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## SECTION 16100

### REMOVALS, TEMPORARY WIRING AND GOVERNMENT FURNISHED EQUIPMENT

#### PART 1 GENERAL

The work of this section will involve certain Government-furnished equipment. Some of the government furnished equipment is in storage at Lock and Dam No. 5A and shall be transported to the construction site by the Contractor.

##### 1.1 APPLICABLE PUBLICATIONS

Quality, characteristics and ratings of products such as switchboards, panelboards, circuit breakers, cables, etc. specified for the permanent installation are applicable to any temporary wiring and distribution systems that are installed under this contract. Publications referenced in SECTIONS: POWER DISTRIBUTION EQUIPMENT; LOCK ELECTRICAL WORK; LIGHTING SYSTEM; and COMMUNICATION SYSTEM; shall be considered a part of this section to the extent they apply to the work.

##### 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

###### SD-01 Data

Temporary Equipment Data; FIO.

Catalog cuts and specification sheets for cables and other equipment to be used for the temporary installation.

Maintenance Contact; FIO.

Submit the name of the individual acting as the Contractor's Maintenance Coordinator.

###### SD-04 Drawings

Contractor's Scheme for Implementing the Requirements for Keeping the Lock Operational; GA.

Drawings, details, riser diagrams, schematics showing the Contractor's scheme for implementing the requirements for keeping the lock operational while carrying on the construction work for the permanent installation. Prior to preparing such drawings and details, ascertain the requirements for lock operation from reference drawings and from lock personnel and incorporate all such requirements in the Contractor's scheme.

Temporary Switchboard and Panelboards; GA.

Drawings and details of temporary switchboard and panelboards to demonstrate that the temporary switchboard and panelboards will meet all of

the power distribution and control requirements for the entire lock during construction.

#### SD-08 Statements

Government Furnished Equipment Storage; FIO.

The Contractor shall submit a detailed description of the proposed storage facilities, and a plan for storage, maintenance and inspection before any storage actually begins.

## PART 2 PRODUCTS

### 2.1 GENERAL

#### 2.1.1 Government Furnished Equipment Storage

Upon delivery at the worksite, all items of the Government Furnished Equipment shall be stored in a weathertight building. A framework covered with a plastic film, or any other such expedient or makeshift arrangement, shall not be acceptable. The Contractor shall submit a detailed description of the proposed storage facilities, and a plan for storage, maintenance and inspection before any storage actually begins.

### 2.2 MATERIALS

Distribution switchboard modifications and panelboards in weatherproof enclosure, cables for power, control and communications and other equipment and accessories to be used for the temporary or transition phase shall be equal to that specified for the permanent installation under SECTIONS: POWER DISTRIBUTION EQUIPMENT, LOCK ELECTRICAL WORK, LIGHTING SYSTEM and COMMUNICATION SYSTEM.

#### 2.2.1 Government Furnished Equipment

The Government shall provide certain items as described in CONTRACT CLAUSE: GOVERNMENT FURNISHED ITEMS. Upon completion of this contract all of these items shall remain in the possession of the Government.

##### 2.2.1.1 General

Additional wiring information and installation details about the generator and automatic transfer switch will be provided prior to installation. Lock lighting and machinery control will require the addition of some circuit breakers, control relays, operators, pilot lights and revisions and additions to enclosures in MDP-1, MCC-1 and MCC-2 and also some wiring revisions as indicated. Adjustments to the wiring of control stands CS1 and CS2 shall be required during start-up to ensure correct operation. Such additions, revisions and fine-tuning of the controls during start-up are a part of this contract and shall be provided by the Contractor.

#### 2.2.2 Contractor Furnished Equipment

All material shall be new and unused and shall be in accordance with the respective publications and other requirements specified below or on the drawings. All materials shall be from a manufacturer who has manufactured similar equipment for at least 5 years and shall be manufactured in the United States.

#### 2.2.2.1 Contractor Provided Anchor Bolts

The Contractor shall provide and install anchor bolts for the Government furnished equipment, generator set assembly, MDP1, MCC1, MCC2 1CS and 2CS to affix this equipment to the floor of the new central control station or control stand building. Dimensions for location of each set of anchor bolts shall be measured directly from the equipment bases.

#### 2.2.3 Preparation

All equipment, cables, related accessories and necessary spare parts shall be on site prior to commencing work related to the rehabilitation of the lock electrical system.

##### 2.2.3.1 Switchboard MDP1

Modify MDP1 as follows: Change lugs to correct size for all circuit breakers that feed wire sizes greater than 1/0 AWG.

##### 2.2.3.2 Motor Control Center MCC2

Modify MCC2 by adding back panels relays timers lighting contactors and starters as shown and indicated. Verify and change the terminal blocks located in section TB-401 to accept the cables for the exterior lighting circuits. Move the terminal blocks as required to allow space for the new terminal blocks. Covers, on blank panels where equipment will be installed, shall be replaced with hinged door covers. Provide and install an additional MCC section that will match the existing sections. The additional section shall have hinged door covers. The new MCC section will be used for the installation of the new equipment as indicated.

##### 2.2.3.3 Motor Control Center MCC1

Modify MCC1 as shown and as described below.

- a. Modify CS1, and CS2 panels by adding operators, pilot lights and new panel top coverings as indicated in the contract drawings. The exteriors of CS1 and CS2 shall be cleaned and repainted with two coats of finished enamel, matching the existing color.
- b. Provide additional wiring and relays in MCC1 for the small boat signal circuit as shown.

### PART 3 EXECUTION

#### 3.1 GENERAL

The Lock and Dam shall remain operational during navigation seasons. Operational is defined as each miter gate, tainter valve, lock lights, guidewall lights, navigation lights, traffic lights and traffic horn having the ability to be remotely controlled from each of the two existing control stands and the existing CCS and local control of the upper tow haul unit, all jib cranes, radio communications and telephone communications.

##### 3.1.1 Navigation Season

The Contractor shall keep the lock operational either by use of existing

wiring systems or temporary wiring systems during the navigation season. The navigation season extends typically from March 1 to December 1, see SECTION 01000 GENERAL. All plans for temporary wiring and equipment must be submitted for approval prior to their installation.

#### 3.1.1.1 Maintenance

Contractor shall be responsible for maintaining all temporary power, control and lighting equipment installed by the Contractor to keep the system operating. Contractor's maintenance personnel shall be on call 24 hours a day during the navigation season. The response time to a maintenance call shall be within one hour. Contractor shall designate an individual who will be responsible for coordinating the maintenance aspect of such temporary systems.

#### 3.1.2 Dam Feeder

Maintain a 480V, 3 phase feeder to the dam year round until the permanent feeders from the new CCS can be energized. Power interruptions of these feeders shall be coordinated as described in SECTION: GENERAL.

#### 3.1.3 Lock Lighting System

Lock lighting system consisting of high mast, traffic, navigation, guide-wall lights, etc. and other general lighting for safety, communication system including small-boat intercom and river level monitoring are all considered as essential to lock operation. Maintain these lighting systems in a fully operable condition during the navigation season. General area and walkway (path) lighting for safety of personnel shall be maintained year round during construction.

#### 3.1.4 Tow Haulage Units

Maintain power wiring to tow haulage units.

#### 3.1.5 Convenience Outlets

Maintain power wiring to 120V convenience outlets on the lock and riverward walls for use by lock personnel during the navigation season.

#### 3.1.6 Jib Cranes

Maintain power wiring to jib cranes for use by lock personnel during the navigation season.

#### 3.1.7 Existing Switchboard

Upon completion and acceptance of the new power, control and lighting distribution system, the Contractor will be allowed to begin the removal of the existing switchboard.

#### 3.1.8 Interfering Locations of Equipment

During construction, the location of electrical equipment may have to be relocated on more than one occasion to facilitate installation of new work. The Contractor shall move and reconnect power and control wiring and equipment as often as required and maintain it in operating condition. The Contractor's attention is drawn especially to the work in the areas of the temporary Control Stands CS1 and CS2, which will require careful planning

and close coordination to keep the lock operational while carrying out all of the required construction activities in these areas.

#### 3.1.9 Damaged Equipment

Any existing equipment damaged by the Contractor's construction activities shall be promptly repaired or replaced by the Contractor at no cost to the Government.

#### 3.1.10 Ground System

Provide additional ground conductors and ground connections as required to maintain the integrity of the existing ground system during construction.

#### 3.1.11 Safety

All temporary installations by the Contractor shall be in compliance with all applicable State, Federal and OSHA regulations and shall be installed so as not to create a safety hazard for the Contractor's personnel nor the lock personnel.

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SECTION 16250

SANITARY SEWER DUPLEX PUMP PANEL

PART 1 GENERAL

This section includes the duplex pump control panels and devices, installation and connection of all motors and electrical equipment furnished for the sanitary sewer system. The electrical power feeders for the sanitary sewer system pump control panels shall be provided and installed under SECTION: LOCK ELECTRICAL SYSTEM.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARDS

ANSI C2	(1997) National Electrical Safety Code
ANSI C80.1	(1990) Rigid Steel Conduit - Zinc Coated
ANSI C119.1	(1986) Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI C135.30	(1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) PUBLICATIONS

ASTM D 709	(1992) Laminated Thermosetting Materials
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA) STANDARDS

NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Control Devices, Controllers and Assemblies
NEMA ICS 3	(1993) Industrial Systems
NEMA ICS 4	(1993) Industrial Control and Systems Terminal Blocks
NEMA ICS 6	(1993) Industrial Controls and Systems Enclosures
NEMA RN 1	(1989) Polyvinyl-Chloride (PVC) Externally Coated Rigid Steel Conduit and Intermediate Metal Conduit

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) PUBLICATIONS

NFPA 70	(1996) National Electrical Code
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UNDERWRITERS' LABORATORIES, INC. (UL) PUBLICATIONS

UL 6	(1993) Rigid Metal Conduit
UL 44	(1991; Rev thru Jan 1995) Rubber-Insulated Wires and Cables
UL 83	(1991; Rev thru Oct 1994) Thermoplastic-Insulated Wires and Cables
UL 467	(1993) Grounding and Bonding Equipment
UL 508	(1993) Industrial Control Equipment
UL 943	(1993; Rev thru Jan 1995) Ground-Fault Circuit Interrupters

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Bill of Materials; FIO.

Submit a bill of materials for all components and devices supplied. Identify each item by name, manufacturer, catalog number or model number and quantity furnished. Include catalog cuts of all material.

Equipment Settings; FIO

Submit the final field settings for adjustable equipment.

SD-04 Drawings

Pump Panel Shop Drawings; GA.

Submit shop drawings for equipment as follows.

- a. Dimensioned outline drawing of the duplex pump panel enclosure. Include mounting supports.
- b. Elementary and internal wiring diagrams for the power and control system.
- c. Device nameplate list. Supply a sample nameplate.

SD-13 Certificates

UL Certification; FIO

Submit written certification of the UL serialized label for the pump control panel.

SD-19 Operation and Maintenance Manuals

Operation and Maintenance Manual; FIO

Submit 4 copies of the operation and maintenance manuals.

## PART 2 PRODUCTS

### 2.1 GENERAL

The pump supplier shall furnish the duplex pump panel and equipment and supervise its installation. The equipment shall be supplied complete and ready for use without field modification.

#### 2.1.1 Rules

Unless otherwise specified all work shall comply with the National Electrical Code, NFPA 70, AND SECTION: LOCK ELECTRICAL SYSTEM. The wet well is designated as a Class 1, Division 1 hazardous location.

#### 2.1.2 UL Ratings

The pump control panel construction shall comply with the requirements of Underwriter's Laboratories Industrial Control Panels listing and follow-up service. Use only UL listed and recognized components.

#### 2.1.3 Coordination

Make all changes to the electrical design at no additional cost if the pumps supplied have electrical ratings and characteristics different from the pumps specified or shown. Provide the calculations used to make revised component selections. Revised selections shall comply with the specifications. Verify that final field adjustments comply with factory recommendations.

#### 2.1.4 Storage and Shipment

Store all electrical materials and equipment at the site in trailers or temporary buildings which provide protection from the effects of weather. The Contracting Officer reserves the right to approve storage facilities for electrical materials and equipment. Wrap pump panel enclosure surfaces in a protective plastic wrap before crating and shipment. Crate the pump control panel to protect it from damage during shipment and storage.

#### 2.1.5 Operation and Maintenance Manuals

Prepare an operation and maintenance manual for the duplex pump panel and control equipment. Manuals shall be made up with hard cover post type binders. Include index, tabbed section dividers, all approved shop drawings, installation, and maintenance instructions packed with equipment, and parts lists. Provide a written description of equipment operation, special features and maintenance requirements. Provide instructions for setting all adjustable components. Record the final field settings of all adjustable components in a comprehensive table. Large sheets shall be neatly folded and installed with post hole reinforcements such that sheets will unfold without need to open binder posts.

### 2.2 MATERIALS

#### 2.2.1 Conductors

Cables shall conform to UL 83 and shall be of annealed copper. Conductor size shall be based on the requirements of the National Electrical Code. Cables shall be single-conductor type, unless otherwise noted.

#### 2.2.1.1 Control Wire

Provide UL listed, #14 AWG., (41/31) flexible stranded, copper wire. Control wire insulation shall be 90 degree C, XLP type SIS, rated for 600 Volt operation.

#### 2.2.1.2 Grounding Cables

Grounding cables shall be bare or shall have green low-voltage insulation.

#### 2.2.2 Conduit Systems

Provide all raceway, fittings, outlet boxes, junction and pull boxes, supports, sleeves, and other appurtenances required to provide a complete raceway system.

- a. Rigid Heavy Wall Conduit. UL 6.
- b. PVC Coated Rigid Steel Conduit. NEMA RN 1. All components and accessories for this type of raceway system shall be provided by one manufacturer.

