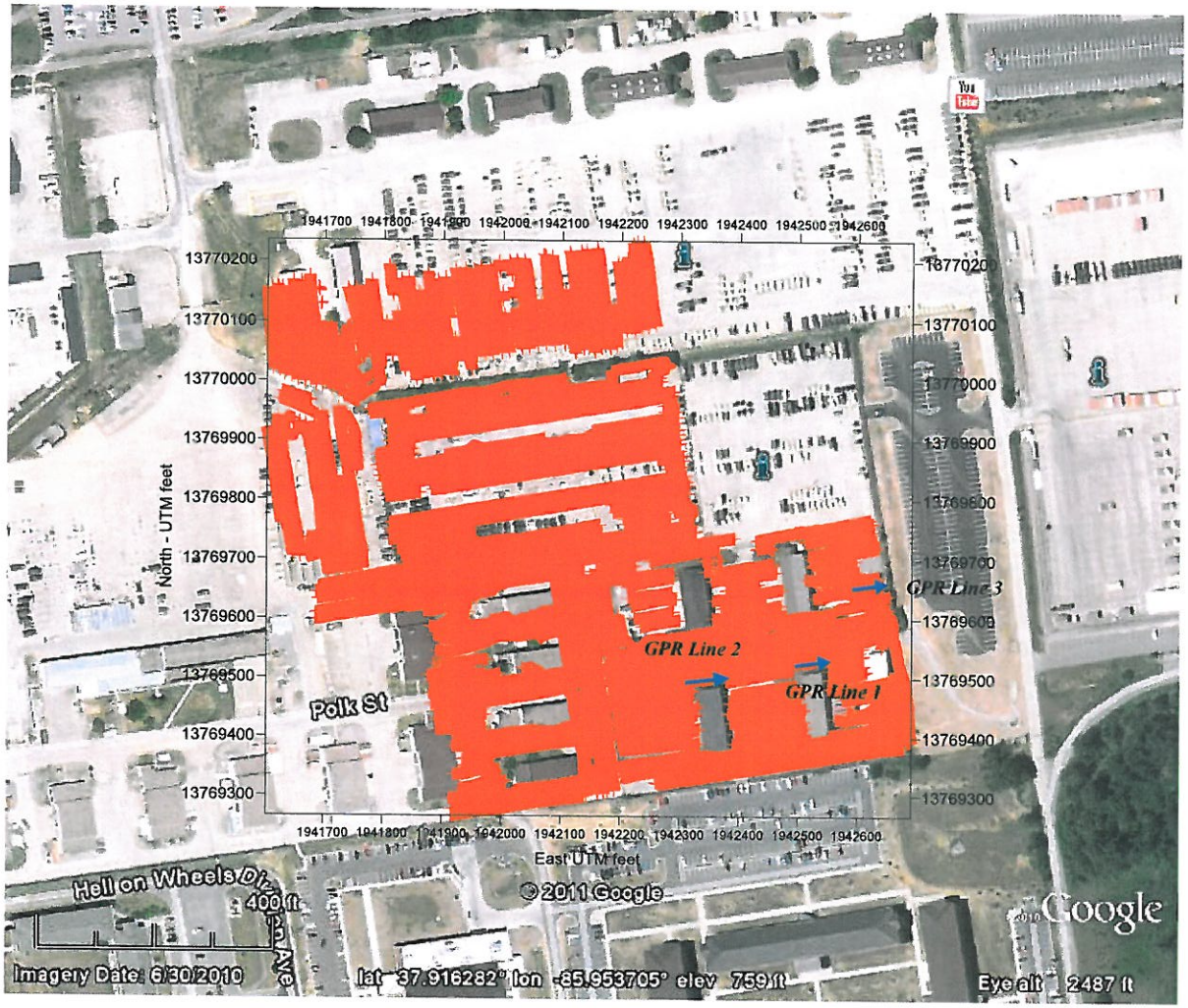
GPR Line 2 was conducted at Anomaly G north of Building 2786 (Figure 1). GPR Line 2 indicates two anomalies centered at approximately 9 feet East and 31 feet East about 2 feet below ground surface (Figure 5). The TDEM survey indicates the anomaly is metal. The anomaly appears a large mass of metal such as USTs.

GPR Line 3 was conducted east of Building 2788 (Figure 1). GPR Line 3 indicates one anomaly centered at approximately 10 feet East about 5 feet below ground surface (Figure 6). The anomaly at appears to be an excavation such as a former UST pit.

The geophysical survey indicated five anomalies (E through H) that appears to be a large mass of buried metal (Figure 7) that is not from surface anthropogenic interferences such as military vehicles. Anomaly E that is located southwest of Building 2786 appears to be a large mass of buried metal such as oil/water separator. Anomaly F that is located southeast of Building 2789 appears to be a large mass of buried metal such as oil/water separator. Anomalies G that is located north of Building 2786 appears to be a large mass of buried metal such as USTs. Anomalies H that is located north of Building 2786 appears to be a large mass of buried metal such as a UST. The anomalies G and H were painted in the field by orange paint and orange pin flags.

The geophysical survey indicated one anomaly east of Building 2788. The anomaly appears to be a former UST pit. (Figure 7). The anomaly was marked in the field by orange paint.

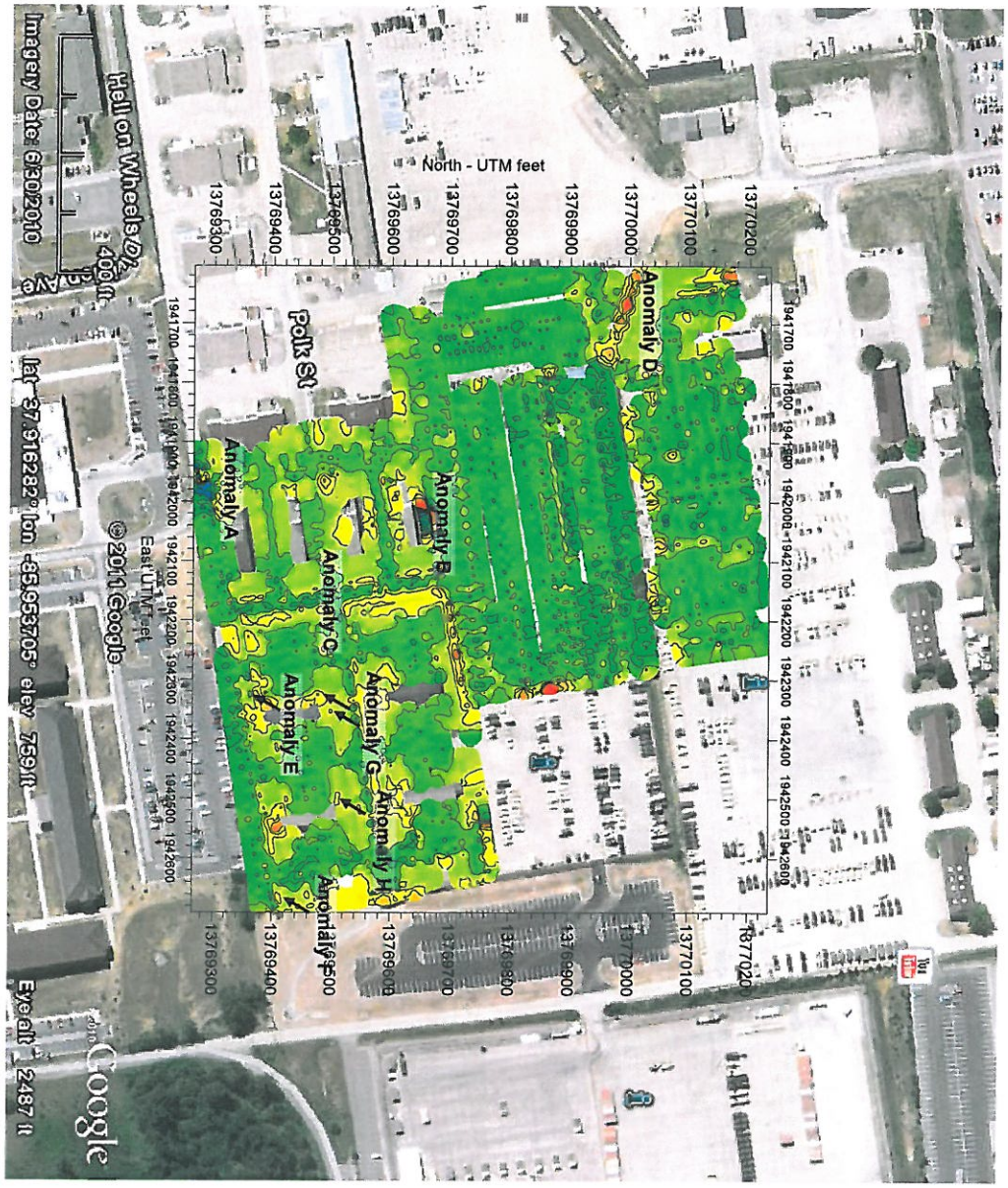
The geophysical survey in areas of surface anthropogenic interferences such as military vehicles were inconclusive that included northern section of buildings 2787 and 2788 and at the parking lots. The anthropogenic interferences will mask subsurface burial because of the surface metal.



Legend

- *GPR Line*
- *Geophysical Survey Area*

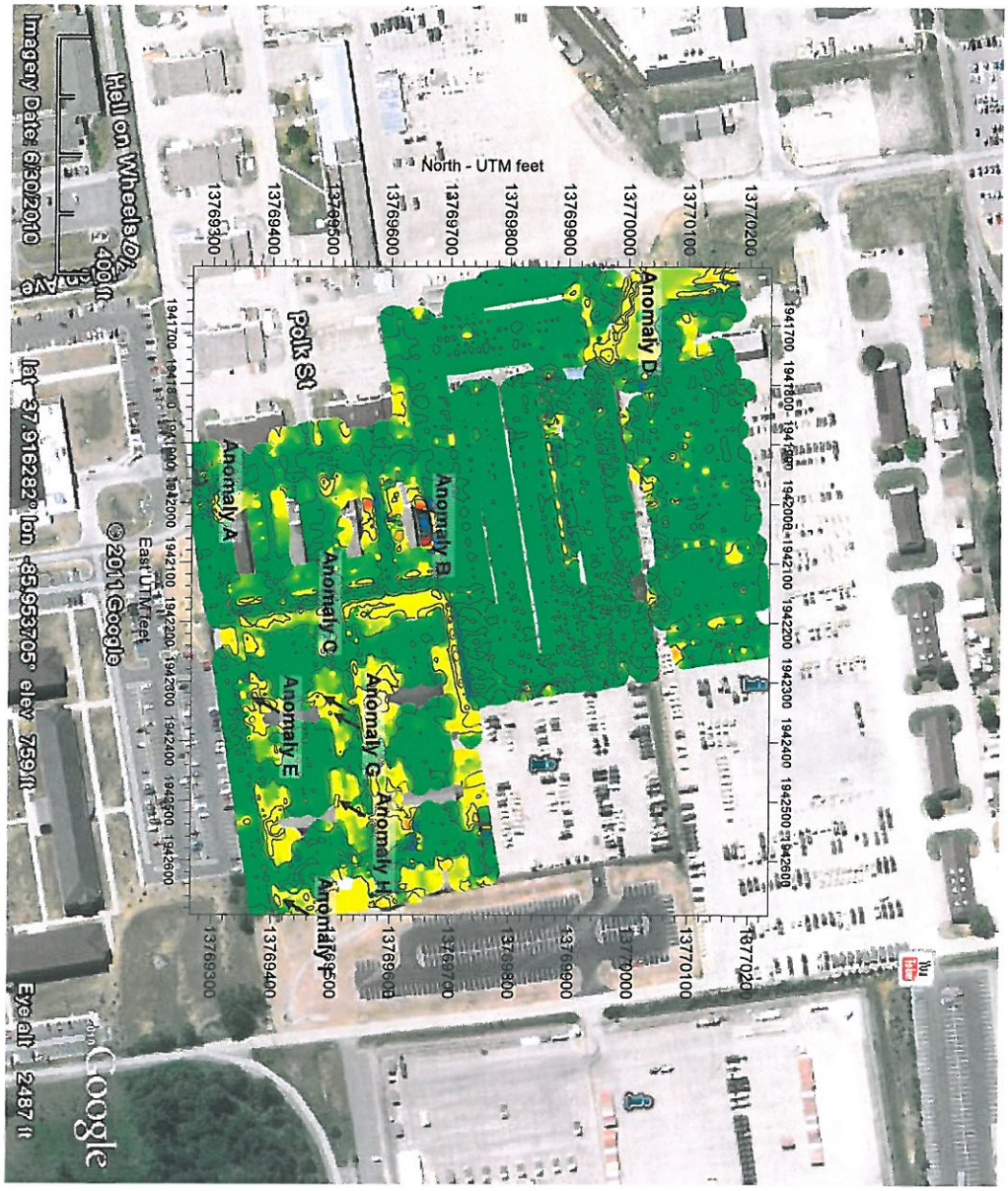
Forrest Environmental Services, Inc. Oak Hill, Virginia (703) 648-9090 www.fesinc.net	DATE: August 2011	SCALE: 1 inch ~ 200 feet	TITLE: ***Geophysical Site Map New Battalion HQ Building Fort Knox, Kentucky***
	DRAWN BY:	APPROVED BY:	
	JOB NO.: 11178	DWG. NO./ REV. NO.: BWSCFtKnoxF1	CLIENT: Barge Waggoner Sumner & Cannon, Inc.
			FIGURE: 1

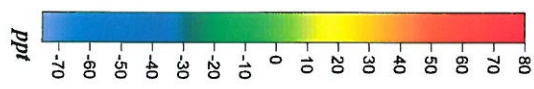


Forrest Environmental Services, Inc.
Oak Hill, Virginia
(703) 648-9090
www.fesinc.net

DATE	August 2011
DRAWN BY	
SCALE	1 inch = 200 feet
APPROVED BY	
JOB NO.	11178
DWG NO./REV. NO.	BWSCFtKnoxF2
CLIENT	Burge Waggoner Sumner & Cannon, Inc.
FIGURE	2

TITLE
Apparent Conductivity Contour Map
New Battalion HQ Building
Fort Knox, Kentucky

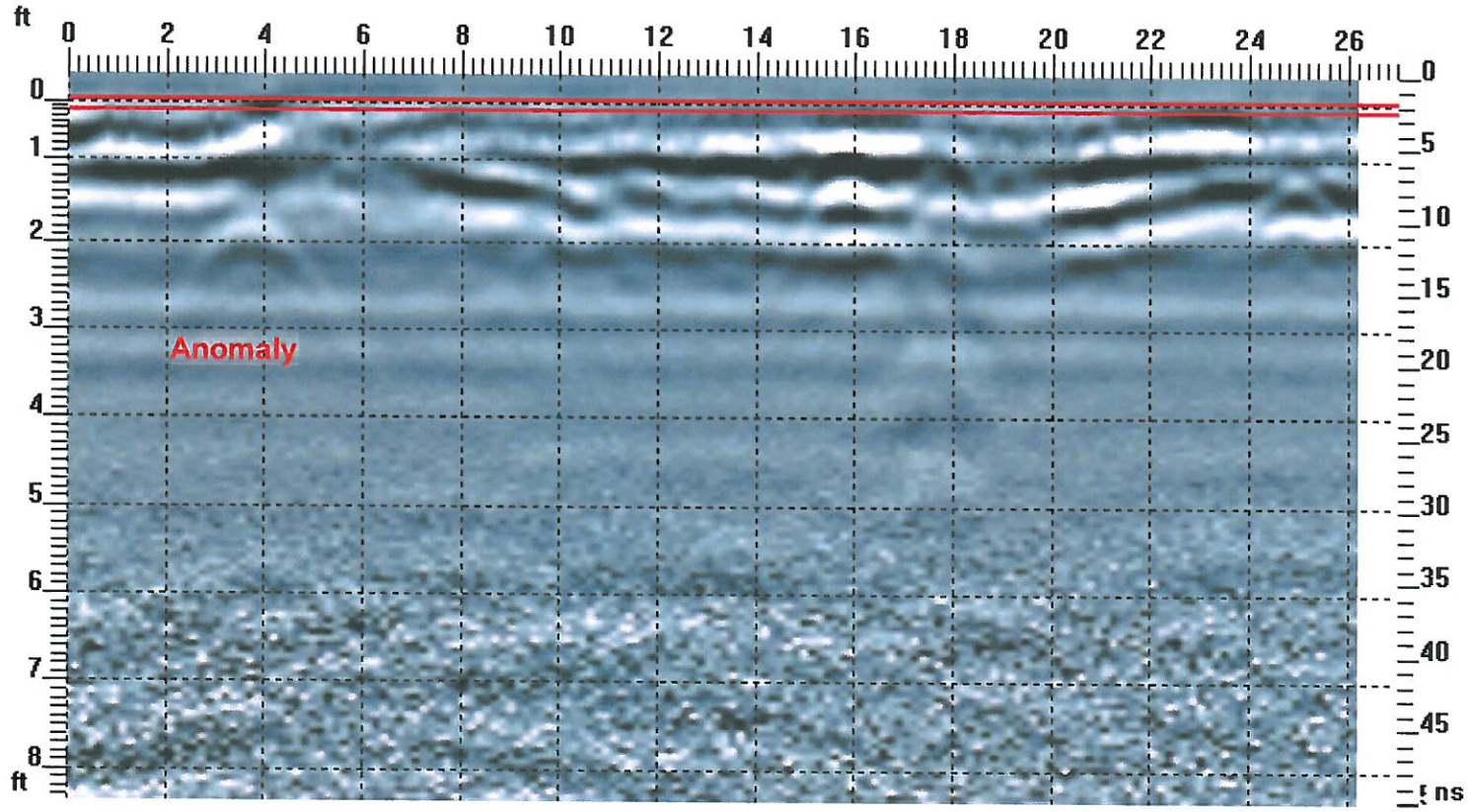




Forrest Environmental Services, Inc.
Oak Hill, Virginia
(703) 648-9090
www.fesinc.net

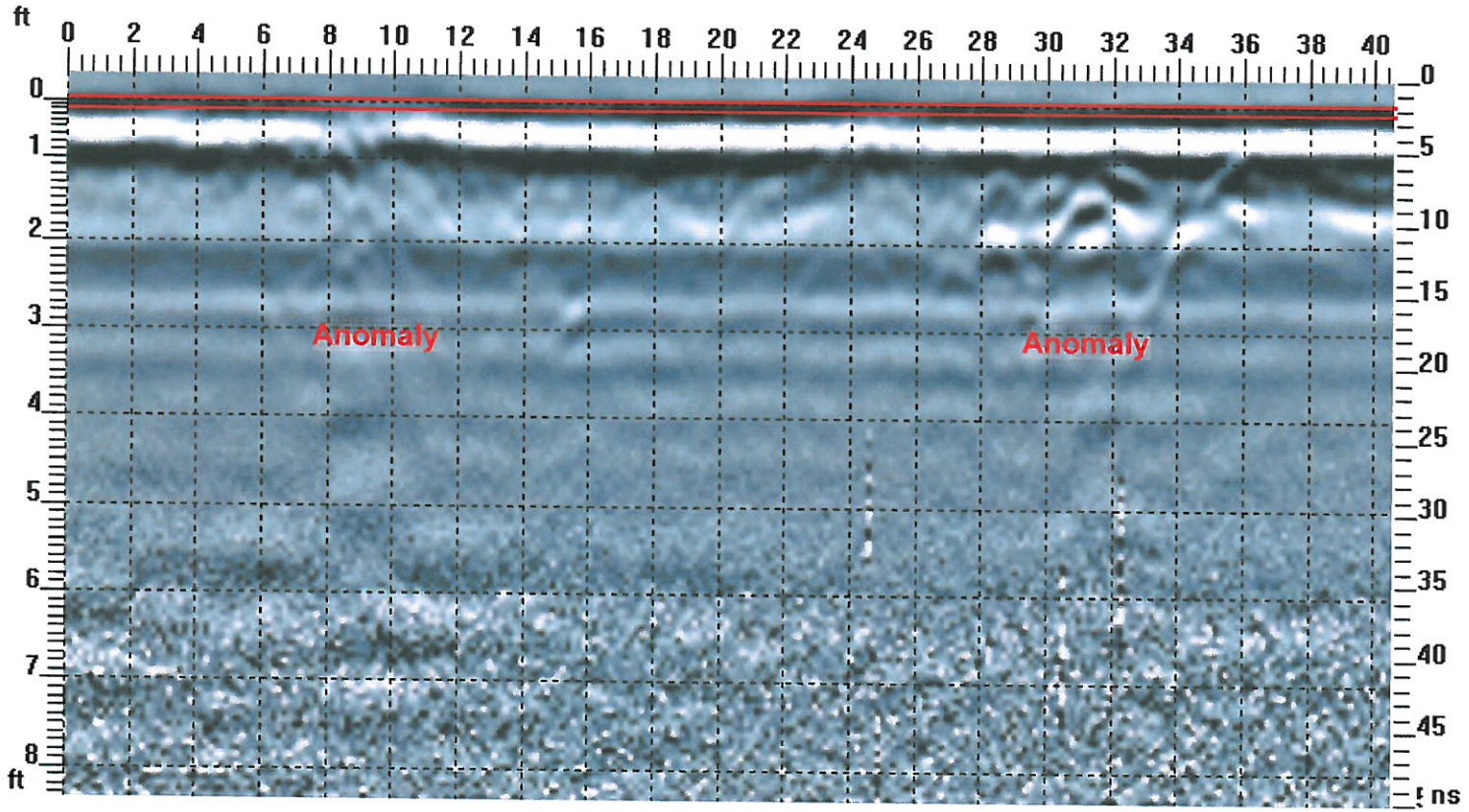
DATE	August 2011
DRAWN BY	
SCALE	1 inch = 200 feet
APPROVED BY	
JOB NO.	11178
DWG. NO / REV. NO.	BWSCRKnoxF3
CLIENT	Barge Waggoner Sumner & Cannon, Inc.
FIGURE	3

TITLE
Average Magnetic Susceptibility Map
New Battalion HQ Building
Fort Knox, Kentucky



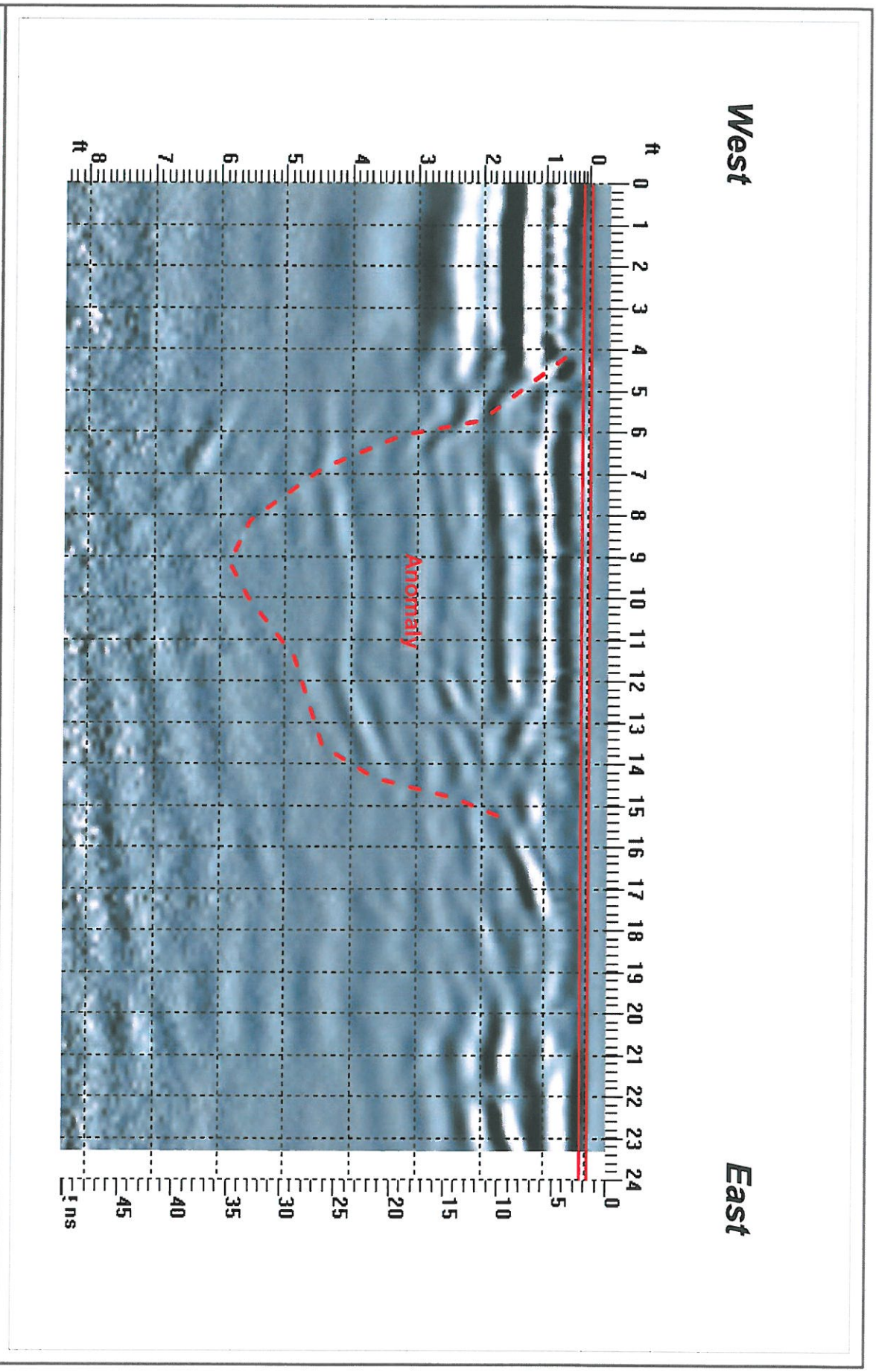
Forrest Environmental Services, Inc.
Oak Hill, Virginia
(703) 648-9090
www.fesinc.net

DATE: August 2011	SCALE: shown	TITLE: *GPR Line 1 - Building 2789* *New Battalion HQ Building* *Fort Knox, Kentucky*	
DRAWN BY:	APPROVED BY:		
JOB NO: 11178	DWG NUMBER NO: BWSCFtKF4	CLIENT: Barge Waggoner Sumner & Cannon, Inc.	FIGURE: 4



Forrest Environmental Services, Inc.
Oak Hill, Virginia
(703) 648-9090
www.fesinc.net

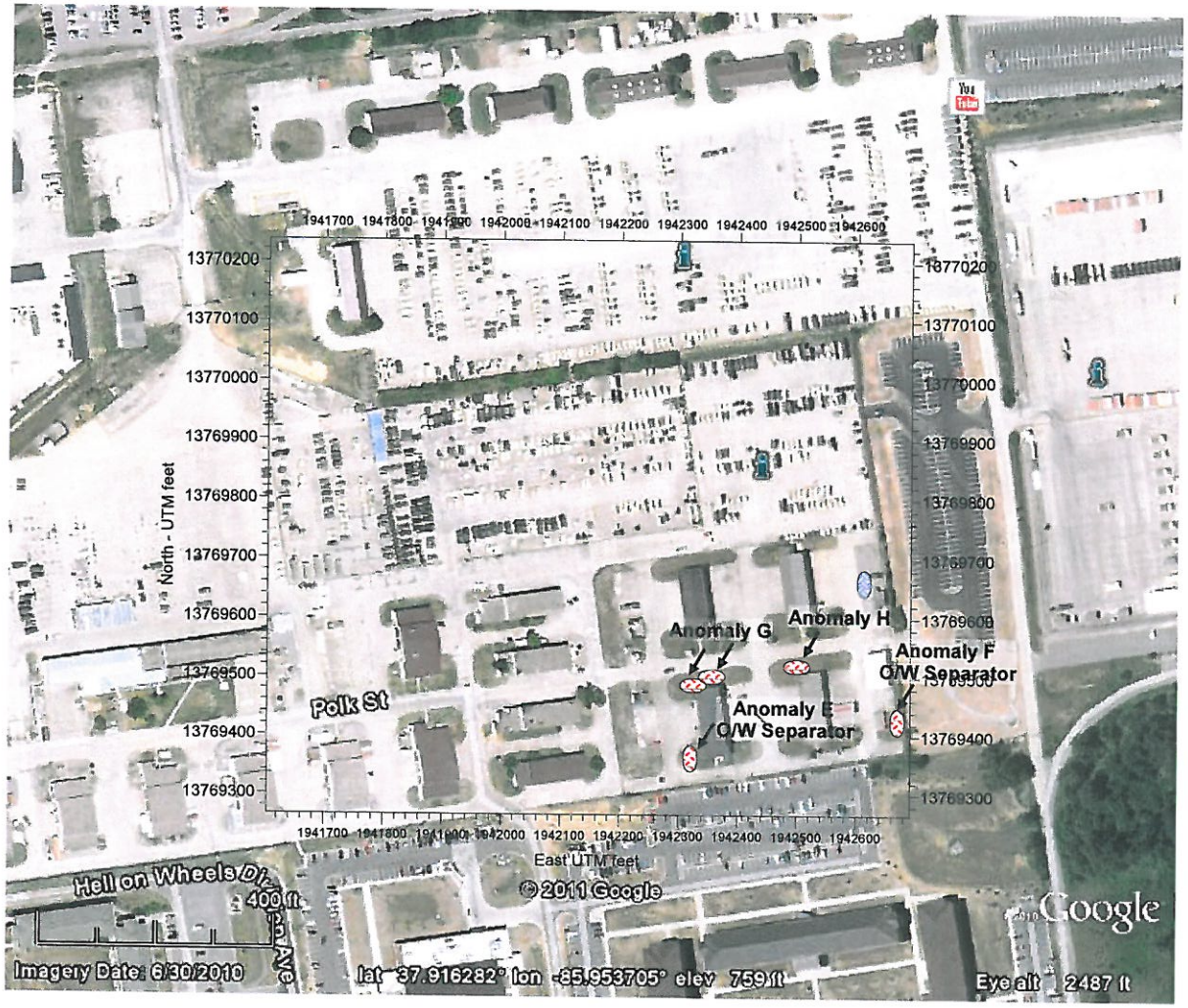
DATE: August 2011	SCALE: shown	TITLE: *GPR Line 2 - Building 2786 New Battalion HQ Building Fort Knox, Kentucky*	
DRAWN BY:	APPROVED BY:		
JOB NO: 11178	DATA SOURCE NO: BWSCFtKF5	CLIENT: Barge Waggoner Sumner & Cannon, Inc.	SHEET: 5



Forest Environmental Services, Inc.