#### 2.2.3 Duplex Pump Panel Enclosure

NEMA 3R enclosure, welded seamless construction. Material shall be 14 gauge, Type 304, stainless steel unless noted.

- a. Weatherdoor. Gasketed continuously hinged, weatherdoor(s) with doorstop kit. Three point latch with padlock provision.
- b. Deadfront. Continuously hinged deadfront held closed with two slotted nickel plated brass captive panel screws with knurled edges to allow for finger or screwdriver tightening.
- c. Backpanel. Fixed rigid backpanel, 12 gauge hot-dipped galvanized steel, white baked enamel finish.
- d. Mounting Lugs. Mounting lugs shall be provided on the enclosure for mounting on the wall.
- e. Hardware. Stainless steel bolts, nuts, washers, lockwashers, and machine screws.

#### 2.2.4 Control Devices

##### 2.2.4.1 Combination Magnetic Starters

Provide full voltage across-the-line magnetic type motor starters designed for use with Class 10, 20, and 30 rated overload devices. Provide molded construction coils. Replacement coil and contacts shall not require the removal of the starter or power wiring from the control panel. Starters shall meet NEMA IC1 and NEMA IC2, UL 508 and NEC requirements. Half-size rated starters not permitted. Size starter for motor supplied. Square D Class 8536, Type S, Allen-Bradley Bulletin 500, Cutler-Hammer File A10 or

equal.

- a. Motor Overload Protection. Provide manual reset temperature compensated, Melting alloy thermal overload relays. When applicable provide a manual reset temperature compensated overload to protect the motor start winding. Size overloads for motors supplied in accordance with the National Electrical Code.

#### 2.2.4.2 Relays

Provide NEMA B300, general purpose plug-in relays. Operating temperature -45 degrees C to +45 degrees C. Three Form C (3PDT) Silver Cadmium Oxide contacts rated 120/240 volts, 10 amps continuous, 30/15 amps make, 3/1.5 amps break. Continuous rated coils with AC pickup voltages of 85% of nominal voltage at 60 Hertz, 25 degrees C. Coil voltage as required. Transparent polycarbonate dust cover, 11 blade plug-in base. Rail mounted relay base with retainer clips to secure relay in socket. Square D Class 8501, Type K, Allen-Bradley Bulletin 700, Type HB, Cutler-Hammer File D5 or equal.

- a. Time Delay Relays. Provide NEMA B300, general purpose plug-in adjustable time delay relays. Operating temperature -10 degrees C to +55 degrees C. Two Form C (DPDT) silver cadmium oxide contacts rated 120/240 volts, 10 amps continuous, 30/15 amps make, 3/1.5 amps break. Voltage range +10%, -15% of nominal at 60 HZ for AC operation. Operating voltage as required. Repeat accuracy +/-1% for constant voltage and temperature, +/-10% for any variation of voltage and temperature within specifications. Timing range and "OFF" or "ON" delay as required for application. Polycarbonate dust cover with adjustable timing dial. Eight pin tube or blade type plug-in base. Rail mounted relay base with retainer clips to secure relay in socket. Square D Class 9050, Type JCK, Allen-Bradley Bulletin 700, Type H, or equal.

- b. Alternator Relay. Provide general purpose, plug-in, duplex alternating relay. Operating temperature -20 degrees C to +55 degrees C. Two Form C (DPDT) Silver Cadmium Oxide contacts rated 120/240 volts, 10 amps continuous, 30/15 amps make, 3/1.5 amps break. Continuous rated operating duty. Solid-state alternating circuit driving electrical-mechanical relay coil. Coil shall have AC pickup voltages of 85% of nominal voltage at 60 Hertz, 25 degrees C. Coil voltage shall be as required. Relay enclosed in polycarbonate dust cover with state indicating LEDs in cover. 11 pin tube or blade type plug-in-base. Rail mounted relay base with retainer clips to secure relay in socket. TimeMark Model 261 series, Diversified Electronic, Inc. Duplexors or equal.

#### 2.2.4.3 Push-button, Selector Switches and Pilot Lights

Provide heavy duty, oil-tight, watertight NEMA 4 control units. 1-3/16 inch minimum knockout diameter. Pilot lights shall be push to test transformer type. Pilot lights and pushbuttons which require boots to make complete station watertight are NOT PERMITTED. Provide contact blocks suitable for side-by-side and tandem mounting to the operator base. Contact blocks shall have captive mounting screws, with drilled and tapped heads to permit easy tandem mounting of contact blocks. Square D Class 9001, Type X, Cutler-Hammer Type T, Allen Bradley Bulletin 800H, or equal.

#### 2.2.4.4 Running Time Meters

Provide non-resetable hour indicating time meters with 6 digit registers. Numbers shall be at least 1/4 inch high. Registers shall have white numbers on black background. Last digit shall have contrasting colors to indicate tenths of an hour. Enclosure shall be at least 3-1/2 inches square or round. Unit shall be designed for 120VAC operation. General Electric, Type 240, Simpson Model 2153ET, or equal.

#### 2.2.4.5 Liquid Level Sensors

Provide direct acting float switches for level detection. Molded polyethylene body. Internal redundant polyurethane foam flotation. Potted switch and cable connections. Fine stranded 18 AWG cable with heavy duty synthetic rubber jacket. Length as required. Floats shall be connected to control circuitry via an intrinsically-safe, transducer signal module.

#### 2.2.4.6 Terminal Blocks

Provide channel mounted sectional type terminal blocks rated 600 Volts, 20 Amp minimum. Provide terminal blocks with flat terminal connectors for power and control conductors No. 12 AWG and smaller. Provide terminal blocks with solderless box lugs for power and control conductors larger than No. 12 AWG. Square D, Class 9080, Type G, Allen-Bradley Bulletin 1492, Style C or equal.

#### 2.2.4.7 Nameplates

Provide laminated sheet plastic nameplates, 1/16 inch thick conforming to ASTM D 709. Nameplates shall have matte black finish with white center core, square corners, beveled and minimum 3/16 inch block lettering. Minimum nameplate dimensions shall be 3/4 inch by 2-1/2 inch. Fasten nameplates with rivets, sheet metal screws or permanent adhesive.

#### 2.2.5 Disconnect Switches

Provide Type HD, horsepower rated where applicable. UL Service Equipment listing required when applicable.

#### 2.2.6 Grounding and Bonding Equipment

UL 467.

#### 2.2.7 Alarm Beacon

The alarm beacon globe shall be NEMA 4X, red lexan. The globe shall be mounted to the pump panel enclosure with stainless steel screws and a closed cell neoprene gasket to insure watertight integrity. The bulb and socket shall be removable from the inside pump panel without the use of any tools. A 40 watt rough service lamp shall be used in the alarm beacon. The alarm light shall glow dim during normal operations and flash with normal intensity during alarm conditions. The flasher shall be solid state, totally encapsulated and shall flash the alarm beacon at a rate of approximately 60 flashes per minute. Ohio Electric or equal.

#### 2.2.8 Audible Alarm

Provide a weatherproof audible alarm horn on the exterior of the enclosure. The horn shall provide 103 db output adjustable on the front from 103 db to 78 db. Operating voltage as required. Edwards Adaptahorns or equal.

## PART 3 EXECUTION

### 3.1 INSTALLATION

#### 3.1.1 Grounding and Bonding

Ground the electrical system in accordance with the National Electrical Code, NFPA 70. The pump panel, sump vent, access hatch frame, pump guide rails, and discharge piping shall be bonded together with an equipment grounding conductor sized in accordance with the National Electrical Code. Each ground connection shall be made with mechanical connectors or exothermic welds (Cadweld) and shall be accessible for inspection and checking. Ground conductors shall be stranded copper.

#### 3.1.2 System Operation

Provide a three float duplex pump alternator control system to operate the sewage pumps in accordance with variations in wet well levels. One float shall be set to provide "Common-Off", "Pump-Alternation" operation. The remaining two floats shall provide "Lead", "Lag" and "High Level Alarm: operation respectively. The alternator circuit shall permit the selection of "1-2, Auto, 2-1" pump operation and provide staggered restart. Each level sensor alarm circuit shall include a three position, "Test-Off-Normal" selector switch which will allow simulation of sensor operation for test purposes. The entire control assembly shall operate from a 24 volt power supply.

##### 3.1.2.1 Alarms

Unless otherwise noted, each pump alarm shall actuate a separate seal-in circuit to prevent operation of the affected pump until the alarmed condition has been cleared and the circuit manually reset. Provide local indication of alarmed conditions. Use pilot lights with identification nameplates for local alarms. Provide Test and Reset pushbuttons for alarm circuits. Pump alarm circuit operation shall not be affected by momentary power interruptions.

- a. Wet Well High Level Alarm. Provide "quelled" alarm float operation. High level alarm shall activate an indicator light on deadfront and an alarm beacon and horn mounted on the enclosure. Provide alarm silence push-button to acknowledge alarm and turn off horn. Beacon and indicator light shall reset when alarm condition has cleared.
- b. Motor Over Temperature Alarm. The alarm circuit shall be actuated by thermal sectors embedded in the stator windings of the pump motors.
- c. Motor Overload Tripped Alarm. The alarm circuit shall be actuated by the pump motor thermal overload relay.

#### 3.1.3 Enclosure

The enclosure shall be designed as specified in paragraph "MATERIALS". All selector switches, circuit breakers, and similar devices shall be semi-flush mounted on the deadfront so that all the components normally actuated by operating personnel are accessible without opening the deadfront, and yet are not exposed to the elements or to unauthorized

personnel. The enclosure shall be designed and constructed to accept all of the control equipment as specified. The enclosure shall have suitable conduit openings in the bottom to accommodate incoming feeder, branch power, and control to eliminate field cutting the enclosure.

#### 3.1.4 Control Wiring

Loop wire for proper twist rather than bending at hinge points. Bundle power and control wire neatly. Use nylon tie wraps or continuous plastic spiral binding to secure wire bundles behind devices mounted through deadfront. Tie-wrap bases installed on the back-panel shall be screw attached. Tie-wrap bases installed on enclosure exterior wall shall be attached with a two-part epoxy approved by the Contracting Officer. Use "Panduit" wiring channel to route wire to devices mounted on backpanel. Use insulated fork type compression lugs on both ends of each control wire. The use of splices or wire nuts is not permitted.

#### 3.1.5 Terminal Blocks

Locate terminal blocks for external connection near bottom of enclosure. Use no more than one wire per terminal point. Identify and segregate power conductors and terminals.

#### 3.1.6 Identification

Identify each wire and device as indicated on approved elementary drawings. Provide screw-applied, engraved, black, laminated plastic nameplates with white letters for control equipment mounted on the deadfront and backpanel. Label control wires 2" from each termination with properly sized and oriented, heat-stamped, black on yellow PVC sleeve markers. Label all terminal blocks with pre-printed vinyl-cloth markers. The use of "DYMO" type labels is not permitted.

#### 3.1.7 Control Components

The control system shall be designed and constructed to include the following control components installed in the specified enclosure, along with the necessary interconnecting wiring, terminal blocks and miscellaneous devices for a complete control system:

- a. UL listed disconnect switch with provision for locking in the off position.
- b. Individually mounted branch circuit breaker for each pump.
- c. NEMA rated full voltage magnetic starters with ambient compensated overload elements in each phase for each pump.
- d. Hand-Off-Automatic control stations, O.L. reset controls, and running time meter, for each pump motor.
- e. Pump alternator with associated relays, and selector switches.
- f. Pump Motor Overtemperature protector for each motor, including motor temperature sensor, manual reset PB, and switchable override.
- g. Pump Required, Pump Run, OL Tripped, and Overtemp pilot lights and push-buttons for each pump.

- h. Top mounted weatherproof high level alarm light and horn with servicing disconnect.
- i. Sufficient space to permit convenient servicing.
- j. Motor start or run capacitors, or any other device furnished with the motors and deemed by the motor supplier as necessary for the proper or efficient operation.
- k. Supply and integrate all motor protection or control modules, required for the supplied pump. All sensors and alarm circuits shall be completely operational.

### 3.1.8 Duplex Panel Installation

The duplex pump panel shall be rigidly mounted as indicated in the plans. All conduits entering the pump panel shall be sealed to prevent the entrance of moisture. Use explosion-proof fittings on conduit runs which enter the sump. Install and connect pump and float, power and control cables. Adjust float switches to operate at the elevations shown on the drawings.

#### 3.1.8.1 Wet Well Connections

All conductors from the wet well to the junction box enclosure shall be installed without splice.

#### 3.1.8.2 Sensors

Float level switches shall be supported from one vertical column. The sensors shall be supplied with sufficient cable to reach the junction box enclosure.

#### 3.1.9 Spare Parts

##### 3.1.9.1 Accessories and Special Tools

Provide a complete set of accessories and special tools required to erect, handle, dismantle, test, and maintain the equipment supplied.

##### 3.1.9.2 Spare Parts

Spare parts shall be identical in all respects to corresponding original equipment provided.

##### 3.1.9.3 Spare Parts Required

- One complete set of fuses, 10 fuses of each type and size.
- One circuit breaker auxiliary contact, when used, for each type and size breaker.
- One complete relay for each type provided.
- One operating coil for each size of ac contactor provided.
- One complete set of 3 pole or 2 pole stationary and moving contact assemblies for each size of ac contactor provided.

- One set overload relays for each type and rating provided.
- One pilot light with lens for each type provided.
- One contactor auxiliary contact for each type provided.

### 3.2 FACTORY INSPECTION AND TESTS

#### 3.2.1 General

After the installation is completed, and at such time as the Contracting Officer may direct, the Contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements of this specification. The test shall be performed in the presence of the Contracting Officer. The Contractor shall furnish all instruments and personnel required for the tests, and the Government will furnish the necessary electric power.