Oak Hill, Virginia
(703) 648-9090
www.fesinc.net

DATE: August 2011	SCALE: shown	TITLE: GPR Line 3 - Building 2788 New Battalion HQ Building Fort Knox, Kentucky	
PROJECT NO.: 11178	DRAWING NO.: BWSCFtKF6	CLIENT: Barge Waggoner Sumner & Cannon, Inc.	VOLUME: 6



Legend

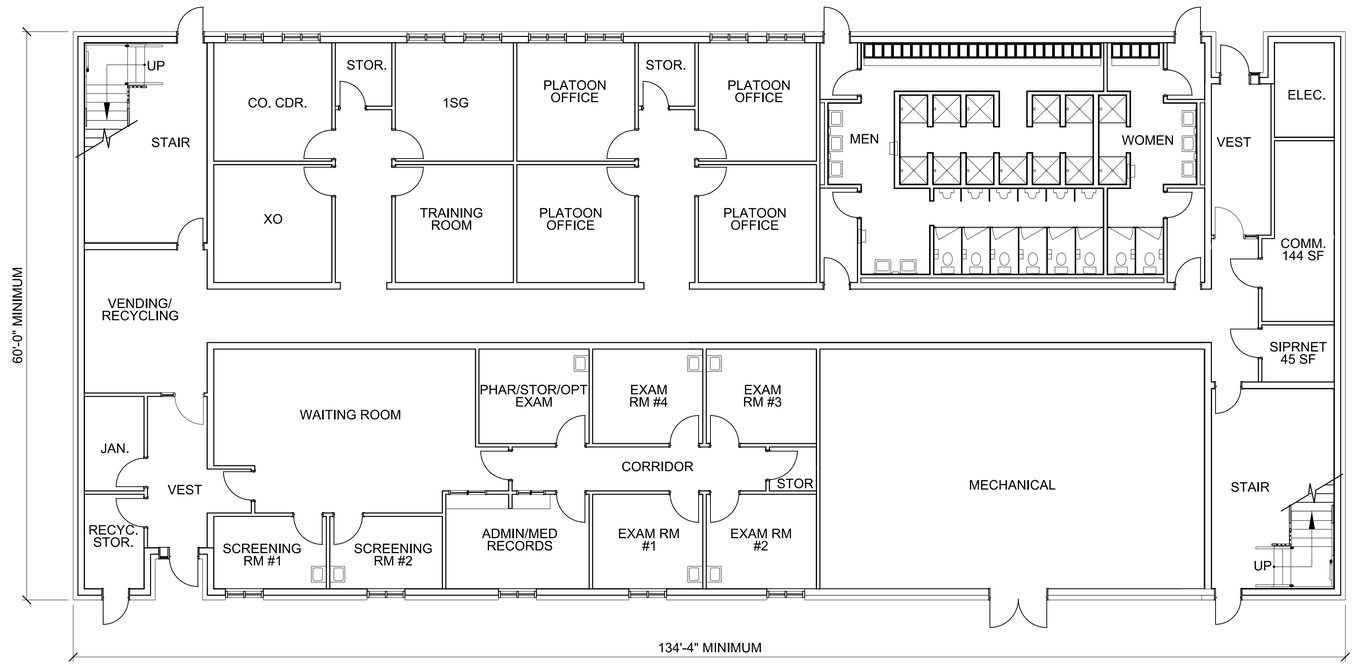
- *Former UST Pit*
- *Buried Metal*

Forrest Environmental Services, Inc. Oak Hill, Virginia (703) 648-9090 www.fesinc.net	DATE: August 2011	SCALE: 1 inch ~ 200 feet	TITLE: ***Geophysical Anomaly Map New Battalion HQ Building Fort Knox, Kentucky***
	DRAWN BY	APPROVED BY	
	JOB NO.: 11178	DWG. NO./ REV. NO.: BWSCFtKnoxF7	CLIENT: Barge Waggoner Sumner & Cannon, Inc.
			FIGURE: 7

APPENDIX D

NOT USED

APPENDIX EE
Building Layouts



COF ADMIN - FIRST FLOOR PLAN

SCALE: 1/8"=1'-0"

FIRST FLOOR	8060 GSF MINIMUM
SECOND FLOOR	8060 GSF MINIMUM
TOTAL SF SHOWN	16120 GSF MINIMUM
MAXIMUM ALLOWABLE GROSS AREA	16442 GSF

FLOOR PLAN INDICATES THE ARMY STANDARD SOLUTION IN SCHEMATIC FORM. THE DESIGNER-OF-RECORD IS ALLOWED TO MAKE ADJUSTMENTS FOR EXTERIOR FACADE/ARCHITECTURAL THEME, AND/OR TO ACCOMMODATE SPECIFIC BUILDING ENGINEERING SYSTEMS (STRUCTURAL, MECHANICAL, ELECTRICAL, FIRE PROTECTION, AND SUSTAINABLE DESIGN). THESE ADJUSTMENTS WILL BE EVALUATED BY THE CENTER OF STANDARDIZATION (COS) DURING ITS COMPLIANCE REVIEW. INNOVATIVE, COST SAVING SOLUTIONS WILL BE GIVEN PROPER CONSIDERATION BY THE COS, AND WILL BE ADOPTED AS APPROPRIATE.

AREAS SHOWN ON THE FLOOR PLAN ARE TO BE CONSIDERED NET PROGRAM REQUIREMENTS. THE MAXIMUM ALLOWABLE GROSS BUILDING AREA IS THE MAXIMUM GROSS SPACE PERMISSIBLE FOR THE FACILITY. A REDUCED OVERALL GROSS AREA IS ACCEPTABLE IF ALL NET PROGRAM REQUIREMENTS AND ADJACENCIES ARE MET.

PLAN N

0 2' 4' 8' 16'

SCALE: 1/8" = 1'-0"

01

US Army Corps of Engineers
Louisville District

MARK	DESCRIPTION	DATE	APPR.

MARK	DESCRIPTION	DATE	APPR.

DESIGNED BY: XXX
DWN BY: XXX
CKD BY: XXX
SUBMITTED BY: BWSC
PLOT SCALE: AS NOTED
SIZE: ANSI D
DATE: APRIL 11, 2012
SOLICITATION NO.: W912QR-12-R-0030
CONTRACT NO.:
FILE NUMBER:
PLOT DATE: 04/11/2012
FILE NAME: EBC_CADM_A-101.dgn

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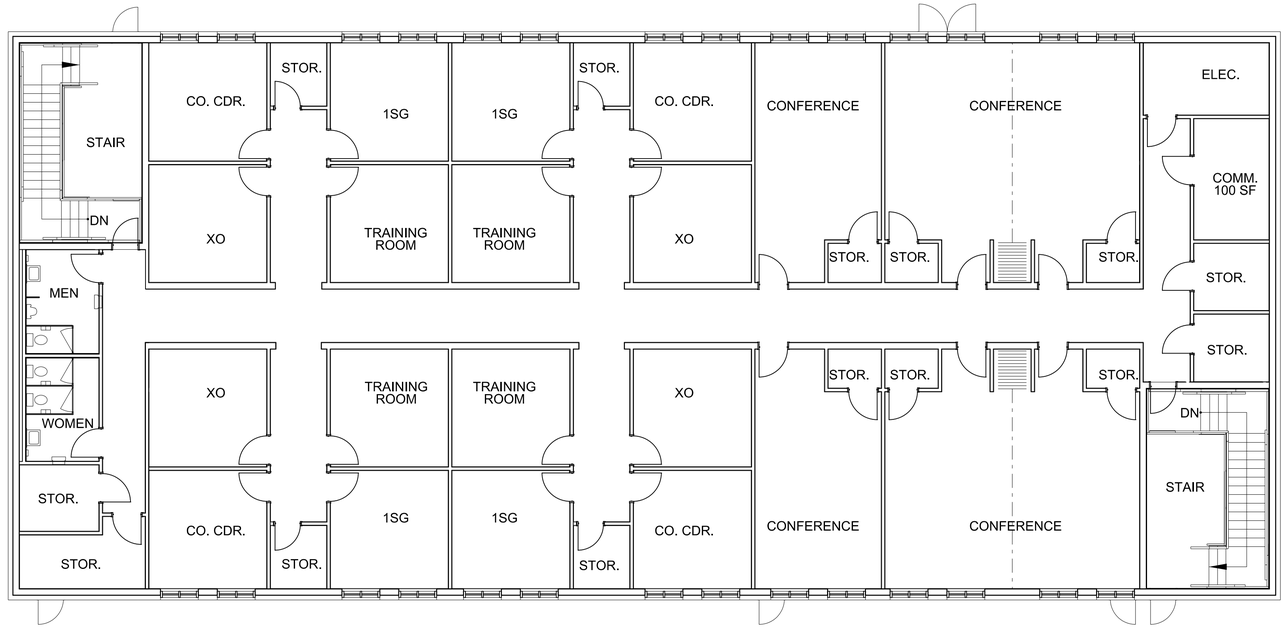
LOUISVILLE DISTRICT
LOUISVILLE, KENTUCKY

BWSC
BAKER, WARMBRODT, SCHNEIDER & CHRISTIAN, INC.

FY2012, P/N 65233
19th ENGINEERING BATTALION COMPLEX
FT. KNOX, KENTUCKY

COF ADMIN.
FIRST FLOOR PLAN

SHEET IDENTIFICATION
A-101
SHEET X OF 71



COF ADMIN - SECOND FLOOR PLAN

SCALE: 1/8"=1'-0"

FLOOR PLAN INDICATES THE ARMY STANDARD SOLUTION IN SCHEMATIC FORM. THE DESIGNER-OF-RECORD IS ALLOWED TO MAKE ADJUSTMENTS FOR EXTERIOR FACADE/ARCHITECTURAL THEME, AND/OR TO ACCOMMODATE SPECIFIC BUILDING ENGINEERING SYSTEMS (STRUCTURAL, MECHANICAL, ELECTRICAL, FIRE PROTECTION, AND SUSTAINABLE DESIGN). THESE ADJUSTMENTS WILL BE EVALUATED BY THE CENTER OF STANDARDIZATION (COS) DURING ITS COMPLIANCE REVIEW. INNOVATIVE, COST SAVING SOLUTIONS WILL BE GIVEN PROPER CONSIDERATION BY THE COS, AND WILL BE ADOPTED AS APPROPRIATE.

AREAS SHOWN ON THE FLOOR PLAN ARE TO BE CONSIDERED NET PROGRAM REQUIREMENTS. THE MAXIMUM ALLOWABLE GROSS BUILDING AREA IS THE MAXIMUM GROSS SPACE PERMISSIBLE FOR THE FACILITY. A REDUCED OVERALL GROSS AREA IS ACCEPTABLE IF ALL NET PROGRAM REQUIREMENTS AND ADJACENCIES ARE MET.

PLAN N

COF ADMIN. - SECOND FLOOR PLAN

0 2' 4' 8' 16'

SCALE: 1/8" = 1'-0"

01

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Louisville District

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CKD BY: XXX
SUBMITTED BY: BWSC
DATE: APRIL 11, 2012
SOLICITATION NO.: W912QR-12-R-0030
CONTRACT NO.:
FILE NUMBER:
PLOT SCALE: 1=1'-0"
PLOT DATE: 4/11/2012
ADOPTED SIZE: ANSI D
FILE NAME: E6C_CADM_A-102.dgn

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COF ADMIN.
SECOND FLOOR PLAN

SHEET IDENTIFICATION
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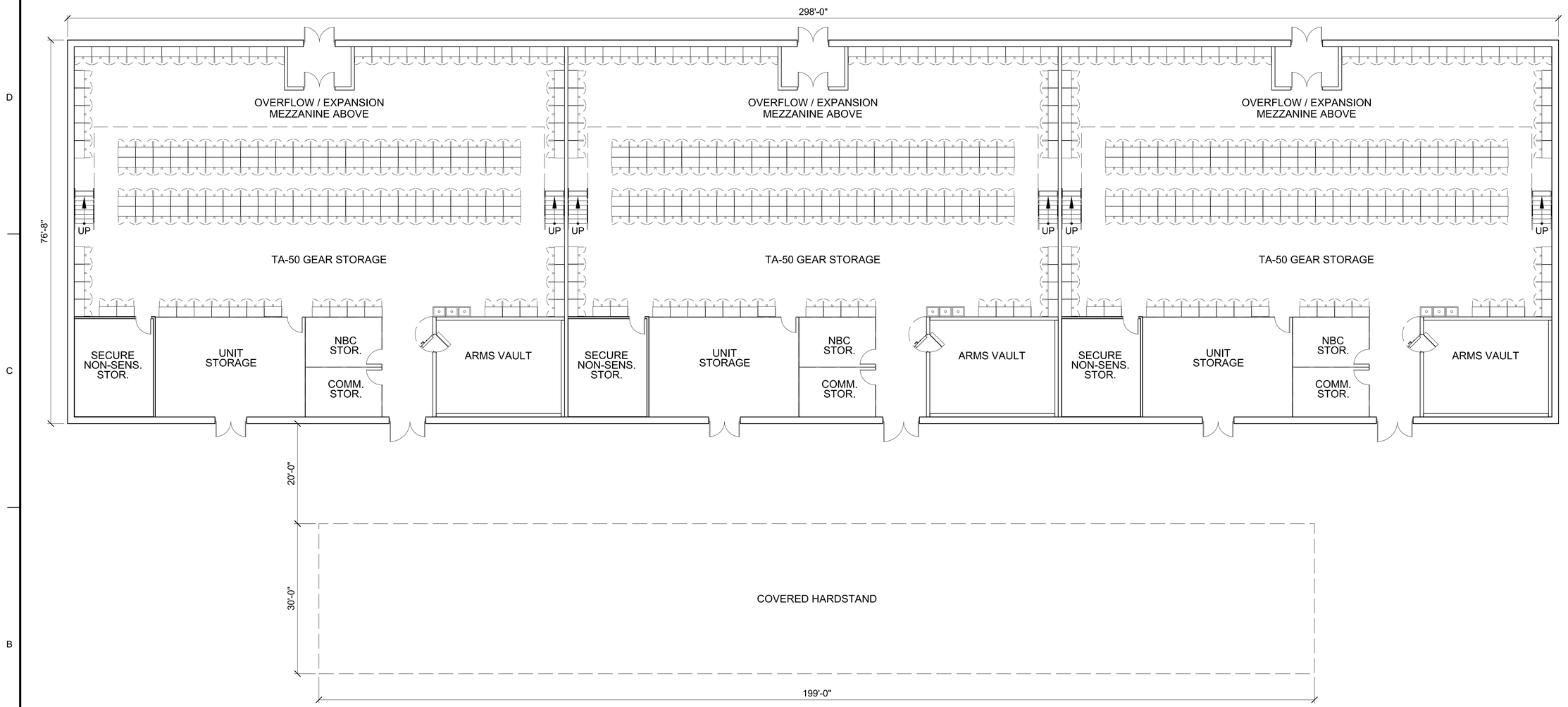
SHEET X OF 71



COF - FIRST FLOOR PLAN

SCALE: 1/8"=1'-0"

FIRST FLOOR	22847 GSF MINIMUM
SECOND FLOOR	5165 GSF MINIMUM
TOTAL SF SHOWN	28012 GSF MINIMUM
MINIMUM ALLOWABLE GROSS AREA (SUM OF MOD 1 + MOD 2)	52389 GSF MINIMUM
MAXIMUM ALLOWABLE GROSS AREA (SUM OF MOD 1 + MOD 2)	53756 GSF MAXIMUM

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PLAN N

0 2' 4' 8' 16' SCALE: 3/32" = 1'-0"

COF MOD 1 - FIRST FLOOR PLAN

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PLOT SCALE: AS NOTED
PLOT DATE: 04/11/2012
SIZE: ANSI D
FILE NAME: EBC_COF1_A-101.dgn
DATE: APRIL 11, 2012
SOLICITATION NO.: W912QR-12-R-0030
CONTRACT NO.:
FILE NUMBER: -

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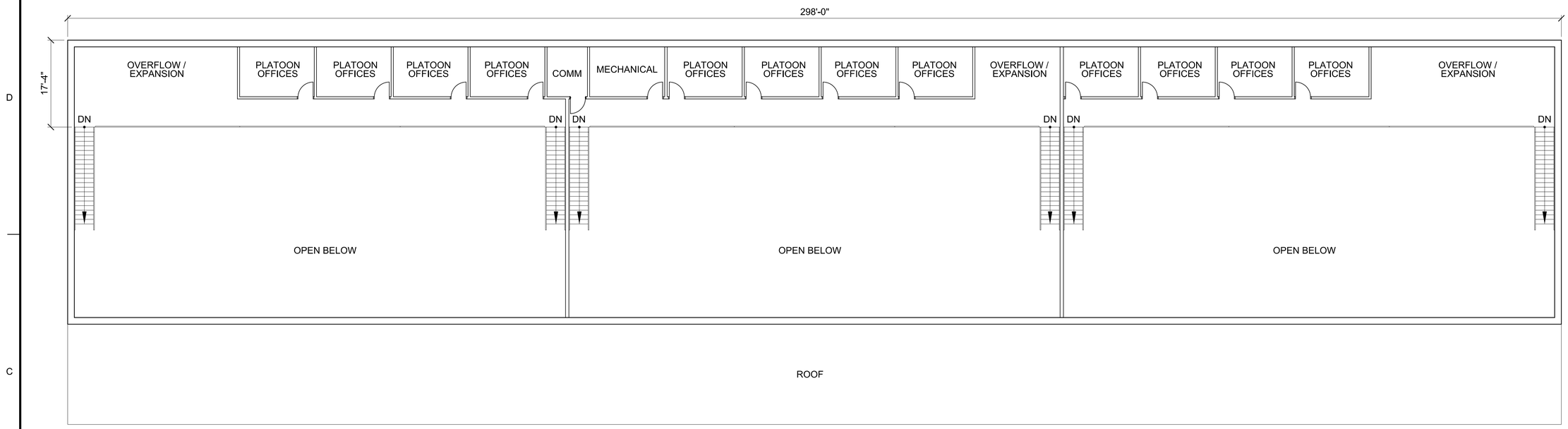
COF MOD 1
FIRST FLOOR PLAN

SHEET IDENTIFICATION
A-101
SHEET X OF 71



COF - SECOND FLOOR PLAN

SCALE: 1/8"=1'-0"

FLOOR PLAN INDICATES THE ARMY STANDARD SOLUTION IN SCHEMATIC FORM. THE DESIGNER-OF-RECORD IS ALLOWED TO MAKE ADJUSTMENTS FOR EXTERIOR FACADE/ARCHITECTURAL THEME, AND/OR TO ACCOMMODATE SPECIFIC BUILDING ENGINEERING SYSTEMS (STRUCTURAL, MECHANICAL, ELECTRICAL, FIRE PROTECTION, AND SUSTAINABLE DESIGN). THESE ADJUSTMENTS WILL BE EVALUATED BY THE CENTER OF STANDARDIZATION (COS) DURING ITS COMPLIANCE REVIEW. INNOVATIVE, COST SAVING SOLUTIONS WILL BE GIVEN PROPER CONSIDERATION BY THE COS, AND WILL BE ADOPTED AS APPROPRIATE.