#### 3.2.2 Duplex Pump Panel Test

Give each item of equipment supplied a routine functional test and also other tests specified. The pump panel shall not be shipped until it has been inspected at the factory by the Contracting Officer. Before shipment from the factory and also after final field installation check the operation and adjustment of all control devices, accessories and indicating lamps. These checks shall be made at rated voltage with power supplied to the control power circuit. Verify that adjustable devices are set in accordance with manufacturer's recommendations before shipment. Provide a list of the recommended device settings for shipment with the control panel and O&M manuals for future reference.

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POWER DISTRIBUTION EQUIPMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARDS

ANSI C2 (1997) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA) STANDARDS

NEMA AB 1 (1993) Molded Case Circuit Breakers and Molded Case Switches

NEMA ICS 1 (1993) Industrial Control and Systems

NEMA ICS 2 (1993) Industrial Control Devices, Controllers and Assemblies

NEMA ICS 3 (1993) Industrial Systems

NEMA ICS 4 (1983) Industrial Control and Systems Terminal Blocks

NEMA ICS 6 (1993) Enclosures for Industrial Controls and Systems

NEMA PB 1 (1990) Panelboards

NEMA PB 2 (1989) Deadfront Distribution Switchboards

NEMA PB 2.1 (1991) Handling, Installation, Operation, and Maintenance of Dead-Front Switches Rated 600 Volts or Less

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) PUBLICATIONS

NFPA 70 (1996) National Electrical Code

UNDERWRITERS' LABORATORIES, INC. (UL) PUBLICATIONS

UL 03 (1995 with Quarterly Supplements) Electrical Construction Materials Directory

UL 67 (1993; Rev thru Dec 1993) Panelboards

UL 98 (1994, Rev Feb, 1995) Enclosed and Dead-Front Switches

UL 198C	(1986; Rev thru Jun 1993) High-Interrupting-Capacity Fuses, Current-Limiting Types
UL 198H	(1988; Rev thru Nov 1993) Class T Fuses
UL 467	(1993) Grounding and Bonding Equipment
UL 489	(1991; Rev thru Jun 1995) Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
UL 506	(1994; Rev Jul 1994) Specialty Transformers
UL 845	(1995) Motor Control Centers
UL 508	(1993) Industrial Control Equipment
UL 869A	(1993; Rev Apr 1994) Reference Standard for Service Equipment
UL 891	(1994; Rev thru Jan 1995) Dead-Front Switchboards
UL 943	(1993; Rev thru Jan 1995) Ground-Fault Circuit Interrupters

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-01 Data

Spare Parts Data; FIO.

The manufacturer's spare parts data shall be included in the instruction manuals and correlated with the respective item of equipment included as a component part of the switch assembly. Spare parts data shall include the list of recommended spare parts published by the manufacturer of the equipment. The source of supply shall be indicated along with the current cost of recommended spare parts. Spare parts data is not required for Government furnished equipment. See paragraph: Spare Parts.

### SD-04 Drawings

Shop Drawings; GA.

Shop drawings shall be submitted for approval and shall consist of a complete list of equipment and materials, including manufacturer's descriptive and technical data; catalog cuts; and any special installation instructions that may be required. Shop drawings shall be submitted for all materials and equipment specified.

Electrical Drawings; GA.

A one-line diagram of each panelboard shall be provided. In addition, the Contractor shall provide an interface equipment connection diagram that shall show all conduit and wiring between the ATS, primary service, standby service, alarm annunciator and generator fuel transfer equipment. Device and nameplate numbers and item numbers shown on the list of equipment and materials shall appear on drawings wherever the item of equipment or material appears. The interconnection diagram shall show interlocking provisions and cautionary notes, if any. Operating instructions shall be shown on the interconnection diagram or separately, at the discretion of the Contractor. The Contractor shall adapt the manufacturer's approved operating instructions for the ATS from the Government furnished manuals and they shall be laminated in plastic and permanently secured to the cabinet where the operator can see them. The one-line diagram shall be laminated in plastic and permanently secured to the inside of the front enclosure door. Unless otherwise approved, the one-line and elementary or schematic diagrams shall appear on the same drawing.

#### SD-07 Schedules

Equipment and Materials; GA.

A complete list of equipment and materials proposed, containing an adequate description of each separate item of equipment or materials recommended for approval, shall be furnished. The quantity of each item described shall be indicated.

#### SD-13 Certificates

UL Publications; FIO.

The label or listing of the Underwriters Laboratories Inc., will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this label or listing, the Contractor shall submit a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements. However, materials and equipment installed in hazardous locations must bear the UL label unless the data submitted from other testing agency is specifically approved in writing by the Contracting Officer.

Non-UL Publications; FIO.

For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable Federal Specification, or standard of ASTM, NEMA, or other commercial standard, is acceptable.

Certificate of Compliance; FIO.

Certificates of compliance will be accepted as proof of compliance when equipment or materials are required to conform to UL standards, or to be manufactured and/or tested by NEMA standards. Such certificates are not required if manufacturer's published data submitted and approved reflect a UL listing or conformance with applicable publications of the NEMA. Otherwise, evidence of a UL listing, or conformance with applicable NEMA standards, shall be submitted, as appropriate. Proof of the listing by the UL, or conformance with the applicable publications of the NEMA, does not relieve the Contractor of compliance with other provisions of these

specifications.

#### SD-18 Records

GUARANTEE; FIO.

The equipment furnished under this section shall be guaranteed against defective material, design, and workmanship for the period of one (1) year from the date of acceptance. Upon receipt of notice from the Government of failure of any part of the guaranteed equipment during the guarantee period, new replacement parts shall be furnished and installed promptly by the Contractor at no cost to Government.

#### SD-19 Operation and Maintenance Manuals

Instruction Manuals; FIO.

Six copies of instruction manuals shall be furnished within 7 calendar days following the completion of factory tests and shall include assembly, installation, operation and maintenance instructions, spare parts data which provide supplier name, current cost, catalog order number, and a recommended list of spare parts to be stocked and documents submitted and approved. Manuals shall also include data outlining step-by-step 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 and their basic operating features shall also be included. Documents shall be bound in a suitable binder adequately 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 instruction manuals shall be submitted within 30 calendar days following the approval of the manuals. Instruction Manuals are not required for Government furnished equipment.

## PART 2 PRODUCTS

### 2.1 GENERAL

#### 2.1.1 Standard Product

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 5 years prior to bid opening. The experience use shall include applications of equipment and materials under similar circumstances and of the same design and rating as the equipment specified.

#### 2.1.2 Identification Nameplates

Major items of electrical equipment and major components shall be permanently marked with an identification name to identify the equipment by type or function and specific unit number as indicated. Unless otherwise specified, all identification nameplates shall be made of laminated plastic in with black outer layers and a white core. The material shall be

electrically non-conducting, abrasion resistant and good for temperatures up to 160 degrees F. Edges shall be chamfered. Plates shall be fastened with black-finished round-head drive screws or approved nonadhesive metal fasteners. When the nameplate is to be installed on an irregular shaped object, the Contractor shall devise an approved support suitable for the application. In all instances, the nameplate shall be installed in a conspicuous location. At the option of the Contractor, the equipment manufacturer's standard embossed nameplate material with black paint-filled letters may be furnished in lieu of laminated plastic. The following equipment, as a minimum, shall be provided with identification nameplates:

Minimum 1/4-Inch High Letters

Automatic Transfer Switches  
Panelboards  
Starters  
Safety Switches,  
Transformers  
Equipment Enclosures  
Switchboards

Minimum 1/8-Inch High Letters

Control Power Transformers  
Control Devices (Relays,  
Contactors, etc.)

2.1.3 Code Compliance

The installation shall comply with the requirements and recommendations of NFPA 70 and ANSI C2.

2.1.4 Coordination

The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment will be properly located and readily accessible. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change.

2.1.4.1 Relocation of Electrical Service

The contractor shall coordinate the relocation of the electric service with the Electric Power Company that provides electric service to the Lock and Dam. The Contractor shall pay all costs for relocation of the electric service including any charges payable to the Electrical Power Company.

2.1.5 Verification of Dimensions

The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy or conflicts before performing any work.

2.1.6 Manuals for Government Furnished Equipment

Installation and Operation Manuals for the generator, annunciator, and ATS will be provided to the Contractor by the Government. See also SECTION: REMOVALS, TEMPORARY WIRING AND GOVERNMENT-FURNISHED EQUIPMENT for equipment model names and manufacturer.

2.2 MATERIALS

Materials and equipment shall be installed in accordance with

recommendations of the manufacturer and as shown. Materials and Equipment shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this section.

#### 2.2.1 Fuses

- a. Cartridge Fuses. Nonrenewable, dual element, time lag type, UL 198.
- b. Current Limiting Fuses. UL 198C and UL 198H.

#### 2.2.2 Circuit Breakers

Molded-Case Circuit Breakers. NEMA AB 1 and UL 489. Circuit breakers shall be bolt-on type, molded case breakers, and shall have voltage, current, and interrupting ratings as indicated. Single-pole breakers shall be full module size; two poles shall not be installed in a single module. Multipole breakers shall be of the common-trip type having a single operating handle but for sizes of 100 amperes or less may consist of single-pole breakers permanently factory assembled into a multipole unit having an internal, mechanical, nontamperable common trip mechanism and external handle ties. Breakers shall have interchangeable, adjustable magnetic, trips in 225 amperes frame and larger. Breakers equipped with ground fault interrupters shall have ground fault class, interrupting capacity, and voltage and current ratings indicated.

##### 2.2.2.1 Circuit Breaker Lockout/Tagout requirements

- a. The Contractor shall provide lockouts for all new circuit breakers and the Contractor shall provide lockouts for all Government furnished circuit breakers except those located in MCC1. All Government furnished circuit breakers are manufactured by Square D Company.
- b. The Contractor shall supply a Lockout Station to the Contracting Officer, specifically a Ten Lock Station with components.
- c. The Contractor shall supply one(1) Lockout Sign to the Contracting Officer for each switchboard or panelboard including MCC1. Sign shall read; "**CAUTION** LOCKOUT BEFORE DOING MAINTENANCE" Minimum size shall be 5"x 7" Black lettering on Yellow Vinyl.

#### 2.2.3 Ground Fault Interrupters

UL 943, Class A or B.

#### 2.2.4 Panelboards

NEMA PB 1 and UL 67. Lighting and appliance power feeder, and distribution panelboards, Class 1, type as specified. Wall-mounted panelboards shall not exceed 78 inches in height, and shall be mounted such that the height of the top operating handle does not exceed 6 feet 6 inches from the floor. Floor-mounted distribution panels shall not exceed 92 inches in height. Door locks shall be keyed alike. Nameplates shall be as approved. Directories shall be typed to indicate loads served by each circuit and mounted in a holder behind a clear protective covering.

#### 2.2.5 Instruments, Electrical Indicating

ANSI C39.1.

#### 2.2.6 Motor Controls and Motor Control Centers

NEMA ICS 1, NEMA ICS 2, NEMA ICS 3, NEMA ICS 4 and NEMA ICS 6, and UL 508 and UL 845.

#### 2.2.7 Service Equipment

UL 869.

#### 2.2.8 Switchboard, Dead Front Distribution

NEMA PB 2 and UL 891.

#### 2.2.9 Grounding and Bonding Equipment

UL 467. See also SECTION: LOCK ELECTRICAL WORK.

#### 2.2.10 Service Entrance Switchboard

Switchboard shall be freestanding and shall conform to NEMA PB2 and UL 891. A hinged front panel suitable for mounting meters and sockets on the front shall be provided. The front panel shall be equipped with utility sealing provisions. Unit shall accommodate current transformers furnished by power company (Northern States Power Company). Contractor shall install power company furnished meter sockets and current transformers. Power company will provide meter wiring. The switchboard dimensions shall not exceed the following maximum dimensions: 90 inches high, 30 inches wide, and 15 inches deep. The metering compartment and switchboard shall comply with all requirements of the power company. The unit shall have minimum ratings of 480/277 VAC, 800A, 3 phase, 4 wire, with short circuit interrupting capacity not less than 22,000 Amperes RMS Sym.

#### 2.2.11 Motor Control

Each motor or group of motors requiring a single control and not controlled from a motor-control center or starters specifically noted in this section shall be provided under other sections of these specifications with a suitable controller and devices that will perform the functions as specified for the respective motors. Each motor of 1/8-HP or larger shall be provided with thermal overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double-pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating. Automatic control devices such as thermostats, float or pressure switches may control the starting and stopping of motors directly, provided the devices used are designed for that purpose and have an adequate horsepower rating. When the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit. When combination manual and automatic-control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch shall be provided for the manual control. When the automatic-control device actuates the pilot control circuit of a magnetic starter, the latter shall be provided with a three-position selector switch marked HAND-OFF-AUTOMATIC.

Connections to the selector switch shall be such that only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any HAND-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts ac, unless otherwise indicated.

a. Combination Starters. Combination starters shall be full-voltage magnetic starters, three-pole non-reversing, rated for 480 volts ac, NEMA size 1 minimum. Starters shall be provided with 480-120 volt control power transformers and heavy duty, oiltight pilot and control devices.

b. Pumps. Combination starters in NEMA 12 enclosures shall be provided for pumps in the Central Control Station Building and in the Old Central Control Station Building as indicated on the drawings.

2.2.12 Transformers

Dry-Type Utilization Transformers. UL 506 as modified herein. Utilization transformers shall be general-purpose dry-type in an indoor enclosure. Single or three-phase transformers shall have not less than two windings per phase. Use of dry type transformers is limited to 500 kVA maximum. Use of auto-transformers is not allowed. Full-capacity NEMA standard taps shall be provided in the high-voltage winding. "T" connected transformers may be provided in the range of 15 kVA and less.

a. Three-phase Transformers. Three-phase transformers shall be dry type, with 220 C insulation system and designed for full load operation at a maximum temperature of 80 C above a 40 C ambient.

b. Transformer Sound Levels. Transformers with sound levels with sound levels greater than 50 dBs shall be installed on resilient, vibration-isolating mountings to prevent amplification of sound. Transformers shall have sound levels tested and guaranteed by the manufacturer not to exceed the following:

Transformer	Average Sound
<u>Rating, kVA</u>	<u>Level, Decibels</u>
0-9	40
10-50	45
51-150	50
151-300	55
301-500	60

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Painting and Finishing

#### 3.1.1.1 Field Painting

Ferrous surfaces shall be cleaned and painted. Surfaces to be painted shall be free of all oil, grease, welding slag and spatter, mill scale, deleterious corrosion, dirt and other foreign substances. Painting shall include at least one coat of rust-inhibiting primer and one coat of finish enamel. The rust-inhibiting primer shall be applied to a clean, dry surface as soon as practicable after cleaning. Painting shall be manufacturer's standard material and process except that the total dry film thickness shall be not less than 2.5 mils. Color of the finish coat may be the manufacturer's standard color, if approved, or an approved ANSI61 Gray. The finish shall be free from runs, sags, peeling or other defects.

#### 3.1.1.2 Factory Coat

Field-applied paint on exposed surfaces shall be provided under SECTION: PAINTING, GENERAL.

#### 3.1.2 Switchboard

The switchboard shall be installed as indicated and in accordance with approved manufacturer's instructions.

#### 3.1.3 Tests

After the building and lock-wiring-system installation is completed, and at such time as the Contracting Officer may direct, the Contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements of this specification. The test shall be performed in the presence of the Contracting Officer. The Contractor shall furnish all instruments and personnel required for the tests, and the Government will furnish the necessary electric power.

##### 3.1.3.1 Automatic Transfer Switch

The Contractor shall demonstrate that all features of the Government-furnished automatic transfer switch are operational and properly interface with the Government-furnished generator and controls.

##### 3.1.3.2 Generator

The Contractor shall provide the services of a ONAN manufacturers authorized field service engineer to supervise the start-up and testing of the Government-furnished generator, its auxiliary equipment, controls and the automatic transfer switch.

##### 3.1.3.3 Switchboard MDP-1

The Contractor shall demonstrate that all features of the Government-furnished switchboard are operational and make any corrections necessary to bring it into compliance.

#### 3.2 SPARE PARTS

Spare parts do not apply to Government-furnished equipment. Provide a complete set of accessories and special tools required to erect, handle, dismantle, test, and maintain electrical system apparatus. Spare parts shall be identical in all respects to corresponding original equipment

provided. Spare parts required include:

- a. One complete set of fuses, 10 fuses of each type and size.
- b. One circuit breaker auxiliary contact, when used, for each type and size breaker.
- c. One complete relay for each type provided.
- d. One operating coil for each size of ac contactor provided.
- e. One complete set of 3 pole or 2 pole stationary and moving contact assemblies for each size of ac contactor provided.
- f. One set overload relays for each type and rating provided.
- g. One pilot light with lens for each type provided.
- h. One contactor auxiliary contact for each type provided.
- i. Twelve one-quart containers of finish paint for electrical equipment (outside surface)

-- 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 in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARDS

ANSI C2	(1997) National Electrical Safety Code
ANSI C80.1	(1990) Rigid Steel Conduit - Zinc Coated
ANSI C119.1	(1986) Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI C135.30	(1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) PUBLICATIONS

ASTM A 36/36M	(1996) Structural Steel
ASTM A 48M	(1994) Gray Iron Castings
ASTM A 123 E1 Rev A	(1989) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(1995) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM B 8	(1995) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 117	(1995) Salt Spray (Fog) Testing
ASTM B 174	(1995) Bunch-Stranded Copper Conductors For Electrical Conductors
ASTM C 478 Rev A	(1995) Precast Reinforced Concrete Manhole Sections
ASTM D 709	(1992) Laminated Thermosetting Materials
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2447	(1995) Polyethylene (PE) Plastic Pipe, Schedules 40 and 80 Based on Outside Diameter

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 142	(1991) Recommended Practice for Grounding of Industrial and Commercial Power Systems
IEEE 383	(1974 R 1992) Type Test of Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA) STANDARDS

NEMA FB 1	(1993) Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
NEMA FG 1	(1993) Fiberglass Cable Tray Systems
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Control Devices, Controllers and Assemblies
NEMA ICS 3	(1993) Industrial Systems
NEMA ICS 4	(1993) Industrial Control and Systems Terminal Blocks
NEMA ICS 6	(1993) Industrial Controls and Systems Enclosures
NEMA KS 1	(1990) Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
NEMA MG 1 Incl Rev 1	(1987) Motors and Generators
NEMA OS 1	(1989) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA RN 1	(1989) Polyvinyl-Chloride (PVC) Externally Coated Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(1990) Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA TC 6	(1990) PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA VE 1	(1991) Metallic Cable Tray Systems
NEMA WC 7 (ICEA S-66-524)	(1988) Cross-Linked-Thermosetting-Polyethylene Insulated Wire And Cable For The Transmission And Distribution of Electrical Energy
NEMA WC 8	(1988) Ethylene-Propylene-Rubber-Insulated

(ICEA S-68-516) Wire and Cable for the Transmission and Distribution of Electric Energy

NEMA WD 1 (1983; R 1989) General Requirements for Wiring Devices

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) PUBLICATIONS

NFPA 70 (1996) National Electrical Code (NEC)

NFPA 101 (1994) Code for Safety to Life from Fire in Buildings and Structures

UNDERWRITERS' LABORATORIES, INC. (UL) PUBLICATIONS

UL 03 (1996) Electrical Construction Materials Directory

UL 1 (1993; Rev thru Jan 1995) Flexible Metal Conduit

UL 5 (1995) Surface Metal Raceways and Fittings

UL 6 (1993) Rigid Metal Conduit

UL 20 (1995) General-Use Snap Switches

UL 44 (1991; Rev thru Jan 1995) Rubber-Insulated Wires and Cables

UL 50 (1992; Rev thru Nov 1994) Enclosures for Electrical Equipment

UL 67 (1993; Rev thru Dec 1993) Panelboards

UL 83 (1991; Rev thru Oct 1994) Thermoplastic-Insulated Wires and Cables

UL 94 (1991; Rev thru Apr 1995) Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

UL 98 (1994; R Feb 1995) Enclosed and Dead-Front Switches

UL 198B (1995) Class H Fuses

UL 198C (1986; Rev thru Jun 1993) High-Interrupting-Capacity Fuses, Current-Limiting Types

UL 198D (1995) Class K Fuses

UL 198E (1988; Rev Jul 1988) Class R Fuses

UL 198G (1988; Rev May 1988) Fuses for Supplementary Overcurrent Protection

UL 198H	(1988; Rev thru Nov 1993) Class T Fuses
UL 198L	(1995) D-C Fuses for Industrial Use
UL 360	(1986; Rev thru Dec 1994) Liquid-Tight Flexible Steel Conduit
UL 467	(1993) Grounding and Bonding Equipment
UL 486A	(1991; Rev Oct 1991) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1991; Rev thru Apr 1992) Wire Connectors or Use with Aluminum Conductors
UL 486C	(1991; Rev thru Sep 1992) Splicing Wire Connectors
UL 489	(1991; Rev thru Jun 1995) Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
UL 497	(1995) Protectors for Paired Conductor Communication Circuits
UL 498	(1991; Rev thru Oct 1994) Attachment Plugs and Receptacles
UL 506	(1994; Rev Jul 1994) Specialty Transformers
UL 508	(1993) Industrial Control Equipment
UL 510	(1994) Insulating Tape
UL 512	(1993) Fuseholders
UL 514A	(1991; Rev Apr 1995) Metallic Outlet Boxes
UL 514B	(1992; Rev thru Apr 1995) Fittings for Conduit and Outlet Boxes
UL 514C	(1988; Rev Apr 1995) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 542	(1994) Lampholders, Starters, and Starter Holders for Fluorescent Lamps
UL 651	(1989; Rev thru Dec 1989) Schedule 40 and 80 Rigid PVC Conduit
UL 651A	(1995) Type EB and A Rigid PVC Conduit and HDPE Conduit
UL 674	(1994; Rev Jul 1995) Electric Motors and Generators for Use in Division 1 Hazardous Classified) Locations
UL 698	(1995) Industrial Control Equipment for

	Use in Hazardous (Classified) Locations
UL 719	(1985; Rev thru Dec 1994) Nonmetallic-Sheathed Cables
UL 797	(1993; Rev May 1995) Electrical Metallic Tubing
UL 817	(1994; Rev thru Aug 1994) Cord Sets and Power-Supply Cords
UL 844	(1995) Electric Lighting Fixtures for Use in Hazardous (Classified) Locations
UL 845	(1995) Motor Control Centers
UL 857	(1994) Busways and Associated Fittings
UL 869A	(1993; Rev Apr 1994) Reference Standard for Service Equipment
UL 870	(1995) Electrical Wireways, Auxiliary Gutters and Associated Fittings (7th Ed.)
UL 943	(1993; Rev thru Jan 1995) Ground-Fault Circuit Interrupters
UL 1004	(1994) Electric Motors
UL 1025	(1980) Electric Air Heaters (2nd Ed.; Dec 3, 1991 and Bulletins)
UL 1042	(1994) Electric Baseboard Heating Equipment (3rd Ed.)
UL 1277	(1996) Electrical Power and Control Tray Cables with Optional Optical-Fiber Members
UL 1569	(1995) Metal-Clad Cables (2st Ed.; May 1996 and Bulletins)

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Contractor's Data; FIO.

The Contractor shall submit the following types of data to supplement the manufacturer's data and drawings and the Contractor's drawings.

Certifications: Certifications shall be submitted when specified or required, Certified Factory and Field Test Reports, and Certificates of Compliance may be submitted in lieu of other proofs of compliance with these contract provisions.

Certified Field Test Reports: Field tests shall be made and test reports shall be written and certified by the Contractor to the Contracting Officer. Field tests shall include cable, operational and resistance-to-ground tests.

#### SD-04 Drawings

Shop Drawings; GA.

Shop drawings shall be submitted for approval and shall consist of a complete list of equipment and materials, including manufacturer's descriptive and technical data; catalog cuts; and any special installation instructions that may be required. Shop drawing shall be submitted for all materials and equipment specified. Drawings shall show applicable schematic diagrams; equipment layout and anchorage; and conduit and cable tray runs, anchorage, and support.

Contractor's Drawings; GA.

The Contractor shall submit drawings as required to supplement contract drawings, manufacturer's data and drawings, and Contractor's data to demonstrate compliance with applicable contract requirements. Drawings shall be dimensioned or scaled to show the relative arrangement and mounting details of the equipment or equipment assemblies.

#### SD-07 Schedules

Equipment and Materials; FIO.

A complete itemized listing of equipment and materials proposed for incorporation into the work shall be submitted. Each such itemization shall include an item number, the quantity of items proposed, and the name of the manufacturer of each item.

#### SD-13 Certificates

UL Publications; FIO.

The label or listing of Underwriters Laboratories, Inc., will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this label or listing, the Contractor shall submit a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements. However, materials and equipment installed in hazardous locations must bear the UL label unless the data submitted from other testing agency is specifically approved in writing by the Contracting Officer.

Certificates of Compliance; FIO.

Certificates shall be prepared by the manufacturers when the manufacturer's published data or drawings do not indicate conformance with other requirements of these specifications.

Certified Factory Test Reports; FIO.

Certified factory test reports shall be submitted when manufacturers

perform routine factory tests normally performed by the manufacturer, including tests required by standards listed in paragraph: APPLICABLE PUBLICATIONS.

GUARANTEE; FIO.

The equipment and materials furnished under this section shall be guaranteed against defective material, design, and workmanship for the period of one (1) year from the date of acceptance. Upon receipt of notice from the government of failure of any part of the guaranteed equipment during the guarantee period, new replacement parts shall be furnished and installed promptly by the Contractor at no cost to the Government.

Non-UL Publications; FIO.

For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable standard of ASTM, NEMA, or other commercial standard, is acceptable.

#### SD-14 Samples

Samples and Schedules; FIO.

Samples and Schedules shall be submitted in accordance with Paragraph: PRODUCTS of this Section.

#### SD-19 Operation and Maintenance Manuals

Instruction Manuals; FIO.

Six copies of instruction manuals shall be furnished within 7 calendar days following the completion of operational tests and shall include 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 and all documents previously submitted and approved. Manuals shall also include data outlining step-by-step 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 and their basic operating features shall also be included. Documents shall be bound in a suitable binder adequately marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information and the 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 instruction manuals shall be submitted within 30 calendar days following the approval of the manuals.

## PART 2 PRODUCTS

### 2.1 GENERAL

Items of the same classification shall be identical including equipment, assemblies, parts, and components.

### 2.1.1 Hazardous Locations

Wiring and equipment in locations indicated shall be of the classes, groups, divisions, and suitable for the operating temperature; all as indicated. Paint storage room 115 in the Central Control Station Building (CCS) shall be classified as Class I, Division 2, Group D. Gasoline tanks and dispensing equipment area shall be classified area and meet all the requirements of NFPA 70.

### 2.1.2 Prevention of Corrosion

Metallic materials shall be protected against corrosion as specified. Aluminum shall not be used in contact with earth or concrete. Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 123 and ASTM A 153.

### 2.1.3 Standard Products

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall be essentially duplicate items that have been in satisfactory use for at least 5 years prior to bid opening.

### 2.1.4 Identification Nameplates

Major items of electrical equipment and major components shall be permanently marked with an identification nameplate to identify the equipment by type or function and specific unit number as indicated. Nameplate designation shall be in accordance with the names shown on the drawings.