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PLAN N

0 2' 4' 8' 16'

SCALE: 3/32" = 1'-0"

COF MOD 1 - SECOND FLOOR PLAN

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SOLICITATION NO.: W912QR-12-R-0030
CONTRACT NO.:
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COF MOD 1
SECOND FLOOR PLAN

SHEET IDENTIFICATION
A-102
SHEET X OF 71

COF - FIRST FLOOR PLAN

SCALE: 1/8"=1'-0"

FIRST FLOOR	19882 GSF MINIMUM
SECOND FLOOR	4495 GSF MINIMUM
TOTAL SF SHOWN	24377 GSF MINIMUM
MINIMUM ALLOWABLE GROSS AREA (SUM OF MOD 1 + MOD 2)	52389 GSF MINIMUM
MAXIMUM ALLOWABLE GROSS AREA (SUM OF MOD 1 + MOD 2)	53756 GSF MAXIMUM

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PLAN N

COF MOD 2 - FIRST FLOOR PLAN

0 2' 4' 8' 16' SCALE: 3/32" = 1'-0" 01

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DESIGNED BY: XXX
DWN BY: XXX
CKD BY: XXX
SUBMITTED BY: BWSC
PLOT SCALE: AS NOTED
PLOT DATE: 04/11/2012
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FILE NAME: EBC_COF2_A-101.dgn
DATE: APRIL 11, 2012
SOLICITATION NO.: W912QR-12-R-0030
CONTRACT NO.:
FILE NUMBER: -

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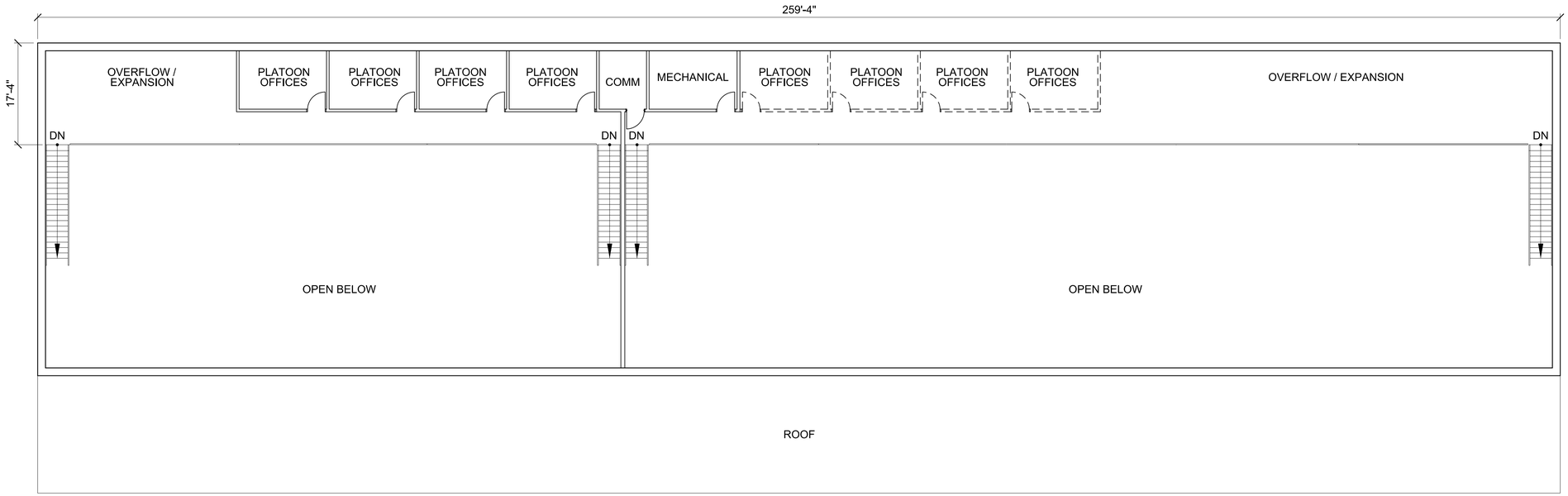
FT. KNOX, KENTUCKY

COF MOD 2
FIRST FLOOR PLAN

SHEET IDENTIFICATION
A-101
SHEET X OF 71



COF - FIRST FLOOR PLAN

SCALE: 1/8"=1'-0"

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PLAN N

COF MOD 2 - SECOND FLOOR PLAN

0 2' 4' 8' 16' SCALE: 3/32" = 1'-0"

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SOLICITATION NO.: W912QR-12-R-0030
CONTRACT NO.:
FILE NUMBER: -

FY2012, PN 65293
19th ENGINEERING BATTALION COMPLEX
FT. KNOX, KENTUCKY

COF MOD 2
SECOND FLOOR PLAN

SHEET IDENTIFICATION
A-102
SHEET X OF 71

EXTRA LARGE BATTALION FIRST FLOOR PLAN

SCALE: 1/8"=1'-0"

FIRST FLOOR	11972 GSF MINIMUM
CLASSROOM AREA	4300 GSF MINIMUM
SECOND FLOOR	7725 GSF MINIMUM
TOTAL SF SHOWN	19697 GSF MINIMUM
MAXIMUM ALLOWABLE GROSS AREA	20100 GSF

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CONTRACT NO.:
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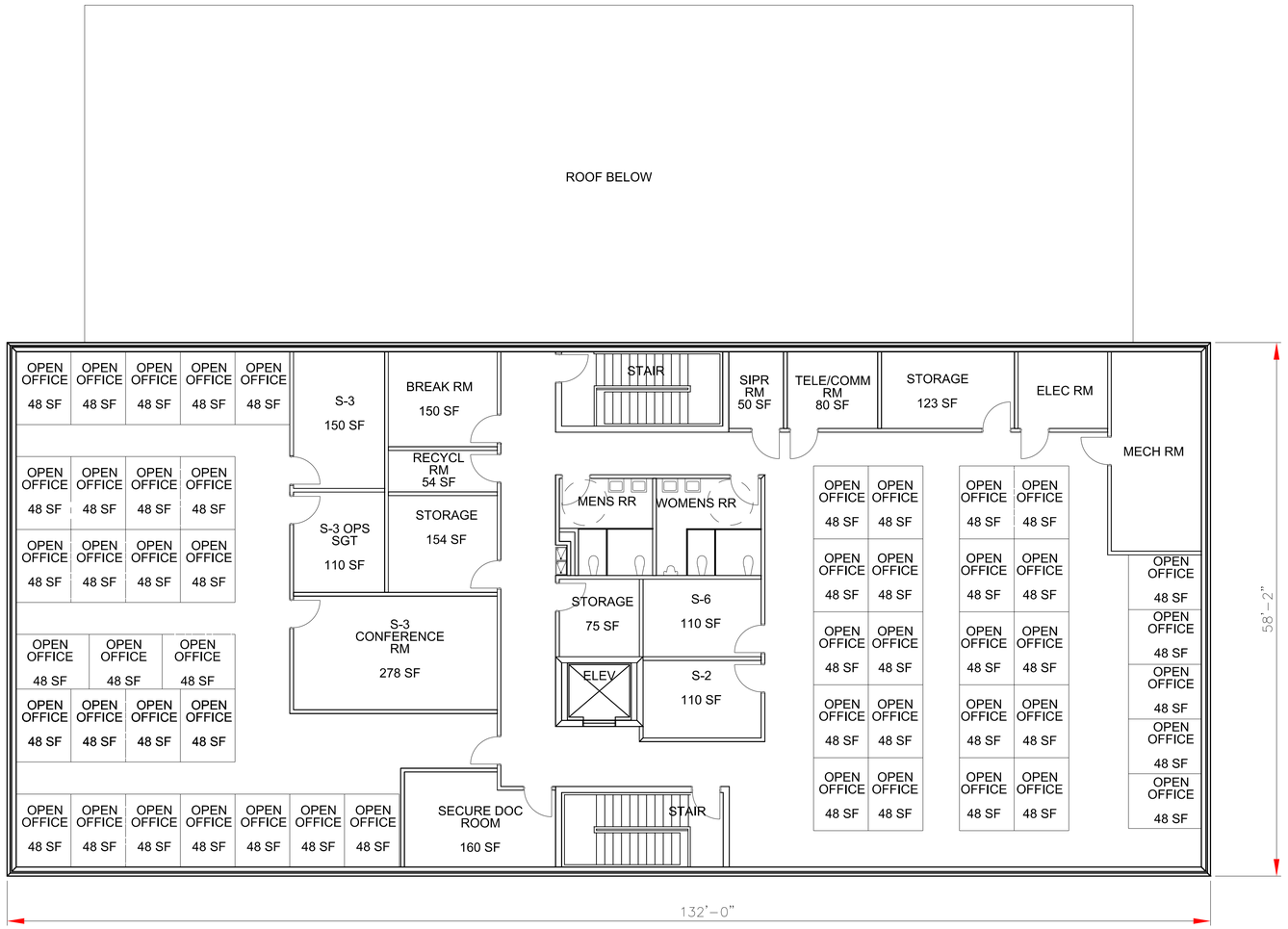
BATTALION HEADQUARTERS
FIRST FLOOR PLAN

SHEET IDENTIFICATION
A-101

BATTALION HEADQUARTERS - FIRST FLOOR PLAN

SCALE: 1/8" = 1'-0"
01



EXTRA LARGE BATTALION SECOND FLOOR PLAN

SCALE: 1/8"=1'-0"

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BWSC Brandt Williamson Slusher & Schmitz, Inc.

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BATTALION HEADQUARTERS
SECOND FLOOR PLAN

SHEET IDENTIFICATION
A-102
SHEET X OF 71

BATTALION HEADQUARTERS - SECOND FLOOR PLAN

0 2' 4' 8' 16'
SCALE: 1/8" = 1'-0"
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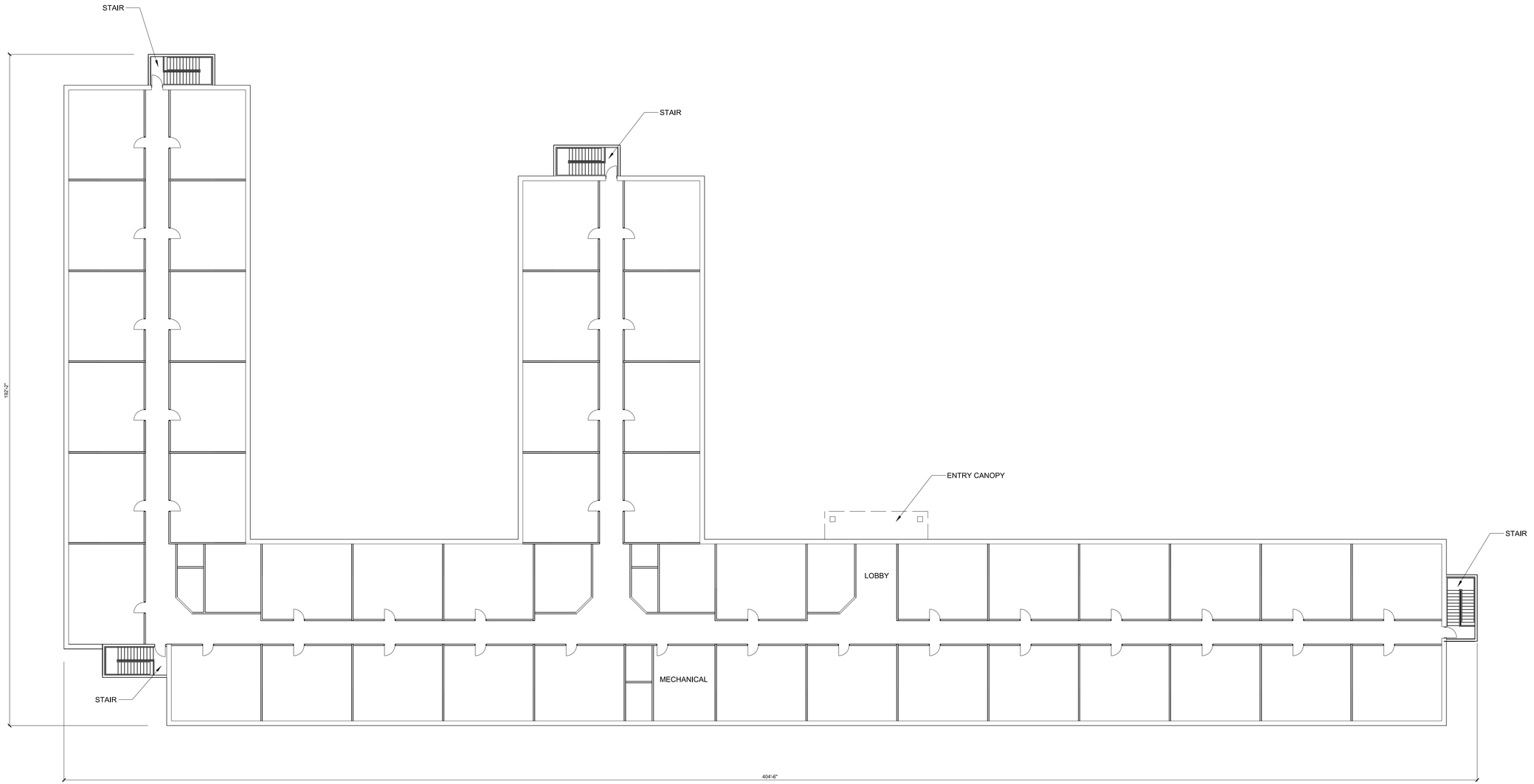
FLOOR PLAN REPRESENTS A WORKABLE SOLUTION FOR THE FIRST FLOOR AND IS NOT A REQUIREMENT OF THE RFP.



FLOOR PLAN INDICATES AN EXAMPLE OF A WORKABLE SOLUTION, AND IS NOT A REQUIREMENT. THE DESIGNER-OF-RECORD IS ALLOWED TO MAKE ADJUSTMENTS FOR EXTERIOR FACADE/ARCHITECTURAL THEME, AND/OR TO ACCOMMODATE SPECIFIC BUILDING ENGINEERING SYSTEMS (STRUCTURAL, MECHANICAL, ELECTRICAL, FIRE PROTECTION, AND SUSTAINABLE DESIGN). INNOVATIVE, COST SAVING SOLUTIONS WILL BE GIVEN PROPER CONSIDERATION BY THE COS, AND WILL BE ADOPTED AS APPROPRIATE.

BARRACKS FIRST FLOOR PLAN

SCALE: 1/16"=1'-0"

PLAN N

BARRACKS (UEPH) - FIRST FLOOR PLAN

0 4' 8' 16' 32' SCALE: 1/16" = 1'-0"

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BARRACKS (UEPH)
FIRST FLOOR PLAN

SHEET IDENTIFICATION
A-101
SHEET X OF 71

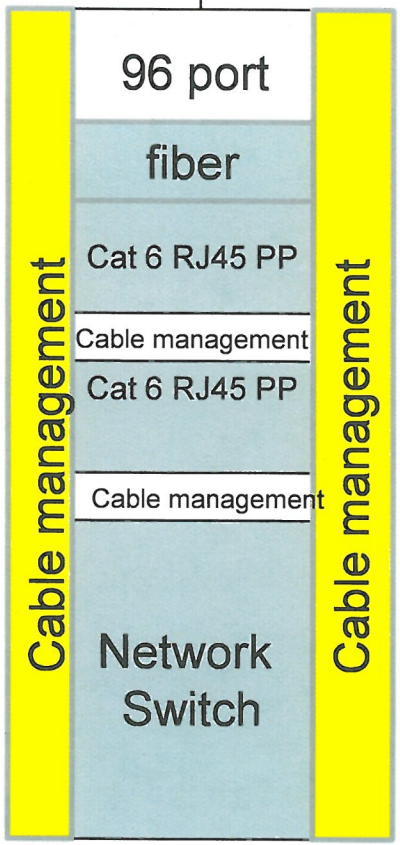
APPENDIX FF
Building Telecommunications

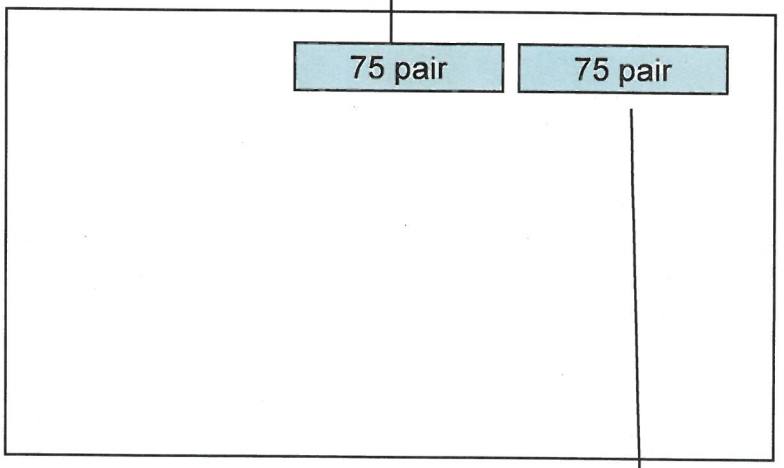
Bldg w/requirement for 75 pair OSP Cable

Extend to 2nd floor Rack Mounted Patch Panel

Extend OSP to 110/RJ45 PP

75 Pair 1to1 feeder





All communication rooms will have L6-30 & L5-30 plus a quad 20A per Fort Knox Standard Design

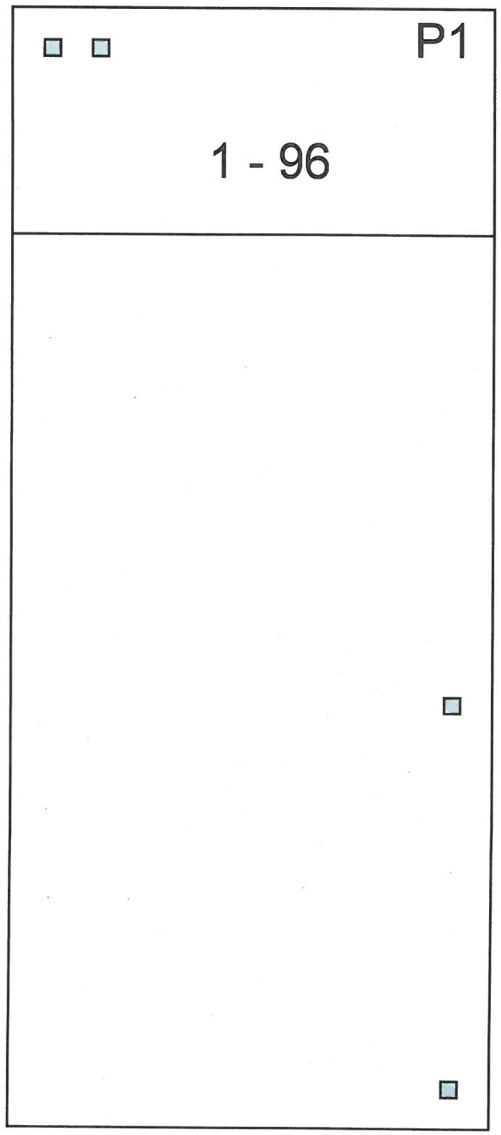
Outside plant

RJ45/110 Patch Panels

All voice/data Punched down On cat 6 patch panels

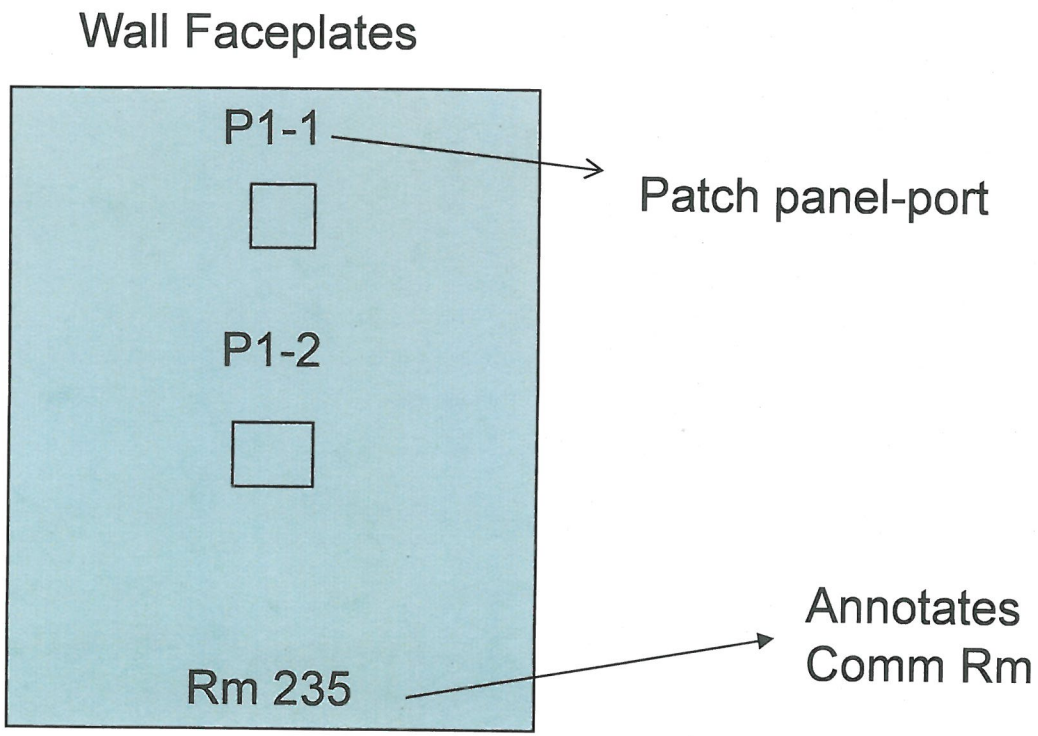
- Use standard Cat6 patch Cables for both data and voice
-

CABLE COUNTS WILL VARY DEPENDING ON PROJECT SCOPE



All patch panels in a comm room
Will be labeled P1 through P? (depending
On # of patch panels.

All voice/data will be punched down on
These patch panels “B” Standard



APPENDIX GG
Ft. Knox Basewide Energy Management and Control System

SECTION 15951
BASE WIDE ENERGY MANAGEMENT AND CONTROL SYSTEM

PART 1- GENERAL

1.1 SECTION INCLUDES

1. Related Sections
2. Description
3. Approved Control System Contractors and Manufacturers
4. Quality Assurance
5. Codes and Standards
6. System Performance
7. Submittals
8. Warranty
9. Ownership of Proprietary Material

1.3 DESCRIPTION

General: This controls system shall be an extension of the existing Ft. Knox Base Wide Energy Management and Control System (EMCS). The existing Ft. Knox Base Wide EMCS system includes the DDC controls system architecture, Base Wide Energy Metering System and Dashboards, and Base Wide Network Monitoring System (NMS). The new controls system and system controllers shall interface seamlessly into the DDC controls system, Energy Metering System and Dashboards, and NMS system. Reference section 2, paragraph A through E. The control system shall be as shown and consist of a high-speed, peer-to-peer network of DDC controllers residing and communicating on a network. Operating system shall communicate to system level controllers

A. Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of mechanical systems on this project.

B. The control system shall accommodate simultaneous multiple user operation. Access to the control system data should be limited only by operator password. Multiple users shall have access to all valid system data. An operator shall be able to log onto any workstation on the control system and have access to all appropriate data.

C. The control system shall be designed such that each mechanical system will be able to operate under stand-alone control. As such, in the event of a network communication failure, or the loss of any other controller, the control system shall continue to independently operate under control.

D. The Contractor shall provide hardware and software necessary to implement the functions and sequences shown.

E. The Contractor shall provide connection to the existing Centralized Monitoring of Network Devices through the Base Wide NMS. IP Based devices will be monitored using the existing base wide third party network monitoring software (NMS). Reference section 2.3.A.

1.4 APPROVED CONTROL SYSTEM CONTRACTORS AND MANUFACTURERS

A. The new controls system shall fully integrate to the existing Base Wide Energy Management System. The existing Trane Tracer Summit graphical operator interface and Energylogix Energy Metering Services software tool utilized for Base Wide system control and energy monitoring shall be interfaced to the new controls system. Reference section 2 for communication protocols.

B. The acceptable manufacturers applies to controller software, the custom application programming language, System Controllers, Control Units, and Unit Controllers. All other products specified herein (i.e., sensors, valves, dampers, and actuators) need not be manufactured by the above manufacturers.

C. The Contractor shall use only listed the manufacturers products as shown in this division. When a product or component is referred to by manufacturer's name and/or model number, the Contractor shall use only that product.

D. The Basis of design is Trane Tracer Summit DDC controls / Energylogix Energy Metering software.

1.5 QUALITY ASSURANCE

A. Contractor/Manufacturer Qualifications

1. The Installer shall have successfully completed Control System Manufacturer's classes on the control system. The Installer shall present for review the certification of completed training, including the hours of instruction and course outlines upon request.
2. All products used in this installation shall be new, currently under manufacture, and shall be applied in standard off the shelf products. This installation shall not be used as a test site for any new products unless explicitly approved by the Government in writing. Spare parts shall be available for at least 5 years after completion of this contract.

1.6 CODES AND STANDARDS

A. All work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local, state, and federal authorities and the following:

3. ASHRAE 135
4. FCC Regulation, Part 15- Governing Frequency Electromagnetic Interference
5. Underwriters Laboratories UL916

1.7 SYSTEM PERFORMANCE

A. Performance Standards. The system shall conform to the following:

1. Graphic Display. The graphic displays shall match the existing base wide system color graphic templates currently in use with the Trane Summit System. The color graphics system shall include an enterprise level graphic view for ease of system navigation. System navigation will include the enterprise level view, multiple building level views based on building size and arrangement, and access to application level views of each component in the system. The application level graphics shall include in depth diagnostic graphics for remote troubleshooting and the ability to reset system remotely. The application level graphics shall include set point control, set point limits, occupancy, and

fan control editing. The system shall display a graphic with a minimum of 20 dynamic points. All current data shall be displayed within 20 seconds of the request. Reference section 2.4 paragraph B.

2. Graphic Refresh. The system shall update all dynamic points with current data within 30 seconds.

3. Object Command. The maximum time between the command of a binary object by the operator and the reaction by the device shall be 10 seconds. Analog objects shall start to adjust within 10 seconds.

4. Object Scan. All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or workstation will be current, within the prior 60 seconds.

5. Alarming. The system shall conform to the Base Wide Alarming standard currently in place. Notification of alarm classes, service response, and messaging shall match the Ft Knox standards in place. The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed 45 seconds.

6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.

7. Performance. Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every 5 seconds. The controller shall scan and update the process value and output generated by this calculation at this same frequency.

8. Multiple Alarm Annunciation. All workstations on the network shall receive alarms within 5 seconds of each other.

9. Reporting Accuracy. Table 1 lists minimum acceptable reporting accuracies for all values reported by the specified system.

TABLE 1: Reporting Accuracy

Measured Variable	**Reported Accuracy**
Space temperature	±0.5°C [±1°F]
Ducted air	±1.0°C [±2°F]
Outside air	±1.0°C [±2°F]
Water temperature	±0.5°C [±1°F]
Delta-T	±0.15°C[±0.25°F]
Relative humidity	±5% RH
Water flow	±5% of full scale
Air flow (terminal)	±10% of reading *Note 1
Air flow (measuring stations)	±5% of reading
Air pressure (ducts)	±25 Pa [±0.1 "W.G.]
Air pressure (space)	±3 Pa [±0.01 "W.G.]
Water pressure	±2% of full scale *Note 2
Electrical Power	5% of reading *Note 3
Carbon Monoxide (CO)	± 50 PPM
Carbon Dioxide (CO_2)	± 50 PPM

Note 1: (10%-100% of scale) (cannot read accurately below 10%)
Note 2: for both absolute and differential pressure
Note 3: * not including utility supplied meters

1.9 OWNERSHIP OF PROPRIETARY MATERIAL

A. The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. All software licensing shall be made to the Owner not the FMS Contractor or vendor, and such license shall grant use of all programs and application software to owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software. All software shall be capable of adding other manufacture licensed vendors if of the same firmware. Any and all required IDs, passwords, and software keys for access to any component or software program shall be provided to the owner. All project-developed hardware and software shall become the property of the Owner. These items include but are not limited to:
   i. Project graphic images
   ii. Record drawings
   iii. Project database
   iv. Project-specific application programming code
   v. All documentation
   vi. All software, software licenses and software keys

PART 2 – PRODUCTS

2.1 SECTION INCLUDES

A. Materials

B. Communication

C. Operator Interface

D. System Software / Intelligent Services

E. Building Controllers

2.2 MATERIALS

A. All products used in this project installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of two years. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner's Representative in writing. Spare parts of equal protocol product shall be available for at least five years after completion of this contract.

2.3 COMMUNICATION

A. Communications between the Central Server, Building Controllers and the Operator PC Workstations shall use the BACnet Protocol. This communication shall utilize Annex J of ASHRAE Standard 135 (BACnet). Local connections of the workstation shall be on ISO 8802-3 (Ethernet).

B. Implement Centralized Monitoring of Network Devices through Base Wide NMS. IP Based devices will be monitored using the existing base wide third party network

monitoring software (NMS). Existing device must be documented and configured in the NMS. Device data must include the following:

Hostname	IP
Address	MAC
Address	Building
Number	Section ID

C. If a device has the provision to configure the above mentioned criteria, it must be completed. The devices must be documented following the defined nomenclatures.

D. New devices must be documented and added to the NMS at time of device install.

E. Devices must be polled between the defined minimum interval of 1minute and maximum interval of 1 hour. Alarming to Intelligent Services through the NMS shall take place in the event of a device or network failure.

F. Unidentified devices detected by the NMS must be investigated and/or removed from the network.

G. A wireless / wired Ethernet device /router shall be provided to interface into the existing Ft. Knox Base Wide wireless Energy Management System. The wireless network interface shall be provided and will allow for remote operator interface using the BACnet / IP protocol. Devices must be monitored by the base wide NMS system.

H. All control products provided for this project shall comprise a network.

I. The Contractor shall provide all communication media, connectors, repeaters, bridges, hubs, and routers necessary for the network.

J. All controllers shall have a communication port for connections with the operator interfaces using layer protocol. If the device is not provided as standard from the manufacturer with a communications port a field installed port shall be mounted directly next to the controller using industry standard networking hardware.

K. The network shall have the following minimum capacity:
   1. The network shall have the ability to accommodate future access controls, lighting controls, IP video camera monitoring, internet capabilities.
   2. Each Building Controller shall have routing capacity for 99 controllers.
   3. The Building Controller network shall have capacity for 1000 Building Controllers.
   4. The system shall have an overall capacity for 12,500 Building Controller, Custom Application Controller, and Application Specific Controller input/output objects.