## 2.2 MATERIALS AND EQUIPMENT

### 2.2.1 Workmanship

Materials and equipment shall be installed in accordance with recommendations of the manufacturer and as shown.

### 2.2.2 Publications

Materials and equipment shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this Section.

### 2.2.3 Wire and Cables

All wire and cable shall have annealed copper conductors. All conductors shall be Class B stranded per ASTM B 8, unless otherwise noted. Aluminum conductors shall not be allowed. Cables shall be single conductor, unless otherwise noted.

#### 2.2.3.1 Low-Voltage Cables

Low-voltage cables shall utilize either ethylene-propylene-rubber (EPR) insulation conforming to NEMA WC 8, or Cross-Linked-Polyethylene (XLPE), or polyvinyl chloride (PVC) insulation conforming to UL 83; all as indicated on the drawings or as specified herein.

#### 2.2.3.2 Grounding Cables

Grounding cables shall be bare, except where installed in conduit with associated phase conductors. Insulated grounding cables shall be rated 600 volts and shall have green colored insulation of the same material as the associated phase conductors. Bare cables shall be ASTM B 8 soft-drawn unless otherwise indicated; aluminum is not acceptable.

#### 2.2.3.3 Cord Sets and Power-Supply Cords

UL 817.

#### 2.2.4 Cable Trays

NEMA VE 1 for metallic cable trays.

#### 2.2.5 Connectors for Low-Voltage Cables

UL 486A for copper conductors; and ANSI C119.1 for sealed insulated connectors.

#### 2.2.6 Cast Iron

ASTM A 48, Class 30B, minimum.

#### 2.2.7 Concrete

Concrete shall be 2500 psi at 28 days as specified in SECTION: CONCRETE FOR BUILDING CONSTRUCTION. Duct liner shall be of monolithic construction. Where a connection is made to an existing duct line, the concrete encasement shall be well bonded or doweled to the existing encasement.

#### 2.2.8 Conduit and Fittings

- a. Liquidtight Flexible Steel Conduit: UL 360.
- b. Rigid Steel Conduit: ANSI C80.1 and UL 6, hot dipped galvanized.
- c. Electrical Metallic Tubing (EMT): UL 797.
- d. PVC Coated Rigid Steel Conduit: NEMA RN 1. All components and accessories for this type of raceway system shall be provided by one manufacturer.
- e. Surface Metal Raceways: UL 5.
- f. Conduit Outlets and Fittings, Steel: NEMA FB 1 and UL 514.
- g. Multioutlet Assembly: UL 5.
- h. Conduit Coatings:
  - Plastic Resin System: NEMA RN 1, Type A-40.
  - Epoxy System: NEMA RN 1, Type A-40.
- i. PVC Conduit: NEMA TC 2 and NEMA TC 6.

#### 2.2.9 Connectors, Wire Pressure

UL 486A.

#### 2.2.10 Duct and Conduit Caulking Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 35 F, shall not slump at a temperature of 300 F, and shall not harden materially when exposed to the air. Compounds shall readily calk or adhere to clean surfaces of asbestos-cement, 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. Sealing compounds shall be as manufactured by O.Z. Gedney Co. or approved equal.

#### 2.2.11 Duct and Fittings, Nonmetallic Type for Installation Underground

Wall thicknesses and fittings shall be suitable for the application or as indicated. Ducts shall be single, round-bore type. Ducts shall be of the same material when used for applications requiring the same type of wall thickness. All ducts shall be UL listed and shall bear the UL label.

##### 2.2.11.1 Concrete Encased

NEMA TC 6.

##### 2.2.11.2 Direct Buried

NEMA TC 2.

##### 2.2.11.3 Conduit Fittings

Conduit fittings shall conform to the applicable NEMA standards, except that where NEMA standards for conduit fittings do not exist for the type of plastic installed, fittings shall be as recommended by the conduit manufacturer.

#### 2.2.12 Fittings, Cable and Conduit

UL 514A.

#### 2.2.13 Fuses

- a. Cartridge Fuses: Nonrenewable, dual element, time lag type, UL 198B, Class H.
- b. Current Limiting Fuses: UL 198E, Class R.
- c. Plug Fuses: Tamperproof, instantaneous, time delay, UL 198F, maximum 30A.

#### 2.2.14 Motor-driven Equipment

##### 2.2.14.1 General

Electric motor-driven equipment specified under this section of the specifications shall be provided complete with motors, motor starters and controls. Electrical equipment and wiring shall be in accordance with this section. Electrical characteristics shall be as indicated. Motor starters shall be provided complete with properly-sized thermal-overload protection

and other appurtenances necessary for the motor control indicated. Each motor shall be of sufficient power to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices shall be provided under this section of the specifications.

2.2.14.2 Motors, AC, Fractional and Integral Horsepower (500 HP and Smaller)

NEMA MG 1 and UL 1004.

2.2.15 Outlet Boxes

- a. Cast-Metal: UL 514
- b. Sheet-Steel: NEMA OS 1.
- c. Switch, Box, (Enclosed), Surface-mounted: UL 98.
- d. Floor: UL514A.
- e. Nonmetallic, for Use with Nonmetallic Wiring Systems: UL 514A.

2.2.16 Receptacles and Plugs

- a. General Purpose Receptacles: UL 498, MEMA WD1.
- b. Ground Fault Interrupters: UL 943, Class A or B.
- c. Attachment Plugs: UL 498.

2.2.17 Splice, Conductor

IEEE 383.

2.2.18 Switches

- a. Disconnect Switches: NEMA KS 1.
- b. Snap Switches: UL 20.

2.2.19 Tapes

- a. Plastic Tape: UL 510.
- b. Rubber Tape: UL 510.

2.2.20 Terminal Blocks

Terminal blocks for control wiring shall be molded or fabricated type with barrier, rated not less than 600 volts. The terminals shall be a flat terminal connector screw type, which will accept ring or spade lugs. Wires to terminals shall be installed with spade lug terminals. Terminal points shall be identified by a marking strip on the terminal blocks. Provide at least 25 percent spare terminals in all junction boxes and panels requiring installation of terminal blocks.

Each device to which a connection is made shall be assigned a device designation, as shown on the drawings, or if not shown in accordance with

Part ICS 1-101 of NEMA ICS 1, and each device terminal to which a connection is made shall be marked with a distinct terminal marking corresponding to the wire designation used on the schematic and connection diagrams. Special attention shall be given to wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on the adjacent terminal points. The wire (terminal point) designations used on the wiring diagrams and printed on terminal block marking strips may be according to the supplier's standard practice; however, additional wire and cable designations for identification of remote (external) circuits may be required. Power wires leaving control panels shall be color coded.

#### 2.2.21 Wireway

UL 870.

#### 2.2.22 Grounding and Bonding

Equipment, UL 467. Wire, ASTM B 8, soft-drawn copper. All connections below grade shall be exothermically welded. Connections above grade shall be exothermically welded or connectors in accordance with UL 467 and any other special requirement (such as UL approved for use with "MasterLabel" lightning protection systems, communications, etc.)

#### 2.2.23 Control Relays

Control relays shall be of the electrically-operated, magnetically-held, self-reset, machine tool type, suitable for mounting inside the control compartments, and shall be 120-volt AC coils unless indicated otherwise. Contacts shall be as indicated on the drawings and shall have a contact rating designation of A600 or N600, as required, in accordance with NEMA ICS 2.

### 2.3 OTHER PRODUCTS

#### 2.3.1 Identification Nameplates

##### 2.3.1.1 For Interior Use

Unless otherwise specified, all identification nameplates used indoors and within indoor and outdoor enclosures shall be made of laminated plastic in accordance with ASTM D 709 with black outer layers and a white core. Edges shall be chamfered. Plates shall be fastened with black-finished round-head drive screws or approved nonadhesive metal fasteners. When the nameplate is to be installed on an irregular shaped object, the Contractor shall devise an approved support suitable for the application. In all instances, the nameplate shall be installed in a conspicuous location. At the option of the Contractor, the equipment manufacturer's standard embossed nameplate material with black paint-filled letters may be furnished in lieu of laminated plastic. The following equipment, as a minimum, shall be provided with identification nameplates:

##### Minimum 1/4-Inch High Letters

Safety Switches,  
Equipment Enclosures

##### Minimum 1/8-Inch High Letters

Control Devices (Relays,  
Contactors, etc.)

##### 2.3.1.2 For Outdoor Use

Nameplates shall be made of brass approximately 1/32-inch thick, stamped to provide indented letters not less than 1/4-inch high. Indented letters shall be physically darkened, per the manufacturer's standard method, to permit easy reading.

a. Equipment of the plug/connector withdrawal type shall be provided with nameplates mounted on the removable equipment in locations visible when the equipment is in place. Nameplates attached to cable grips of plugs shall be round and secured with two stainless steel "S" hooks.

b. The nameplates shall be fastened to the panels and enclosures in proper positions with brass round-head screws. Samples of engraved nameplates with a schedule of nameplate sizes and lettering shall be submitted for the approval of the Contracting Officer.

### 2.3.2 Conduits and Fittings

a. All conduits installed inside the CCS Building shall be EMT, unless otherwise noted, 3/4-inch minimum size. All outdoor conduits shall be galvanized, rigid steel. All outdoor conduits installed underground shall be as specified below. All other conduits shall be rigid steel, 3/4-inch minimum size. All flexible conduit shall be liquidtight, flexible steel, 1/2-inch minimum size unless otherwise specified.

(1) Underground Service Conductor Conduits. The conduits between the service transformer and the service equipment shall be PVC-coated rigid steel.

b. All conduit installed in Class I, Division 1 or 2 hazardous areas shall be hot-dipped galvanized rigid steel with conduit seal fittings installed where required by NFPA 70. All conduit installed in the CCS electrical vault, cable trenches, manholes, and crossover shall be galvanized rigid steel. All conduit installed outside of the CCS Building shall be galvanized rigid steel, unless indicated otherwise, 3/4-inch minimum size.

c. Conduits shall be continuous from outlet to outlet and from outlets to boxes with heavy duty, watertight, threaded hub connectors.

d. All exposed and exterior outlet boxes and conduit bodies shall be the cast ferrous metal type, threaded for rigid heavy wall conduit and provided with gasketed covers.

e. All fittings used to connect EMT to rigid steel conduit, cast outlet boxes, and conduit bodies shall be UL-listed, compression type fittings. Set screw type connectors are not permitted.

### 2.3.3 Underground Conduit

Nonencased direct-buried conduits shall be Schedule 80 PVC, type EPC-80 heavy wall. All vertical elbows shall be PVC-coated rigid steel, factory formed elbows. Risers at concrete/atmosphere interfaces shall be PVC-coated rigid steel.

#### 2.3.3.1 Requirements

Numbers and sizes of conduits shall be as indicated. Conduit 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. Manufactured 90-degree conduit

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 conduits of less than 3-inch diameter, and 36 inches for conduits 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends as required, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Conduits shall be provided with end bells whenever conduits terminate in manholes or handholes. Conduit markers shall be provided as indicated at the ends of long conduit line stubouts, at 100-foot intervals along straight runs, or for other conduits whose locations are indeterminate because of conduit curvature and terminations at completely below-grade structures. Markers shall be as specified for underground cable installation in this Section. In lieu of markers, a 5-mil brightly colored plastic tape not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers with a continuous metallic backing and a corrosion resistant 1-mil metallic foil core to permit easy location of the conduit, shall be placed approximately 12 inches below finished grade levels of such lines.

#### 2.3.3.2 Treatment

Conduits shall be kept clean of concrete, dirt, or foreign substances during construction. After a conduit is completed, a standard flexible mandrel shall be used for cleaning followed by a brush with stiff bristles. Mandrels shall be at least 12 inches long and have diameters 1/4 inch less than the inside diameter of the conduit being cleaned. Pneumatic rodding may be used to draw in lead wires. A coupling recommended by the conduit manufacturer shall be used whenever an existing conduit is connected to a conduit of different material or shape. Conduits shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Conduits shall be thoroughly cleaned before being laid. Plastic conduits shall be stored on a flat surface and protected from the direct rays of the sun.

#### 2.3.3.3 Nonencased Direct-Burial

Top of conduits shall not be less than 24 inches below finished grade. Conduits shall be installed with a minimum of 3 inches of earth around each conduit, except that between adjacent electric power and communication conduits, 12 inches of earth is required. Bottoms of trenches shall be graded toward manholes or handholes and shall be smooth and free of stones, soft spots, and sharp objects. Where bottoms of trenches comprise materials other than sand or stone-free earth, 3-inch layers of sand or stone-free earth shall be laid first and compacted to approximate densities of surrounding firm soil before installing conduits in direct-contact tiered fashion. Joints in adjacent tiers of conduit shall be vertically staggered at least 6 inches. The first 4-inch layer of backfill cover shall be sand or stone-free earth compacted as previously specified. Conduit banks may be held in alignment with earth. However, high-tiered banks shall use a wooden frame or equivalent form to hold conduits in alignment prior to backfilling. Selected earth at conduit banks shall be thoroughly tamped in 4 to 6-inch layers.

#### 2.3.3.4 Installation of Couplings

Joints in each type of conduit shall be made up in accordance with the manufacturer's recommendations for the particular type of conduit and

coupling selected and as approved. In the absence of specific recommendations, various types of conduit joint couplings shall be made watertight as specified.

- a. Plastic Conduit: Conduit joints shall be made by brushing plastic solvent cement on insides of plastic coupling fittings and on outsides of conduit ends. Each conduit and fitting shall then be slipped together with a quick one-quarter-turn twist to set the joint tightly.