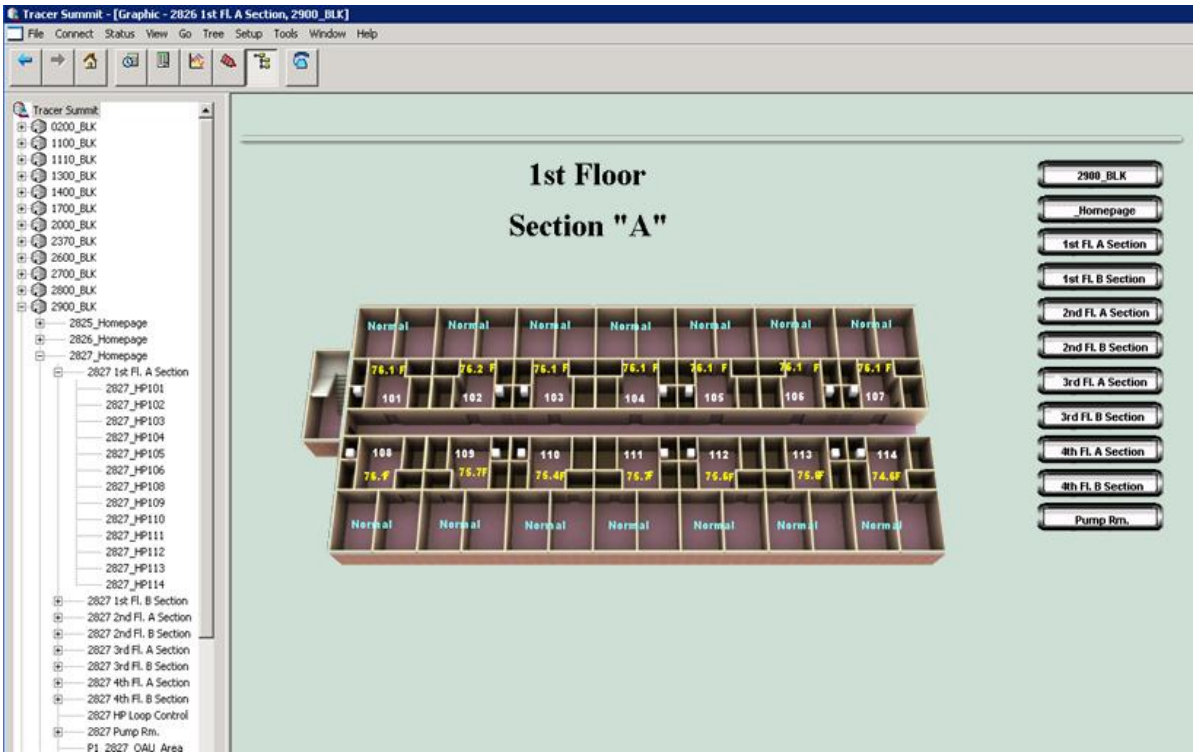
2.4 OPERATOR INTERFACE

A. Operator Interface. The existing Trane Tracer Summit workstation currently residing on the Ft. Knox Base Wide wired / wireless Ethernet network shall be utilized for owner interface to the new controls system. The existing Energylogix Energy Monitoring software application currently residing on the Ft. Knox Base Wide wired / wireless Ethernet network shall be utilized for owner interface to the building metering system including electric, gas, and water. The systems shall be seamlessly integrated to provide temperature control, energy management, and demand control to meet the base wide energy standards. The extension of the enterprise wide network will be provided by the controls contractor. System shall

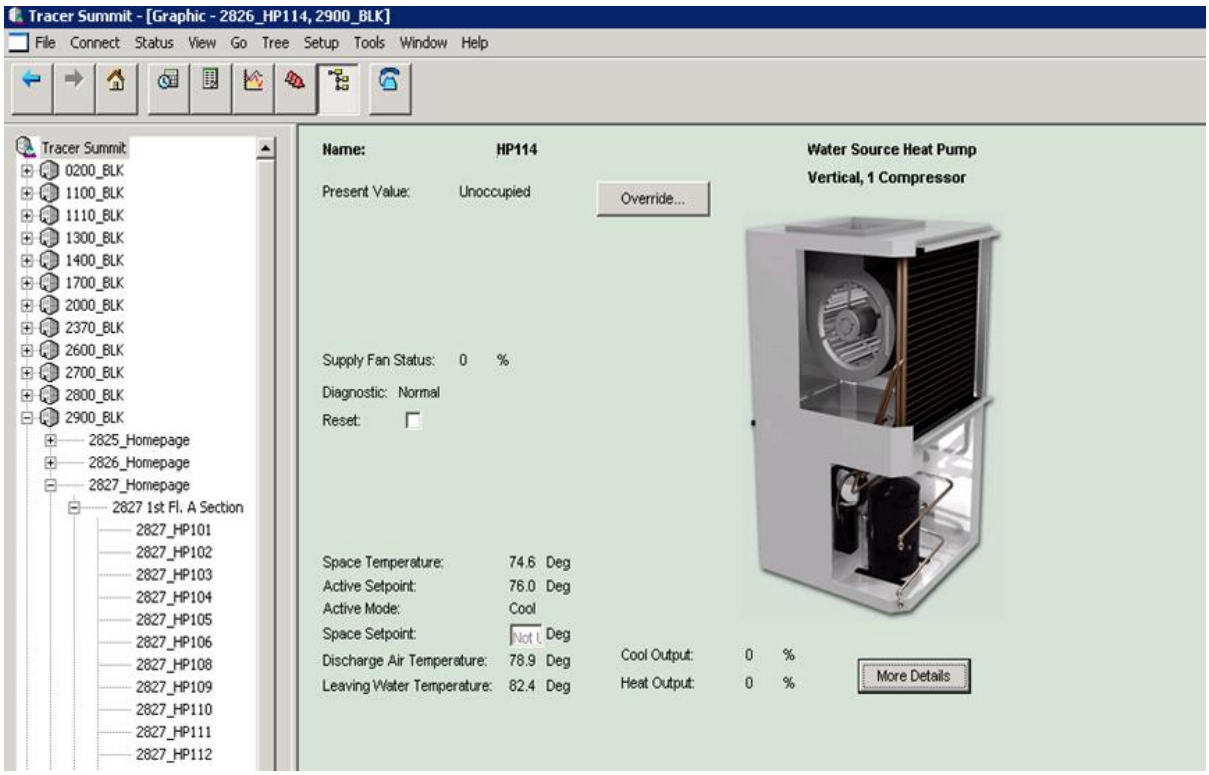
conform to wireless Ethernet standard IEEE 802.3 standards, utilizing frequency hopping spread spectrum (FHSS). This PC should have full access to the direct digital control system via the same user password authority.

B. System Graphics. The existing Tracer Summit operator workstation software is a graphical user interface (GUI). The graphics shall be equal to the existing Ft. Knox color graphics provided with the Trane Summit system. The color graphics system shall include an enterprise level graphic view for ease of system navigation. System navigation will include the enterprise level view, multiple building level / floor plan views based on building size and arrangement, and access to application level views of each HVAC component in the system. The application level graphics shall include in depth diagnostic graphics for remote troubleshooting and the ability to reset HVAC systems remotely. The HVAC application level graphics shall include set point control, set point limits, occupancy, and fan control editing. HVAC device and object naming, and navigation of data shall be equal to the existing graphics currently in use with the Trane Summit system. The system shall allow display of up to 10 dynamic and animated graphic screens at once for comparison and monitoring of system status. Provide a method for the operator to easily move between graphic displays and change the size and location of graphic displays on the screen. The system graphics shall be able to be modified while on-line. An operator with the proper password level shall be able to add, delete, or change dynamic objects on a graphic. Dynamic objects shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall have the ability to show animation by shifting image files based on the status of the object.

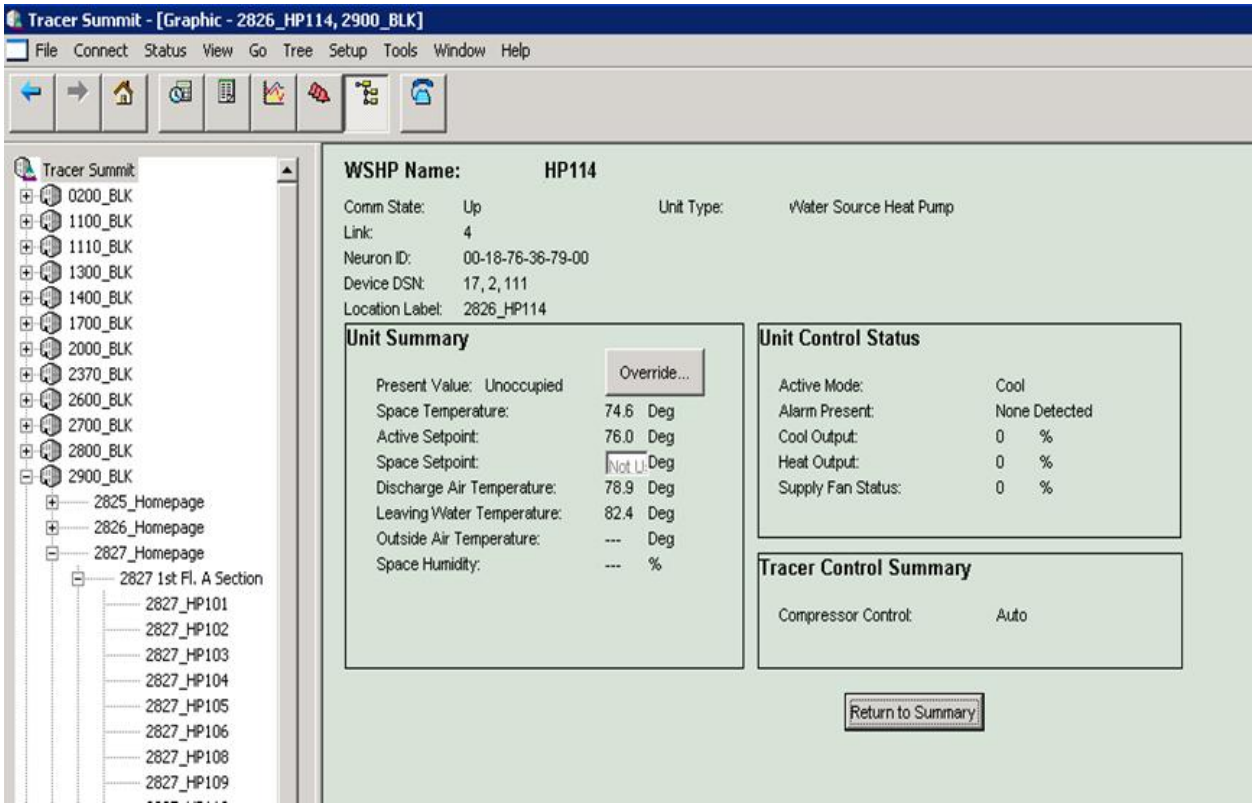
Typical Floor Plan Graphic and Navigation Tree



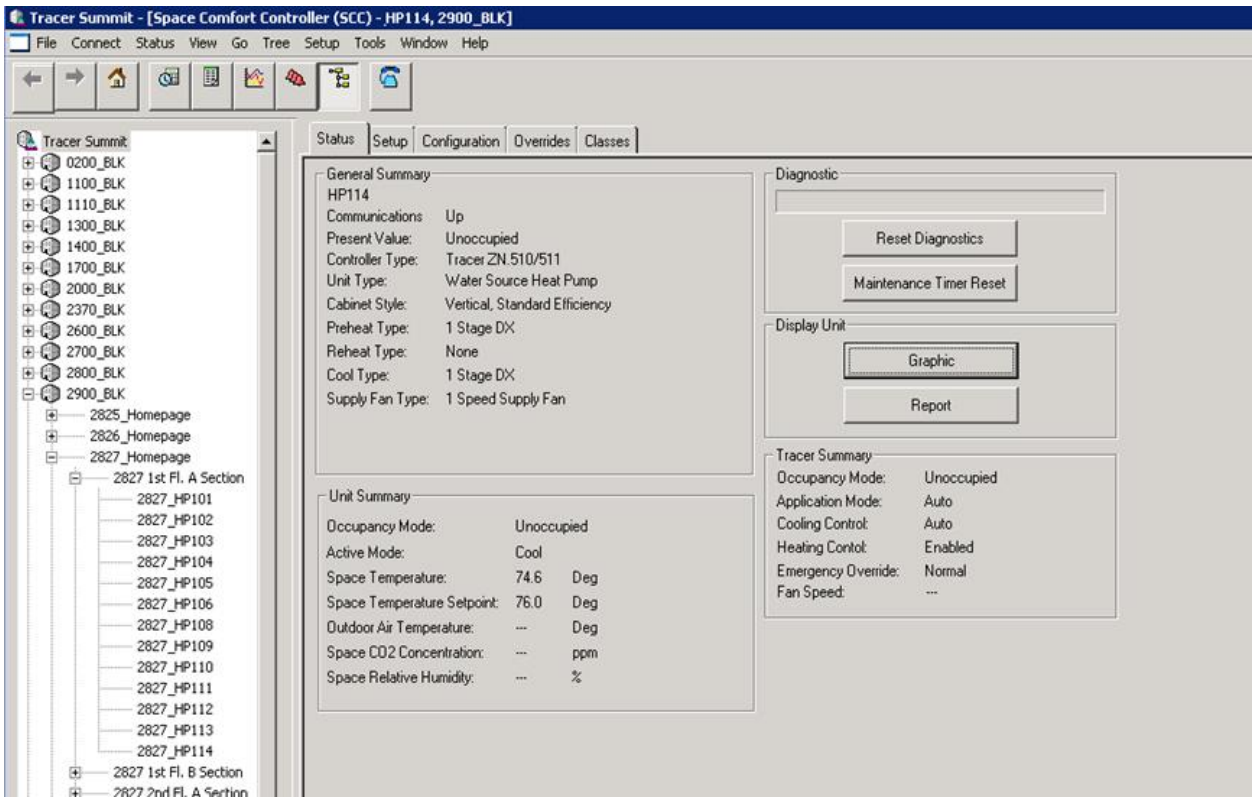
Typical HVAC Application Graphic and Navigation Tree



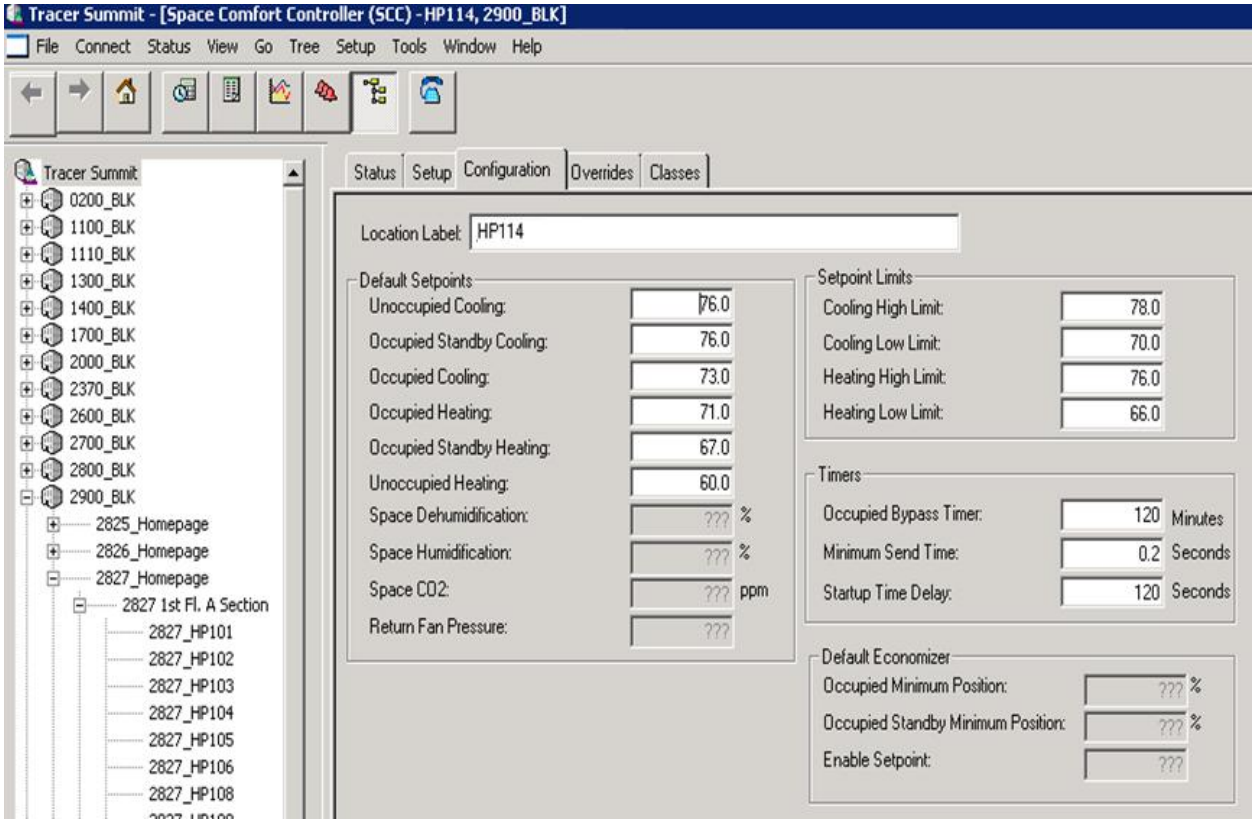
Typical HVAC Application Summary Graphic and Navigation Tree



Typical HVAC Diagnostic Summary and Navigation Tree



Typical HVAC Set points and Occupancy Control



a) Custom Graphics. Custom graphic files shall be created with the use of commonly available graphics packages such as PC Paint. The graphics generation package shall create and modify graphics that are saved in industry standard formats such as PCX, BMP, GIF and JPEG. The graphics generation package shall also provide the capability of capturing or converting graphics from other programs such as Designer, or AutoCAD.

b) Graphics Library. Furnish a complete library of standard HVAC equipment such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. This library shall also include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program.

c) Engineering Units. Allow for selection of the desired engineering units (i.e. Inch pound or SI) in the system. Unit selection shall be able to be customized by locality to select the desired units for each measurement.