#### 2.3.3.5 Existing Lock Crossover Ductbank

Existing ducts shall be dewatered by the contractor, prior to pulling new cables. A standard flexible mandrel shall be used for cleaning followed by a brush with stiff bristles. Mandrels shall be at least 12 inches long and have diameters 1/4 inch less than the inside diameter of the duct being cleaned. Pneumatic rodding may be used to draw in pull wires.

#### 2.3.4 Concrete Cable Trenches

Cast in place Concrete Cable Trenches shall be constructed and installed under and in accordance with SECTION: CONCRETE FOR BUILDING CONSTRUCTION.

##### 2.3.4.1 Trench Covers

Trench covers shall be fabricated and installed under and in accordance with SECTION: MISCELLANEOUS METALS.

##### 2.3.4.2 Concrete Pullboxes

Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers. Concrete reinforcing shall be that which is regularly used in the standard products of the manufacturer. Pullbox tops shall be flush with sidewalks or curbs or placed 2-inch above surrounding grades when remote from curbed roadways or sidewalks. Covers for Utility Service conductors shall be marked "HIGH VOLTAGE", otherwise covers shall be marked "LOW VOLTAGE" and provided with two lifting eyes and two 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.

#### 2.3.5 Cable Trays and Fittings

Stainless Steel cable trays shall be of ladder-rung type design. The cable tray system shall have a basic load carrying capacity of 75 pounds per lineal foot at a 20-foot support span. Cable trays shall be tested in accordance with NEMA FG 1. Cross rungs shall be securely bonded in place and shall be spaced not more than 12 inches apart. Cable trays shall be tested in accordance with NEMA Publication VE-1. Cable trays shall form a wireway system of Type 304 stainless steel. Cable trays shall be of nominal 5-inch loading depth and 36 inch wide unless otherwise noted. Cable trays shall include splice and endplates, dropouts, and miscellaneous hardware fabricated from stainless steel to produce a uniform and continuous tray system. Cable trays shall be supported at not more than 10-foot intervals unless otherwise indicated. All edges, fittings, and hardware shall be finished free from burrs and sharp edges. Fittings shall have not less than the load-carrying ability of straight tray sections and shall have manufacturer's minimum standard radius unless otherwise indicated. Radius of bends shall be 12-inches. Ground conductors, No. 2 AWG bare copper wire shall be laid throughout the interior cable tray

system and bonded to each section thereof. This conductor shall be connected to the ground bus. Bonding of the No. 2 AWG conductor to the cable tray system shall be made by bolted or thermochemical type connections.

#### 2.3.5.1 [Enter Appropriate Subpart Title Here]

##### 2.3.5.1 Cable Tray Hold-Down Clamps

Hold-down clamps shall prevent lateral or vertical movement when the tray is in a horizontal position, and shall limit movement in any direction for vertical positions. Accessories shall be supplied by the manufacturer of the cable tray.

##### 2.3.5.2 Installation

Unless otherwise specified herein, the cable tray systems and installations shall conform to the requirements of NEMA FG 1 or NEMA VE 1 as applicable and NFPA 70. No cable splices shall be made in the cable tray system. Cables shall be anchored in cable trays at required intervals with cable ties or cable clamps. Maximum support spacing shall be 10 feet for straight sections. Supporting brackets and hardware shall be furnished complete with the cable tray and shall be stainless steel and capable of supporting the tray and cable loads as well as any short time addition loads not exceeding the total design loads by more than one-third. Stainless steel wall brackets used for interior installation shall be manufacturer's standard bracket rated as described above. Expansion connectors shall be used in cable trays at building expansion joints, concrete monolith expansion joints, in long tray formations, or as shown on the drawings. Sufficient space shall be provided and maintained above cable trays to permit adequate access for installing and maintaining the cables. Standard radius cable tray sections shall be used when changes in direction are required, except as otherwise required, in which case cable tray details shall be submitted for approval. Sloping trays shall be supported at intervals not to exceed those for horizontal trays of the same design in the same installation.

##### 2.3.5.3 Cable Trays

Cable trays shall terminate 10 inches from both sides of smoke and fire partitions. Conductors run through smoke and fire partitions shall be installed in 4-inch rigid steel conduits with grounding bushings, extending 12 inches beyond each side of the partitions. The installation shall be sealed to preserve the smoke and fire rating of the partitions.

##### 2.3.6 Wireway

Stainless steel wireway shall be installed in outdoor locations as indicated on the drawings. Wireway shall be the standard product of a reputable manufacturer regularly engaged in the manufacture of such equipment. All metal wireway system components and accessories shall be made of stainless steel.

##### 2.3.6.1 Construction

Metallic wireways shall be constructed of 14 gauge type 304 stainless steel covers and bodies and 10 gauge type 304 stainless steel flanges and type 304 stainless steel hardware. Seams shall be continuously welded and ground smooth. Body shall be constructed without holes or knockouts. There shall be smooth rounded edges on all sections and fittings to prevent

damage to insulation. Heavy butt hinges and external screw clamps shall assure complete seal between covers and bodies. Wireway shall be NEMA type 4X, and shall be sized as shown on the drawings. Wireways shall include expansion splices and end plates, and miscellaneous hardware. Junction boxes shall be used to provide adequate cable bending radius for large cable take-offs to conduits. Wireways shall be supported at not more than 10-foot intervals unless otherwise indicated. All edges, fittings, and hardware shall be finished free from burrs and sharp edges. Fittings shall have not less than the load-carrying ability of straight sections. A 2 AWG bare copper conductor shall be laid throughout the wireway system and bonded to each section thereof. This conductor shall be connected to the building ground bus. Bonding of the 2 AWG conductor to the wireway system shall be made by bolted or exothermic weld connections.

#### 2.3.6.2 Accessories

Accessories shall be furnished as shown on the drawings and as required. Accessories shall be supplied by the manufacturer of the wireway.

#### 2.3.6.3 Installation

Unless otherwise specified herein, the wireway systems and installations shall conform to the requirements of UL 870 as applicable and NFPA 70.s No cable splices shall be made in the wireway system. Cable taps made in the wireway system shall be as indicated on the drawings and shall be a waterproof type approved by the Contracting Officer. Cables shall be anchored in wireways at required intervals with cable ties or cable clamps.

Provide supporting brackets for the wireways and additional supports at junction boxes as shown on the drawings. Maximum support spacing shall be 10 feet for straight sections. Supporting hardware shall be of stainless steel and shall be capable of supporting the wireway and cable loads as well as any short time additional loads not exceeding the total design loads by more than one-third. Expansion connectors shall be used in wireways at building expansion joints, concrete monolith expansion joints, and in long wireway formations.

#### 2.3.7 Wire and Cable

The conductor size and number of conductors for any particular application or service shall be as indicated on the drawings, or as specified under the detailed requirements for the particular item. All cables listed in the cable tabulation on the drawings with conductor number such as 2/C, 3/C, 5/C, or indicated as "multi-", shall be multi-conductor cables.

##### 2.3.7.1 Single Conductor Cables

All single conductor low voltage wire and cables shall be NEC types THHN/THWN or XHHW, unless otherwise indicated on the drawings. All underground cables from the utility-owned transformer to the service entrance switchboard in the Central Control Station shall be EPR-insulated, NEC type RHH/RHW/USE. Single conductor cables smaller than 350 MCM shall not be routed in cable trays; multi-conductor cables shall be used instead.

PVC insulated cables, except for communication and instrumentation cables, shall not be installed in outdoor locations including the electrical vault, trenches, manholes, crossover ductbank, outdoor conduit, junction boxes and equipment connections.

##### 2.3.7.2 Multi-conductor Cables

All multi-conductor control or power cables shall be Type TC tray cable conforming to UL 1277. Insulation shall be NEC type THHN/THWN with a PVC jacket, rated 600 volts. Cables shall have an integral ground conductor as specified or shown. Cable shall pass the 70,000 BTU/hour flame test requirements of UL 1277 and the IEEE 383 Standard. Unless otherwise shown or specified, all cables which are installed wholly or partly in any cable tray or wireway, shall be Type TC with NEC type XHHW conductors, a continuous, extruded, corrugated aluminum sheath, and an outer PVC jacket. Aluminum sheathed cables shall comply with UL 1569 as MC cable with sunlight resistant jacket suitable for direct burial.

#### 2.3.7.3 Flexible Power and Control Cables

Flexible cables shall be extra flexible and extra thick, with EPR insulation and a reinforced rubber jacket. Cables shall be highly resistant to impact and abrasion, flame resistant, sunlight resistant, weather resistant, resistant to oils, acids and alkalies; shall be color-coded for permanent conductor identification; and shall be able to withstand constant reeling and flexing. Control cables shall have uncoated copper conductors, stranded per ASTM B 174 Class K or M. Power cables shall have coated copper conductors and shall be flexible rope stranded.

#### 2.3.7.4 Power Conductor Identification, 10 AWG and Smaller

Conductors 10 AWG and smaller shall be color coded using colored insulation; plastic phase tape or markers shall not be allowed. Grounded neutral conductors shall be white or gray in accordance with the NEC. Wires shall be identified at terminals and junction boxes by the circuit number or cable number as shown on the drawings. Conductors in multiphase systems serving single-phase loads shall be color coded. Color coding for ungrounded conductors of different voltage systems shall be as follows:

120/208 volt, 3-phase: red, black, and blue.  
277/480 volt, 3-phase: brown, orange, and yellow.  
120/240 volt, single/phase: red and black.

#### 2.3.7.5 Power Cable Identification, 8 AWG and Larger

Conductors 8 AWG and larger, identification shall be made by color-coded insulation, or conductors with black insulation may be furnished and identified by the use of half-lapped bands of colored electrical tape wrapped around the insulation for a minimum of 75 mm (3 inches) of length near the end, or other method as submitted by the Contractor and approved by the Contracting Officer. Identification shall also be applied to each conductor in all boxes where splices or taps are made.

#### 2.3.7.6 Cable and Control Conductor Identification

Instrumentation, control and power cables shall be identified at all manholes, handholes, junction and termination cabinets, and at 50-foot intervals in cable trays, trenches and wireways. Where cables pass through walls or conduits, one tag for each cable shall be installed on each side of the barrier. Tags shall be 3/4 inches in diameter and fabricated from 1/32-inch thick brass plate. Lettering shall be 1/4-inch minimum height Gothic Style with the letter width as required. Tags shall have a 1/8 inch hole located above the top of the lettering for fastening. Letters shall be machine stamped and filled with black enamel. Cable identification shall correspond to the labels found on the drawings. Tags shall be attached to the cable with stainless steel wire not smaller than 14 AWG so

that movement of the tag along the length of the cable is not possible.

Control and instrumentation conductor identification shall be made by color-coded insulated conductors and installation of heat stamped, black on yellow or white PVC or nylon sleeve markers, or equivalent means as approved. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on plans and approved shop drawings. Hand lettering or marking is not acceptable. Where insulation of the required color is not available, colored plastic tags of the required color attached within the indicated enclosures.

#### 2.3.7.7 Approval of Insulated Wire and Cable

Data is required for approval by the Contracting Officer before manufacture or delivery. Wire and cable shall be constructed as specified in this Section. Any variation or exception to the requirements of these specifications shall be approved in writing by the Contracting Officer prior to manufacture of the cable. Manufacture of the wire and cable shall not be started until all materials to be used in the fabrication of the finished wire or cable have been approved by the Contracting Officer. Failure to obtain such approval shall be sufficient cause for rejection.

#### 2.3.8 Boxes and Supports

Boxes shall be provided in the wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways, 4-inch by 4-inch nominal size and smaller, shall be of the cast-metal hub type when located in normally wet locations, when surface mounted on outside of exterior surfaces, when located in hazardous areas, and when installed exposed up to 7 feet above interior floors and walkways. Large size boxes shall be NEMA 4 or as shown.

##### 2.3.8.1 Weatherproof Junction Boxes

All junction boxes located on the lock walls or in pullbox manholes shall be a heavy duty weatherproof, stainless steel enclosure and shall meet NEMA Type 4X and UL 50 specifications. The boxes shall have an overlapping cover with a flat neoprene gasket cemented to the cover. All associated hardware shall be stainless steel including bolts, clips, nuts, washers, and springs. The boxes shall be surface mounted as shown on the drawings. Drain-Breather fittings shall be provided and installed on all outdoor NEMA 4X enclosures.

##### 2.3.8.2 Submersible Boxes

All cast metal boxes installed in the electrical vault, trenches, or manholes shall meet or exceed NEMA Type 6 (submersible) rating for enclosures. The boxes shall have an overlapping cover. Boxes shall be surface mounted, flat-flanged type constructed of cast iron similar to O-Z/Gedney type "YF".

##### 2.3.8.3 Boxes for Use with Raceway Systems

Boxes for use with raceway systems shall be not less than 1-1/2 inches deep except where shallower boxes required by structural conditions are approved. Sheet metal boxes for other than lighting-fixtures shall be not

less than 4 inches square except that 4- by 2-inch boxes may be used where only one raceway enters the outlet. Minimum size boxes for telephone outlets shall be not smaller than 4-1/2 inches square and 3-1/2 inches deep.

#### 2.3.8.4 Pull Boxes

Pull boxes of not less than the minimum size required by the NFPA 70 shall be constructed of aluminum or galvanized sheet steel, except where cast-metal boxes are required in locations specified above. Boxes shall be furnished with screw-fastened covers. Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation.

#### 2.3.8.5 Clock Outlet

Clock outlet, for use in other than a wired clock system, shall consist of an outlet box, a plaster cover where required, and a single receptacle with clock-outlet plate. The receptacle shall be recessed sufficiently within the box to allow the complete insertion of a standard cap, flush with the plate. A suitable clip or support for hanging the clock shall be secured to the top of the plate. Material and finish of the plate shall be as specified in paragraph: Device Plates.

#### 2.3.8.6 Conduit Stub-Ups

Conduits stubbed up through concrete floors for connections to freestanding equipment shall be provided with a short elbow and an adjustable top or coupling threaded inside for plugs, set flush with the finished floor. Wiring shall be extended in rigid threaded conduit to equipment, except that where required, liquidtight flexible conduit shall be used 6 inches above the floor. Screwdriver-operated threaded flush plugs shall be installed in conduits from which no equipment connections are made to suit the devices installed.

#### 2.3.8.7 Floor Outlets

Floor outlets shall be adjustable and each outlet shall consist of a cast-metal body with threaded openings for conduits, adjustable ring, and cover plate with 2- or 3/4-inch threaded flush plug. Each communication outlet shall consist of horizontal cast housing with a 3/4-inch bushed side opening and a blank cover plate. Each receptacle outlet shall consist of a horizontal cast housing with a receptacle as specified. Gaskets shall be used where necessary to insure a watertight installation. Plugs with installation instructions shall be delivered to the Contracting Officer at the job site for capping outlets upon removal of service fittings.

#### 2.3.9 Device Plates

One-piece type device plates shall be provided for all outlet boxes and fittings. Plates for cast metal boxes shall be cast metal or stamped steel with round edges designed specifically to fit the box with no overlap. Plates for sheet metal boxes concealed in concrete or in finished walls shall be of satin finish stainless steel with rounded edges. Screws shall be of metal with countersunk heads, in a color to match the finish of the plate. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1/16 inch. The use of sectional-type device plates will not be permitted. Plates installed in wet locations shall be gasketed

and provided with a hinged, gasketed cover, unless otherwise specified. Device plates for telephone outlets shall have modular phone jacks. All device plates except telephone outlets shall be UL-listed.

#### 2.3.10 Receptacles and Plugs

##### 2.3.10.1 Single and Duplex Receptacles

Duplex receptacles shall be heavy duty, specification grade, NEMA 5-20R, rated 20 amperes at 125 volts, Type 5362-GRY. Receptacles shall have a nylon body with a continuous mounting strap and detachable plaster ears. Receptacle face shall be impact resistant, gray nylon designed for high abuse. Contact arrangement shall be such that contact is made on two sides of an inserted blade. Receptacle shall be side or back-wired with two screws per terminal. The third grounding pole shall be connected to the metal mounting yoke. Single straight blade (NEMA 5-20R) and locking type (NEMA L5-20R) receptacles shall be of the same construction and rating as the duplex receptacle. Receptacles with ground fault circuit interrupters shall have the class and current rating as indicated. All outdoor receptacles shall be ground fault circuit interrupter type or on a circuit protected by a ground fault circuit interrupter circuit breaker unless otherwise indicated.

##### 2.3.10.2 Weatherproof Receptacles

Weatherproof receptacles shown shall be installed in surface mounted cast boxes with back drilled and tapped for 3/4-inch rigid steel conduit. Conduits shall not be surface mounted on exterior walls. Boxes shall be mounted horizontally for duplex receptacles and vertically for single receptacles. Conduit penetrations and boxes shall be caulked all around for a weathertight seal. Top of box shall be located 24 inches above adjacent grade or roof unless otherwise noted. Receptacles shall be provided with a gasketed, weatherproof cover. Cover shall be UL-listed for Wet Locations (with cover open in continuous use or intermittent use). Covers shall be cast aluminum with a spring-hinged flap (separate flaps for duplex receptacles) and stainless steel springs.

##### 2.3.10.3 Special-Purpose or Heavy-Duty Receptacles

Special-purpose or heavy-duty receptacles shall be of the type and of ratings and number of poles indicated or required for the anticipated purpose. Contact surfaces may be either round or rectangular. One appropriate straight or angle-type plug shall be furnished with each receptacle. Locking of receptacles, indicated to be the locking type, shall be accomplished by the rotation of the plug.

##### 2.3.10.4 Attachment Plugs

Plugs furnished with 120 volt water coolers shall be replaced with locking type plugs, NEMA L5-20R, rated 20 amperes at 125 volts. Outdoor plugs and connectors shall be provided with an elastomer sealing cover which matches the flanged receptacle cover for a watertight seal. Matting plugs and connectors for outdoor installations shall have watertight seals. When matted the covered the seals shall meet the requirements of NEMA 4, 4X and 6 enclosures.

##### 2.3.11 Wall Switches

Wall switches shall be totally enclosed tumbler type with nylon or urea

bodies. Handles shall be gray nylon. Wiring terminals shall be screw type or solderless pressure type having a suitable conductor-release arrangement. Not more than one switch shall be installed in a single-gang position. Switches shall be heavy duty, specification grade, rated 20 amperes at 120 or 277 volts ac.

#### 2.3.12 Fuses

A complete set of fuses for switches, panels, bus plugs, switch-gear, and control centers shall be furnished as required. Time-current-tripping characteristics of fuses serving motors or connected in series with circuit breakers shall be coordinated for the proper operation. Fuses shall have a voltage rating not less than the circuit voltage.

##### 2.3.12.1 Plug Fuses

Plug fuses shall be of the nonrenewable time-delay type and shall be used for circuits rated 125 volts or less and 30 amperes or less.

##### 2.3.12.2 Cartridge Fuses; Noncurrent-Limiting Type

Cartridge fuses of the noncurrent-limiting type shall be Class H, nonrenewable, dual element, time lag type and shall have interrupting capacity of 10,000 amperes. At 500 percent current, cartridge fuses shall not blow in less than 10 seconds. Cartridge fuses shall be used for circuits rated in excess of 30 amperes, 125 volts, except where current-limiting fuses are indicated.

##### 2.3.12.3 Cartridge Fuses; Current-Limiting Type

Cartridge fuses, current-limiting type, Class RK1 or RK5, shall have tested interrupting capacity not less than 100,000 amperes. Fuse-holders shall be of the rejection type.

#### 2.3.13 Control Devices

##### 2.3.13.1 Contacts

Contacts in miscellaneous control devices such as float switches, pressure switches, and auxiliary relays shall have current and voltage ratings in accordance with NEMA ICS 2 for rating designation B300.

##### 2.3.13.2 Safety Controls

Safety controls for boilers shall be connected to a 2-wire, 120-volt grounded circuit supplied from the associated boiler-equipment circuit. Where the boiler circuit is more than 120 volts to ground, safety controls shall be energized through a two-winding transformer having its 120-volt secondary winding grounded. Overcurrent protection shall be provided in the ungrounded secondary conductor and shall be sized for the load encountered.

##### 2.3.13.3 Lighting Contactors

All equipment and devices described in this paragraph shall satisfy requirements of NEMA ICS 2 as applicable. Contactors shall operate satisfactorily on 10 percent over-voltage and 15 percent under-voltage. The contacts shall be silver faced with fine silver or silver alloy insert approximately 1/16 inch thick with a silver plated overlay and shall be

readily accessible for inspection or replacement. The moving structure shall be of simple construction with no metal to metal friction and no sticking from residual magnetism. The magnet coil shall be vacuum impregnated with an oil and waterproof insulating compound. The magnetic structure shall be laminated iron of superior magnetic characteristics with the laminations securely riveted and fastened to reduce noise to a minimum.

Contactors that chatter will be rejected. Control circuits shall be 120 volts unless otherwise indicated on the drawings. In the event a contactor fails to open as a result of induced voltage in long cables, the Contractor shall provide suitable coil shunt resistors to make the contactors "drop-out" properly. Lighting contactors, where indicated shall be of the latching type and have a minimum contact rating of 20 amperes for the voltage specified. Enclosure for lighting contactors located in the downstream control station shall be NEMA 12.

#### 2.3.13.4 Pushbutton Control Stations

Push buttons and indicating lights shall be heavy duty type with colors and nameplates as indicated on the drawings. Indoor enclosures shall be NEMA 13. Outdoor enclosures shall be NEMA 4X stainless steel.

#### 2.3.13.5 Temperature Switch

An explosion proof temperature switch shall be furnished and wall mounted in room 115 of the CCS for exhaust fan control. Temperature switch shall have direct mounting probe, one spdt switching element rated 15 amperes at 250 volts ac, 3/4-inch conduit connection, a 40°F to 225°F adjustable range with wide deadband, and a cast iron enclosure suitable for Class I, Divisions 1 and 2, Groups C and D. Temperature switch shall be Static-O-Ring Model 201L-G125-U9-C7A or approved equal.

#### 2.3.14 Motor-Disconnect Means

Each motor shall be provided with a disconnecting means when required by the NFPA 70 even though not indicated. For single-phase motors, a single or double-pole toggle switch, rated only for alternating current, will be acceptable for capacities less than 30 amperes, provided the ampere rating of the switch is at least 125 percent of the motor rating. Switches shall disconnect all ungrounded conductors. Enclosure shall be NEMA 12 for indoor applications and stainless steel NEMA 4X for outdoor, tunnel, vault and damp locations.

#### 2.3.15 Equipment Connections

All equipment wiring not provided with the equipment shall be furnished and installed as indicated on the drawings and in accordance with the requirements of this Section. Flexible conduits 6 feet or less in length shall be provided to all electrical equipment subject to periodic removal, vibration, or movement and for all motors. Liquid-tight conduits shall be used in damp or wet locations.

##### 2.3.15.1 Motors and Motor Control

All motor control equipment, including automatic-control wiring and signaling devices, shall be connected as indicated on the drawings and in accordance with the requirements of this Section, unless otherwise noted or specified.

##### 2.3.15.2 Installation of Government-Furnished Equipment

Wiring shall be extended to the equipment, and proper connections made thereto.

#### 2.3.16 Clocks

Clocks shall be 12-inch round semi-flush mounting self-starting synchronous motor type with analog 1-12/00-23 hour dial, cordset, backbox and 120 volt receptacle; Simplex 6310, Cincinatti, Edwards or approved equal.

#### 2.3.17 Repair of Existing Work

The work shall be carefully laid out in advance, and where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceiling, or other surfaces is necessary for the proper installation, support, or anchorage of the conduit, raceways, or other electrical work, this work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved, at no additional cost to the Government.

#### 2.3.18 Vehicle Gate Operator

##### 2.3.18.1 Operation

A visitor, approaching the vehicle gate from the outside, stops at the vehicle access control and pushes its call button. The button sounds a horn which alerts lock personnel. A lock employee pushes the "Vehicle Gate Open" button in the control house and the motor driven gate operator opens the gate. The gate automatically stops in the open position. After approximately 20 seconds have elapsed, allowing the visitor to enter, the gate operator automatically closes the gate. Lock personnel may open the gate themselves, from the vehicle access control point, by a control pad on the control stand. Exiting vehicles run over a wire grid in the pavement near the gate, which causes the gate to open as described above, and then timed close. Those leaving by foot may open the gate by pushing a pushbutton near the grid. A second grid installed under the gate will prevent the gate from closing if a vehicle is stopped in the gate area. The gate shall automatically reverse if it hit an obstruction.

##### 2.3.18.2 Gate Operator

New gate operators, furnished and installed under SECTION: FENCING shall be connected ,as indicated on the plans, via underground conduit to power panel in the new CCS.

#### 2.3.19 Heat Tracing

Heat tracing shall be provided for all exterior fuel oil lines and where indicated or specified. Heat trace supplied under other sections shall be connected to power and control circuits as required. The Contractor shall provide all necessary controls, wiring, boxes, conduit, supports and hardware as required for a complete and operational system as specified.

##### 2.3.19.1 Heat Trace Cables

Heat trace cables shall be the self-regulating type rated 5 watts per foot and 120 volts ac. Cables shall have a copper braid over the cable jacket with an additional jacket over the copper braid suitable for the application. The heat trace cables shall not develop temperatures above 150

F on the pipes. Each cable shall be continuous with no splices or taps allowed. Where pipe taps are made the heating cable shall be run on opposite sides of the tap length installed according to the manufacturer's recommendations. The heating cable shall be installed as indicated on the drawings. The heat trace cables shall be provided under this section.

#### 2.3.19.2 [Enter Appropriate Subpart Title Here]

##### 2.3.19.2 Controls

One ambient sensing thermostat shall be located in the fuel oil control panel. Thermostat switch contacts shall be rated a minimum of 10 amperes at 120 volts ac. The thermostat shall have an adjustable range of 0°F to 225°F, and shall be set to operate at 38°F for the water line and 10°F for the fuel oil line. Thermostat shall operate reliably in temperatures between -40°F and +150°F. Thermostats shall be provided with all required contacts and relays to make an operating system.

### PART 3 EXECUTION

#### 3.1 GENERAL

##### 3.1.1 Code Compliance

The installation shall comply with the requirements and recommendations of NFPA 70, ANSI C2 and NFPA 101.

##### 3.1.2 Coordination

The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment will be properly located and readily accessible. Outlets and other equipment and materials shall be located to avoid interference with mechanical or structural features. Raceways, junction and outlet boxes, and lighting fixtures shall not be supported from sheet metal roof decks. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change.

#### 3.2 INSTALLATION

##### 3.2.1 Grounding

Except where specifically indicated otherwise, all exposed noncurrent carrying metallic parts of electrical equipment, metallic raceway systems, ground bus, metallic cable armor, grounding conductor in nonmetallic raceways, lighting poles, surge arresters and neutral conductor of the wiring system shall be grounded. The ground connection shall be made at the main service equipment and shall extend to the four existing lock ground plates. Connection shall be made to existing ground conductors at accessible points nearest to each of the ground plates. Metallic water service shall be grounded as described by NFPA 70. Generally all supplemental grounding electrodes shall be ground rods. Where there are no metallic water services to the building, ground connections shall be made to driven rods on the exterior of the building.