C. System Applications. The workstation shall provide operator interface and off-line storage of system information. Provide the following applications at the workstation.

1. Automatic System Database Save and Restore. Each workstation shall store on the hard disk a copy of the current database of each building controller. This database shall be updated whenever a change is made in any panel in the system. The storage of this data shall be automatic and not require operator intervention. In the event of a database loss in a building management panel, the first workstation to detect the loss shall automatically restore the database for that panel.

2. Manual Database Save and Restore. A system operator with the proper password clearance shall be able to archive the database from any system panel and store on magnetic media. The operator shall also be able to clear a panel database and manually initiate a download of a specified database to any panel in the system.

3. System Configuration. The workstation software shall provide a graphical method of configuring the system. The user with proper security shall be able to add new devices, and assign modems to devices. This shall allow for future system changes or additions.

4. On-Line Help and Training. A free online resource shall be provided to the owner during the warranty period. Product information, technical support, and operator training shall be available. Monthly one hour web-based training classes shall be provided to the owner at no charge during the warranty period. Provide a context sensitive, on line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. Provide an interactive tutorial CD, which will act as on-line training/help for the systems operator. Services shall be equal to those provided through MyTraneControls.com.

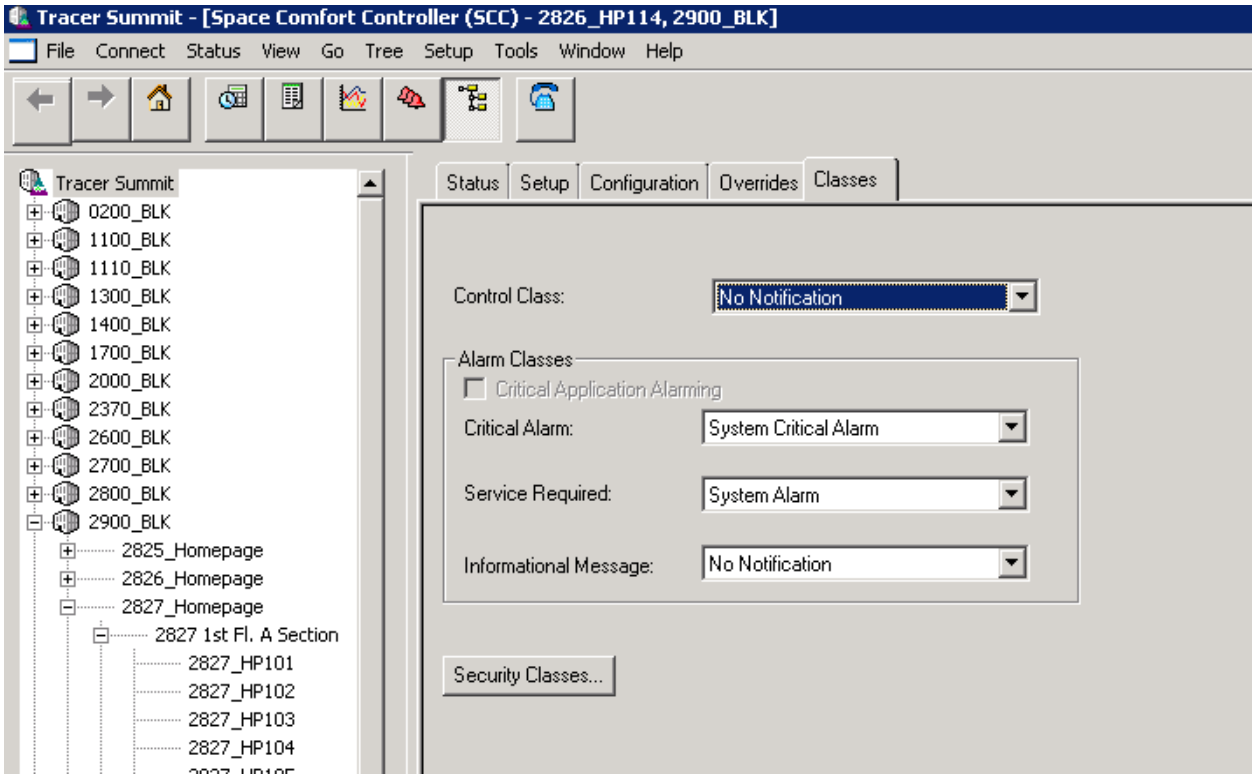
5. Security. Each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system supervisor shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operator’s access for viewing and/or changing each system application, full screen

editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto logoff time shall be set per operator password. All system security data shall be stored in an encrypted format.

6. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.

7. Alarm Processing. The system shall conform to the Base Wide Alarming standard currently in place. Notification of alarm classes, service response, and messaging shall match the Ft Knox standards in place. Any object in the system shall be configurable to alarm in and out of normal state. The operator shall be able to configure the alarm limits, warning limits, states, and reactions for each object in the system.

Typical HVAC Application Alarm Setup



Typical Automatic Alarm Generation Reporting

Diagnostic	
Humidity Input Failure[3]	High/Low Pressure Cutout[2]
CO2 Sensor Failure[3]	Low Air Flow/ Fan Failure[2]
Generic AIP Failure[3]	Space Temperature Failure[2,3]
Maintenance Required	Entering Water Temperature Failure[2,3]
Local Fan Mode Failure[3]	Discharge Air Temperature Limit
Local Setpoint Failure[3]	
Invalid Unit Configuration[2]	Discharge Air Temperature Failure[2,3]
Normal	Outdoor Air Temperature Failure[2,3]

a) Alarm Reactions. The operator shall be able to determine what actions, if any, are to be taken, by object (or point), during an alarm. Actions shall include logging, printing, starting programs, displaying messages, dialing out to remote stations, paging, forwarding to an e-mail address, providing audible annunciation or displaying specific system graphics. Each of these actions shall be configurable by workstation and time of day. An object in alarm that has not been acknowledged within an operator specified time period shall be re-routed to an alternate operator specified alarm receipt device.

b) Binary Alarms. Each binary object shall be set to alarm based on the operator-specified state. Provide the capability to disable alarming when the associated equipment is turned off or is being serviced.

c) Analog Alarms. Each analog object shall have both high and low alarm limits and warning limits. Alarming must be able to be automatically and manually disabled.

8. Trend Logs. The system trends shall conform to the Base Wide trending standards currently in place. The operator shall be able to define a custom trend log for any data in the system. This definition shall include interval, start-time, and stop-time. Trend intervals of 1, 5, 15, 30, and 60 minutes as well as once a shift (8 hours), once a day, once a week, and once a month shall be selectable. All trends shall start based on the hour. Each trend shall accommodate up to 64 system objects. The system operator with proper password shall be able to determine how many samples are stored in each trend. Trend data shall be sampled and stored on the Building Controller panel and be archived on the hard disk. Trend data shall be able to be viewed and printed from the operator

interface software. Trends must be viewable in a text-based format or graphically. They shall also be storable in a tab delimited ASCII format for use by other industry standard word processing and spreadsheet packages.

9. Dynamic Graphical Charting. The operator shall be able to select system values to be charted in real time. Up to three values at one time can be selected for each chart. The type of chart (bar, line, 3-D, etc.) shall be selectable.

10. Alarm and Event Log. The operator shall be able to view all logged system alarms and events from any location in the system. The operator shall be able to sort and filter alarms. Events shall be listed chronologically. An operator with the proper security level may acknowledge and clear alarms. All that have not been cleared by the operator shall be archived to the hard disk on the workstation.

11. Object and Property Status and Control. Provide a method for the operator with proper password protection to view, and edit if applicable, the status of any object and property in the system. These statuses shall be available by menu, on graphics, or through custom programs.

12. Clock Synchronization. The real time clocks in all building control panels and workstations shall be synchronized on command of an operator. The system shall also be able to automatically synchronize all system clocks; daily from any operator designated device in the system. The system shall automatically adjust for daylight savings and standard time if applicable.

13. Reports and Logs. Provide a reporting package that allows the operator to select, modify, or create reports. Each report shall be definable as to data content, format, interval, and date. Report data shall be archived on the hard disk for historical reporting. Provide the ability for the operator to obtain real time logs of designated lists of objects. Reports and logs shall be stored on the PC hard disk in a format that is readily accessible by other standard software applications including spreadsheets and word processing. Reports and logs shall be readily printed to the system printer. The operator shall be able to designate reports that shall be printed or stored to disk at selectable intervals.

a) Custom Reports: Provide the capability for the operator to easily define any system data into a daily, weekly, monthly, or annual report. These reports shall be time and date stamped and shall contain a report title and the name of the facility.

b) Standard Reports. The following standard system reports shall be provided for this project. These reports shall be readily customized to the project by the owner through the Controls and/or Energy Monitoring Systems.

    i. Electrical Meter Report: Provide integration of the building meter system for electrical consumption data to the Base Wide Energy Monitoring System and controls system. This data will be displayed real time on the base wide energy monitoring system and at base wide graphic display panels, Provide a monthly report showing the daily electrical consumption and peak electrical demand for each building meter. Provide an annual (12 month) summary report showing the monthly electrical consumption and peak demand for each meter. Metering shall be provided for buildings greater than 29,000 square feet.

ii. All Points in Alarm Report: Provide an on demand report showing all current alarms.

iii. All Points in Override Report: Provide an on demand report showing all overrides in effect.

iv. Schedule Report: Provide a summary of all schedules including Holiday and Exception schedules.

D. Custom Application Programming. Provide the tools to create, modify, and debug custom application programming. The operator shall be able to create, edit, and download custom programs at the same time that all other system applications are operating. The system shall be fully operable while custom routines are edited, compiled, and downloaded.

2.5 SYSTEM SOFTWARE / INTELLIGENT SERVICES APPLICATIONS

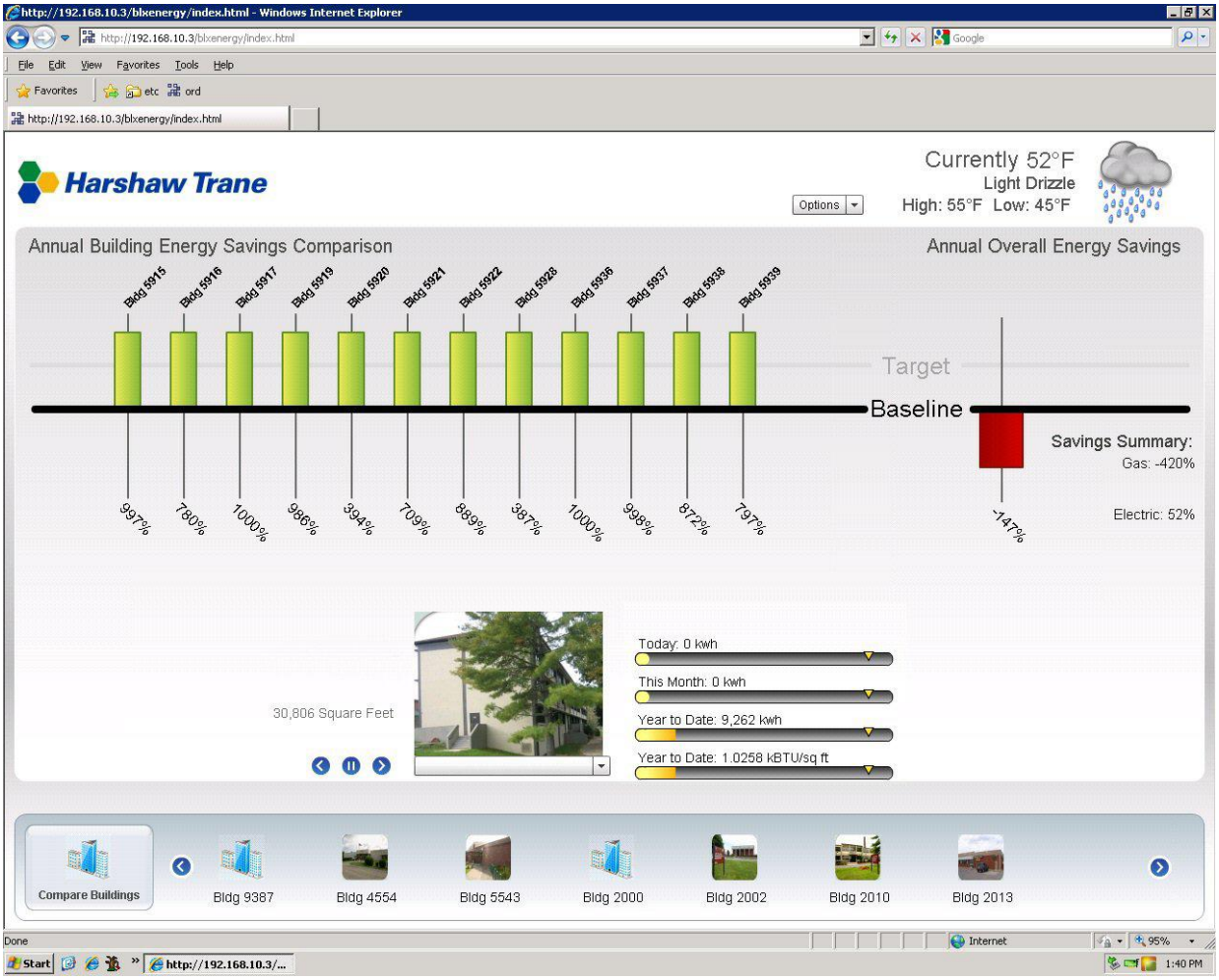
A. Furnish the following applications / interface to the software for building and energy management. All software applications shall reside and run on the Ft Knox controls network or reside in the Ft Knox system server. Editing of applications shall occur at the operator workstation / server.

B. Intelligent Services is an internet powered consulting, diagnostic, and support service. Intelligent Services shall include the following:

(1) Energy Management Application

This Intelligent Services application shall include the installation of electronic metering of the existing utility services which will allow real time monitoring and trending of utility usage. The utility data shall then be processed by the base wide Energy Logix software program that normalizes it for weather conditions, compares it against historical records and industry benchmarks to illustrate any changes in utility usage over similar time periods. Intelligent Services will also report any sudden increase or decrease in energy usage that could indicate system problems. The contractor shall provide the meter data via BACnet /IP protocol to the live dashboard application.

Typical Energy Management System Report / Live Dashboard



(2) Performance Monitoring Application

Intelligent Services will collect data from the Building Automation System to generate performance exception reports. Data Points that are monitored may include, but are not limited to, entering and leaving water temperature, supply air temperature, space temperature, air flow, and compressor start/stops. The collected data is analyzed by Intelligent Services and compared against the equipment design criteria and ASHRAE standards.

(3) Air Filtration Monitoring

Intelligent Services provides real time performance monitoring of the filtration media in the HVAC system through differential pressure transmitters located at selected locations. Each filter type has a manufacture assigned, pre-engineered pressure drop parameter that is used to indicate the optimal time to change the filter. Intelligent Services will collect air flow data from a selected sample of equipment on site to determine optimal filter change frequencies. The client will be notified by Intelligent Services when filter changes are needed. This program provides monitoring, trending and reporting when the filters need to be changed.

(4) Asset Management

Measure and monitor chiller equipment for run time, run speed, start/stops, temperature, and pressure, as applicable. The data will be analyzed and compared against ASHRAE standards for equipment age and maintenance history to determine the projected life expectancy of the equipment.

C. System Security

1) User access shall be secured using individual security passwords and user names.
2) Passwords shall restrict the user to only the objects, applications, and system functions as assigned by the system manager.
3) User logon/logoff attempts shall be recorded.
4) The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.
5) IP Based devices will be monitored using the existing base wide third party network monitoring software (NMS).

D. Scheduling. Provide the capability to schedule each object or group of objects in the system. Each of these schedules shall include the capability for start, stop, optimal start, optimal stop, and night economizer actions. Each schedule may consist of up to [10] events. When a group of objects are scheduled together, provide the capability to define advances and delays for each member. Each schedule shall consist of the following:

1) Weekly Schedule. Provide separate schedules for each day of the week.
2) Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. This exception schedule shall override the standard schedule for that day. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed it will be discarded and replaced by the standard schedule for that day of the week.
3) Holiday Schedules. Provide the capability for the operator to define up to [99] special or holiday schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.
4) Optimal Start/Stop. The scheduling application outlined above shall support an optimal start/stop algorithm. This shall calculate the thermal characteristics of a zone and start the equipment prior to occupancy to achieve the desired space temperature at the specified occupancy time. The algorithm shall calculate separate sets of heating and cooling rates for zones that have been unoccupied for less then and greater than 24 hours. Provide the ability to modify the start/stop algorithm based on outdoor air temperature. Provide an early start limit in minutes to prevent the system from starting before an operator determined time limit.

E. Alarm Reporting. The operator shall be able to determine the action to be taken in the event of an alarm. Alarms shall be routed to the appropriate workstation based on time and other conditions. An alarm shall be able to start programs, be logged in the event log, printed, generate custom messages graphics.

F. Remote Communications. The system shall have the ability to dial out in the event of an alarm. Receivers shall include PC Workstations, email, and alphanumeric pagers. The alarm message shall include the name of the calling location, the device that generated the alarm, and the alarm message itself. The operator shall be ably to remotely access and operate the system using dial up communications in the same format and method used on site under section 2.4 (Operator Interface).

G. Configuration Tool. Open protocol unit controllers shall be fully configurable from the operator workstation.

2.6 BUILDING CONTROLLERS

A. General. Provide an adequate number of Building Controllers to achieve the performance specified in the Part 1 Article on “System Performance.” Each of these panels shall meet the following requirements.
   1. The Building Automation System shall be comprised of one or more independent, standalone, microprocessor-based Building Controllers to manage the global strategies described in the System Software section.
   2. The Building Controller shall have sufficient memory to support its operating system, database, and programming requirements.
   3. Data shall be shared between networked Building Controllers.
   4. The operating system of the Building Controller shall manage the input and output communication signals to allow distributed controllers to share real and virtual object information, and allow central monitoring and alarms.
   5. Controllers that perform scheduling shall have a real-time clock.

B. Building Controllers shall be fully peer to peer.

C. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field- removable, modular terminal strips — or to a termination card connected by a ribbon cable.

D. Memory. The Building Controller shall have as a minimum standard SRAM of 256 KB, standard DRAM of 1MB and standard non-volatile 1 MB of flash memory in lieu of EPROM. Memory shall be user extendible through RAM chip sockets and SIMMs for future memory expansion. Memory. The Building Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.

E. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. The Building Controller shall maintain all database information including BIOS and programming information in the event of a power loss for at least 72 hours. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 ft.

F. The Building Controller shall have sufficient memory to support its operating system, database, and programming requirements.

G. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.

H. Controllers that perform scheduling shall have a real time clock.

I. Data shall be shared between networked Building Controllers.

J. The Building Controller shall utilize industry recognized open standard protocols for communication to unit controllers. Reference paragraph M.

K. The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:

1. Assume a predetermined failure mode.
2. Generate an alarm notification.
3. Create a retrievable file of the state of all applicable memory locations at the time of the failure.
4. Automatically reset the Building Controller to return to a normal operating mode.

L. BACnet. The Building Controller shall use the Read (Initiate) and Write (Execute) Services as defined in these BIBBS:

DS-RP-A,B
DS-RPM-A,B
DS-WP-A,B
DS-WPM-B

M. Communications: Each Building Controller shall reside on the Ft. Knox enterprise wide network. The extension of the wireless / wired enterprise wide network will be provided by the controls contractor. System shall conform to wireless Ethernet standard IEEE 802.3 standards, utilizing frequency hopping spread spectrum (FHSS).Communications between the Central Server, Building Controllers, and the Operator PC Workstations shall use Annex J of ASHRAE Standard 135-2004 (BACnet).Each Building Controller shall perform communications to a network of Custom Application and Application Specific Controllers utilizing the ANSI/EIA/CEA standard 709.1, the LonTalk™ protocol. All Custom Application and Application Specific Controllers shall be LonMark™ certified. In those instances in which Lon-Mark™ certified devices are not available, the FMS contractor shall provide LonWorks™ devices with application source code, device resource files, and external interface definitions. Where necessary or desired, LonTalk™ packets may be encapsulated into TCP/IP messages to take advantage of existing infrastructure or to increase network bandwidth.

N. The system will consist of an open architecture that utilizes EIA standard 709.1, the LonTalk™ protocol, as the common communication protocol between all controllers and integral ANSI / ASHRAE™ Standard 135, BACnet functionality to assure interoperability between all system components. Both the LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135, BACnet protocol are required to assure that the project is fully supported by the two leading HVAC open protocols to reduce future building maintenance, upgrade, and expansion costs

O. Where necessary or desired, LonTalk™ packets may be encapsulated into TCP/IP messages to take advantage of existing infrastructure or to increase network bandwidth.

1. Any such encapsulation of the LonTalk™ protocol into IP datagrams shall conform to existing LonMark™ guide-lines for such encapsulation and shall be based on industry standard protocols.

2. The products used in constructing the BMS shall be LonMark™ compliant.

3. In those instances in which Lon-Mark™ devices are not available, the BMS contractor shall provide LonWorks™ devices with application source code, device resource files, and external interface definitions.

P. The software tools including cables and connectors required to network manage both the LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135, BACnet protocol must be provided with the system. Drawings are diagrammatic only. Equipment and labor not specifically referred to herein or on the plans, that is required to meet the functional intent, shall be provided without additional cost to the Owner. Minimum BACnet compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet/Ethernet IP.

1. The supplied system must incorporate the ability to access all data using non specific version of Java enabled browsers without requiring proprietary operator interface and configuration programs.

2. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage.

    a. This data shall reside on a supplier-installed server for all database access.

    b. Systems requiring proprietary database and user interface programs shall not be acceptable.

    c. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network.

    d. Systems employing a "flat" single tiered architecture shall not be acceptable

I. Building Controller Operator Display. The building controller shall include an operator display allowing the user to perform basic daily operations tasks on the building automation system. At a minimum this operator display shall:

1. Be installed on the building controller and require no additional power source.
2. Consist of a one-quarter VGA touch screen with 320 X 240-pixel resolution. The brightness and the contrast of the backlit touch screen shall be adjustable to allow for easy reading of information on the screen.
3. Be capable of having unique user identification and passwords that can be programmed to limit access to the system and operator functions.
4. Display the current state of an input/output point and equipment controller connected to the system.
5. Give the operator the ability to override the current state of an output point or HVAC equipment controller connected to the building controller.
6. Allow the operator to modify the start and stop times of any time-of-day schedule within the system.
7. Provide a visual indication that a system alarm exists and allow for an optional audible alarm annunciation.
8. Provide the ability to view and acknowledge alarms that are annunciated at that building controller.
9. Allow the operator to view custom graphical displays with dynamic status information.
10. Automatically update displayed system information every 10 seconds.

Q. Inputs/Outputs.

1. Hard-wired inputs and outputs may tie into the system through Building, Custom, or Application Specific Controllers.

2. All input points and output points shall be protected such that shorting of the point to itself, another point, or ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.

3. Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 ma to be compatible with commonly available control devices.

4. Pulse accumulation input points. This type of point shall conform to all the requirements of Binary Input points, and also accept up to 2 pulses per second for pulse accumulation, and shall be protected against effects of contact bounce and noise.

5. Analog inputs shall allow the monitoring of low voltage (0-10 Vdc), current (4-20 ma), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.

R. Uninterruptible Power Supplies (UPS): Furnish one UPS per building controller to maintain system operation upon loss of power.

2.7 CUSTOM APPLICATION CONTROLLERS

A. General. Provide Custom Application Controllers to provide the performance specified in section 1 of this division. Each of these panels shall meet the following requirements.

1. The Building Automation System shall be composed of one or more independent, stand-alone, microprocessor based Building Controllers to manage the local strategies described in System software section.
2. The Controller shall have sufficient memory to support its operating system, database, and programming requirements.
3. Controllers that perform scheduling shall have a real time clock.
4. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
5. The Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:

   a) Assume a predetermined failure mode.
   b) Generate an alarm notification.

6. Custom application controllers shall communicate using LonTalk. Controllers shall use FTT-10 transceivers. All communications shall be with the use of LonMark-approved SNVTs.

B. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.

1. Controller used in conditioned ambient shall be mounted in NEMA 1 type enclosures, and shall be rated for operation at 0 C to 50 C [32 F to 120 F].

2. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40 C to 70 C [-40 F to 158 F].

C. A local operator interface shall be provided at building locations where specified in the sequence of operations or point list. The operator interface shall be provided for interrogating and editing data. A system security password shall be available to prevent unauthorized use of the keypad and display.

D. Serviceability. Provide diagnostic LEDs for power, communications, and processor. All low voltage wiring connections shall be made such that the controller electronics can be removed and/or replaced without disconnection of field termination wiring.

E. Memory. The Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.

F. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.

2.8 APPLICATION SPECIFIC CONTROLLERS

General. Application specific controllers (ASC) are microprocessor-based DDC controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. They are not fully user programmable, but are customized for operation within the confines of the equipment they are designed to serve.

Each ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.

Each ASC will contain sufficient I/O capacity to control the target system.

Environment. The hardware shall be suitable for the anticipated ambient conditions.

1. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40 C to 65 C [-40 F to 150 F].

2. Controller used in conditioned ambient shall be mounted in NEMA 1 type rated enclosures. Controllers located where not to be disturbed by building activity (such as above ceiling grid), may be provided with plenum-rated enclosures and non-enclosed wiring connections for plenum cabling. All controllers shall be rated for operation at 0 C to 50 C [32 F to 120 F].

Serviceability. Provide diagnostic LEDs for power and communications. All wiring connections shall be clearly labeled and made to be field removable.

Memory. The Application Specific Controller shall maintain all BIOS and programming information in the event of a power loss for at least 90 days.

Immunity to Power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%.

Transformer. Power supply for the ASC must be rated at minimum of 125% of ASC power consumption, and shall be fused or current limiting type.

Application Specific Controllers shall communicate using LonTalk. Controllers shall use FTT-10 transceivers. All communications shall follow LonMark profiles. ASCs which do not have a profile that applies must comply with LonMark standards, utilize SNVTs for all listed points, and be provided with a XIF file for self-documentation.

PART 3 – EXECUTION

3.1 SECTION INCLUDES

3.14 PROGRAMMING

A. Provide sufficient internal memory for the specified sequences of operation and trend logging. There shall be a minimum of 25% of available memory free for future use.

B. Software Programming
   1. Provide programming for the system and adhere to the sequences of operation provided. All other system programming necessary for the operation of the system, but not specified in this document, also shall be provided by the Contractor.

D. Operator Interface (Reference Section 2.4)
   1 Standard Graphics. Provide graphics for all mechanical systems and floor plans of the building. This includes each rooftop unit, hot water system, boiler, air handler, and all terminal equipment. Point/object information on the graphic displays shall dynamically update. Show on each graphic all input and output points/objects for the system. Also show relevant calculated points/objects such as set points
   2 Show terminal equipment information on a “graphic” summary table. Provide dynamic information for each point/object show
   3 The Contractor shall provide all the labor necessary to install, initialize, start up, and troubleshoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface database, and any third-party software installation and integration required for successful operation of the operator interface

3.15 CONTROL SYSTEM CHECKOUT AND TESTING

A. Start-up Testing: All testing listed in this article shall be performed by the Contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the Owner’s Representative is notified of the system demonstration.
   1. The Contractor shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification
   2. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
   3. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures per manufacturers’ recommendations
   4. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct
   5. Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The Contractor shall check all control valves and automatic dampers to ensure proper action and

closure. The Contractor shall make any necessary adjustments to valve stem and damper blade travel

6. Verify that the system operation adheres to the Sequences of Operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops and optimum Start/Stop routines.
7. Alarms and Interlocks
   a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm
   b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
   c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action

3.16 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

A. Demonstration
   1. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed its own tests
   2. The tests described in this section are to be performed in addition to the tests that the Contractor performs as a necessary part of the installation, startup, and debugging process and as specified in the “Control System Checkout and Testing” Article in Part 3 of this specification. The Engineer will be present to observe and review these tests. The Engineer shall be notified at least 10 days in advance of the start of the testing procedures.
   3. The demonstration process shall follow that approved in Part 1: “Submittals.” The approved checklists and forms shall be completed for all systems as part of the demonstration

B. Acceptance
   1. All tests described in this specification shall have been performed to the satisfaction of both the Engineer and Owner prior to the acceptance of the control system as meeting the requirements of Completion. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Engineer. Such tests shall then be performed as part of the warranty.
   2. The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1: “Submittals

3.18 TRAINING & SYSTEM EVALUATION

A. Initial System Training: Provide a minimum of two onsite training classes 8 hours in length during the construction period for personnel designated by the owner. Training shall be provided for the building automation and control system and all HVAC equipment furnished by this contractor. Upon substantial completion of the project, the first owner training class shall take place. The training class shall provide a system overview of the mechanical systems control design and installation. The training should include an overview of the field level controllers, main building controllers, system displays, and field device locations and applications. The training shall include an overview of the color graphic interface shall be provided for alarm management, scheduling, set point control, and trending. The second training class shall take place at the completion of all punch list items, system commissioning, and owner acceptance of the project.

During the initial system training session(s), the temperature controls contractor will train the designated staff of Owner's representative and Owner to enable them to proficiently operate the system; create, modify and delete programming; add, remove and modify physical points for the system; add additional panels when required.

The objectives of the building automation and controls training session will be divided into three logical groupings; participants may attend one or more of these, depending on level of knowledge required:

Day-to-day Operators
System Troubleshooter
System Manager

Train the designated staff of Owner's Representative and Owner to enable them to:

Proficiently operate the system
Understand control system architecture and configuration
Understand DDC system components
Understand system operation, including DDC system control and optimizing routines (algorithms)
Operate the workstation and peripherals
Log on and off the system
Access graphics, point/object reports, and logs
Adjust and change system set points, time schedules, and holiday schedules
Recognize malfunctions of the system by observation of the printed copy and graphical visual signals
Understand system drawings, and Operation and Maintenance manual
Understand the job layout and location of control components
Access data from DDC controllers and ASC
Operate portable operator's terminals

System Managers/Administrators:

Maintain software and prepare backups
Interface with job-specific, third-party operator software
Add new users and understand password security procedures

Provide course outline and materials as per "Submittals" Article in Part 1 of this specification. The instructor(s) shall provide one copy of training material per student.

The instructor(s) shall be factory-trained instructors experienced in presenting this material.

Classroom training shall be done using a network of working controllers representative of the installed hardware.

B. Quarterly On Site Owner Training & System Evaluation: In addition to the initial system training, the temperature controls contractor shall provide a minimum of four system hands on training sessions (quarterly), 8 hours each during the contract period for personnel designated by the Owner. The temperature controls contractor shall also provide a minimum of four system evaluations, 8 hours each during the contract period.

Quarterly (Four Times Per Year) Owner Training & System Evaluation: The BAS operator training and instructional program will be initiated to ensure that the owner/operators are instructed and trained on the many functions of their building management system. The building owner/operator will be taught to perform the following functions by factory trained,

authorized building automation service representatives. The building operators will learn how to perform daily operations including:

1) An overview of the building management system architecture and unit level controllers.
2) System logon/logoff procedures
3) Access system using menus and graphics
4) Respond to alarms
5) Make schedule changes
6) Monitor and command objects and properties
7) How to utilize and set up trends
8) Generate and save reports

C. Off-site Owner Training: Provide one off-site training class for the owner four hours in length. The training shall be customized using the color graphics software and database for this project. The training shall take place on a workstation with the ability to remotely communicate with the school system.

D. In addition to the operator training above, the following system points shall be trended daily within the system controller. The BAS contractor shall present and review a hard copy report of the recorded/trend data (as listed below) with the Owner during the quarterly visits to verify proper system operation/control:

1) Outdoor air temperature
2) Heat pump loop supply temperature
3) Heat pump loop return temperature
4) Space temperature set-point (per heat pump unit)
5) Actual space temperature (per heat pump unit)
6) Discharge air temperature (per heat pump unit)

E. This program will be performed on quarterly intervals with the building operators throughout the first year of system operation and warranty period.

F. The instructors shall be factory-trained instructors experienced in presenting this material.

END OF SECTION