##### 3.2.1.1 Ground Rods

Ground rods shall be copper-clad steel, and shall be not less than 3/4 inch in diameter by 8 feet in length. Unless otherwise indicated, ground rods shall be driven into the ground until tops of rods are approximately 1 foot below finished grade. In counterpoise systems, tops of ground rods shall be approximately at elevations of counterpoises. Where the specified ground resistance cannot be met with the indicated number of ground rods, additional ground rods, longer ground rods, or deep-driven sectional rods shall be installed and connected until the specified resistance is obtained, except that not more than three additional 8-foot ground rods shall be required at any one installation. Ground rods shall be spaced as evenly as possible at least 6 feet apart and connected 2 feet below grade.

#### 3.2.1.2 Connections

Connections above grade shall be made with bolted solderless connectors. Connections below grade shall be exothermically welded.

#### 3.2.1.3 Ground Bus

Ground bus shall be provided in the electrical equipment rooms as indicated. The ground bus shall be bare conductor or flat copper in one piece, if practicable. Connections and splices shall be of the brazed, welded, bolted, or pressure-connector type, except that pressure connectors or bolted connections shall be used for connections to removable equipment.

Non-current-carrying metal parts of the following equipment shall be connected to the ground bus: transformer neutrals, service entrance switchboard, standby generator, building steel, steel H-piles for the CCS, metal water piping systems, the grounding conductors in each cable tray in the Cable Room, and other electrical equipment as shown on the drawings. A separate ground bus connected to the CCS steel H-pile, as shown on the drawings, shall be installed adjacent to the welding area in the maintenance shop. All conductors used for grounding to each ground bus shall be 4/0 AWG copper.

#### 3.2.1.4 Neutral Grounding

Neutral conductors shall be grounded where indicated. Ground wires shall be not less than 1/0 AWG, except that where the rated phase current exceeds 400 amperes, the size of neutral ground wires shall be increased to not less than one-half the size of the cross-sectional area of the individual phase conductors. Neutral ground wires shall be protected by conduit where such wires run exposed above grade in nonfence-enclosed areas or are run through concrete construction. Where 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 wire and the opening shall be sealed with a suitable compound after installation of the ground wire. Bends greater than 45 degrees in ground wire connections to the ground rods or counterpoises are not permitted.

#### 3.2.1.5 Equipment Grounding

Equipment frames of metal-enclosed equipment, chain-link fencing, and other noncurrent-carrying metal items, shall be grounded unless otherwise indicated. Connections to earth shall be made in the same manner as required for neutral grounding. Equipment or devices operating at less than 750 volts may be connected to secondary neutral grounds.

#### 3.2.1.6 Handhole or Concrete Pullbox Grounding

Ground rods installed in electrical-distribution-system manholes, handholes, or concrete pullboxes shall be properly connected to the cable shielding, metallic sheath, and armor at each cable joint or splice by means of a 4 AWG or equivalent 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. Ground wires shall be neatly and firmly attached to handhole walls and the amount of exposed bare wire shall be held to a minimum. For utility service conductor pullbox(es), this requirement shall be coordinated to meet the requirements of the utility company.

#### 3.2.1.7 Lighting Pole and Arrester Grounding

Bases of lighting poles shall be connected to an adjacent ground rod or ground conductor in trench, wireway or trough by means of an 8 AWG copper conductor. A ground connection from poles back to neutral ground points shall also be provided utilizing ground wires. Arresters shall be bonded to the pole grounding conductor with an 8 AWG copper conductor.

#### 3.2.2 Conduit Installation Methods

Unless otherwise indicated, wiring shall consist of insulated conductors installed in EMT, rigid steel conduit, or underground plastic conduit, as indicated.

##### 3.2.2.1 Conduit Systems

Conduit systems shall be installed as indicated. Conduit sizes shown are based on conductor insulation types as described in paragraph: Wire and Cable. Raceways shall be kept 6 inches away from parallel runs of flues, steam pipes, and hot-water pipes. Raceways shall be concealed where possible within finished walls, ceilings, and floors other than slabs-on-grade. Raceways crossing structural expansion joints shall be provided with suitable expansion fittings or other suitable means to compensate for the building expansion and contraction and to provide for continuity of grounding.

##### 3.2.2.2 Installing Conductors and Conduit Below Slab-on-Grade or in the Ground

All electrical wiring below slab-on-grade shall be protected by a conduit system. No conduit system shall be installed horizontally within concrete slabs-on-grade. For slab-on-grade construction, horizontal runs of rigid plastic or rigid steel shall be installed below the floor slab. Conduit passing vertically through slabs-on-grade shall be rigid steel. Rigid steel conduits installed below slab-on-grade or in the earth shall have a factory-applied polyvinyl chloride, plastic resin, epoxy coating system.

##### 3.2.2.3 Installing in Slabs Other Than on Grade

Conduits shall be installed as close to the middle of concrete slabs as practicable without disturbing the reinforcement. Outside diameter shall not exceed 1/3 of the slab thickness and conduits shall be spaced not closer than 3 diameters on centers except at cabinet locations where the slab thickness shall be increased as approved by the Contracting Officer.

#### 3.2.2.4 Exposed Raceways

Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings.

#### 3.2.2.5 Changes in Direction of Runs

Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp and wet locations shall be avoided where possible. Care shall be taken to prevent the lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment during the course of construction. Clogged raceways shall be entirely freed of obstructions or shall be replaced.

#### 3.2.2.6 Supports

Raceways shall be securely and rigidly fastened in place at intervals of not more than 10 feet with approved pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps with retainers, or ceiling trapeze. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structures, but no load shall be applied to joist bridging. Fastenings shall be by wood screws or screw-type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded studs, heat-treated or spring-steel-tension clamps on steel work. Nail-type nylon anchors or threaded studs driven in by a powder charge shall not be used. Raceways or pipe straps shall not be welded to steel structures. Holes cut to a depth of more than 1-1/2 inches in reinforced concrete beams or to a depth of more than 3/4-inch in concrete joists shall avoid cutting the main reinforcing bars. Holes not used shall be filled. In partitions of light steel construction, sheet-metal screws may be used. Conduit shall not be supported using wire or nylon ties. Raceways shall be installed as a complete system and be independently supported from the structure. Supporting means will not be shared between electrical raceways and mechanical piping or ducts and shall not be fastened to hung ceiling supports. Conduits shall be fastened to all sheet-metal boxes and cabinets with two locknuts where required by the NFPA 70, where insulating bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, a single locknut and bushing may be used. Bushings shall be installed on the ends of all conduits and shall be of the insulating type where required by the NFPA 70. A pull wire shall be inserted in each empty raceway in which wiring is to be installed by others if the raceway is more than 50 feet in length and contains more than the equivalent of two 90-degree bends, or where the raceway is more than 150 feet in length. The pull wire shall be of 14 AWG zinc-coated steel, or of plastic having not less than 200-pound tensile strength. Not less than 10 inches of slack shall be left at each end of the pull wire.

#### 3.2.2.7 Communications Raceways

Communications raceways indicated shall be installed in accordance with the previous requirements for conduit and with the additional requirements that no length of run shall exceed 50 feet for 2-inch and 3/4-inch sizes, and 100 feet for 1-inch or larger sizes, and shall not contain more than two 90-degree bends or the equivalent. Additional pull or junction boxes shall be installed to comply with these limitations whether or not

indicated. Inside radii of bends in conduits of 1-inch size or larger shall be not less than ten times the nominal diameter.

### 3.2.2.8 Boxes and Supports

In partitions of light steel construction bar hangers with 1-inch long studs, mounted between metal wall studs or metal stud "C" brackets snapped on and tab-locked to metal wall studs, shall be used to secure boxes to the building structure. When "C" brackets are used, additional box support shall be provided on the side of the box opposite the brackets. The edge of boxes for electrical devices shall be flush with the finished surfaces in gypsum, plasterboard installation. Boxes installed for concealed wiring shall be provided with suitable extension rings or plaster covers, as required. The bottom of boxes installed in masonry block walls for concealed wiring shall be flush with the top of a block to minimize cutting of blocks and boxes shall be located horizontally to avoid cutting webs of block. Indicated elevations are approximate. Unless otherwise indicated, boxes for wall switches shall be mounted 48 inches above finished floors. Cast metal boxes installed in wet locations shall be gasketed. Separate boxes shall be provided for flush or recessed fixtures when required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided. Boxes and supports shall be fastened to wood with wood screws or screw-type nails of equal holding strength, with bolts and metal expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel work. Nail-type nylon anchors or threaded studs driven in by powder charge shall not be used. In open overhead spaces, cast metal boxes threaded to raceways need not be separately supported except where used for fixture support; cast metal boxes having threadless connectors and sheet metal boxes shall be supported directly from the building structure or by bar hangers. Hangers shall not be fastened to or supported from joist bridging. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved type fastener not more than 24 inches from the box. Penetration of more than 1-1/2 inches into reinforced concrete beams or more than 3/4-inch into reinforced concrete joists shall avoid cutting any main reinforcing steel.

### 3.2.3 Wire and Cable Installation

#### 3.2.3.1 General

Wiring shall constitute the furnishing and installing of all cable and wire required in the locations specified or shown; the making of all connections, and the proper placing, arranging, and identifying of all materials as specified or directed by the Contracting Officer. All wiring shall be as indicated on the drawings. Unless otherwise specifically indicated, no wire smaller than 12 AWG shall be used for power or lighting.

Where the wire or cable cannot be pulled through the conduit easily, a commercial preparation may be used to facilitate pulling.

#### 3.2.3.2 Splices

No splices or joints will be permitted in either feeders or branches except at outlets or accessible junction boxes. Joints in branch-circuit wiring shall be made mechanically and electrically secure with solderless connectors as listed by UL, as pressure cable type, 600 volt rating, compression or indent type or soldered. Connectors shall be insulated by approved type, integral or separate cover, or by means of taping with

approved plastic or rubber and friction tapes to provide insulating value equal to that of the conductors being joined. In the making of a splice, connectors shall be brought up securely upon the conductors in a workmanlike manner in such a way that all conductors are equally engaged, the insulation is not ruptured, no bare wires are exposed or have "backed off" due to application of pressure and the connector will not loosen due to cycling or vibration, in order to insure an efficient splice. The pressure screw-on type connectors shall incorporate a nonrestricted zinc-coated or plated steel spring which will be capable of holding the wires over at least half the length of the spring under constant compression (tension) after mechanical and thermal stresses have been applied and released. The number and size and combinations of conductors permitted by UL, as listed on manufacturers' packaging of connector shall be strictly complied with. A tool designed for the purpose by the manufacturer of the particular size and type of connector utilized shall be employed unless the design of the connector incorporates an integral "built-in" means of insuring adequate pressure being exerted in fabrication of the splice. Wires 8 AWG and smaller shall be twisted together with a minimum of one turn of the stripped conductors before insertion into connectors. Splice connectors shall be of a type and be so installed that the conductor is fully insulated by a skirt of such design, or taped in such a manner that cold flow of the conductor insulation will not be induced when the conductor is positioned in its final operating position. Connectors for splicing 14 AWG and smaller conductors shall be crimp or pressure indent type. Exception to the above is the connection of lighting fixtures to the branch circuit supply conductors, which may be by screw-on type pressure connectors or any of the other methods herein specified. Temperature rating of connectors shall be at least equal to that of the wire on which they are used. Terminations or splices for stranded conductors 6 AWG and larger shall utilize indent, hex screw, or bolt clamp type connectors with or without tongue, as approved by the Contracting Officer for the particular application. Connectors which are not factory furnished with equipment, for cable sizes 250 MCM and larger, shall have at least two bolt holes unless anti-turning means is provided. All wire and cable connectors shall be of high conductivity corrosion-resistant material, and have ampere capacity at least equal the current carrying capacity of the wire or cable.

### 3.2.3.3 Cable Supports

Metal clad cable shall be supported in equipment recesses and control stand and pullbox manholes, where not in cable tray or conduit, as shown on the drawings. Conduit hangers shall be used to support the cable at intervals not exceeding 5 feet, except as otherwise required. Conduit hangers, mounting channel, and hardware shall be fabricated from stainless steel. Hangers shall accommodate sizes 2 inch through 3 inch in diameter. Cable mounting base shall be secured individually with stainless steel concrete type expansion bolts, nail-type nylon anchors or threaded stainless steel studs driven in by a powder charge. Mounting bolts or screws shall be made of stainless steel. Stainless steel channel strut may be used for multiple fastening of parallel and closely spaced cable. Each hanger shall contain an individual cable. Multiple cables bundled in one conduit hanger is not acceptable. Total support assembly shall be suitable for the load. The Contractor shall submit to the Contracting Officer a list of proposed material and installation details for approval.

### 3.2.3.4 Underground Cables

The type of installation, sizes, and number of cables shall be as

indicated. Conductors larger than 8 AWG shall be stranded. Each circuit shall be identified by means of fiber, laminated plastic, or nonferrous-metal tags, or approved equal, in each manhole, each handhole, each junction box, and at each terminal. Loads shall be divided as evenly as practicable on the various phases of the system. Manufacturer's written recommendations shall be furnished for each type of splice, and shall be approved before any work is done. Compounds and tapes shall be electrical grade suitable for the cable insulation provided and shall use design materials and techniques recommended by the manufacturer. Maximum length of cable pull and cable pulling tensions shall not exceed the cable manufacturer's recommendations.

a. Duct Line Installation: Low-voltage cables shall be installed in duct lines where indicated. Cable splices in low-voltage cables shall be made in manholes and handholes only, except as otherwise noted. Neutral and ground conductors shall be installed in the same duct with their associated phase conductors.

b. Connection to Buildings: Cables shall be extended into the various buildings as indicated, and shall be properly connected to the first applicable termination point in each building. After installation of cables, conduits shall be sealed with caulking compound to prevent entrance of moisture or gases into buildings.

#### 3.2.4 Tests

##### 3.2.4.1 Operating Test

After the installation is completed, the Contractor shall conduct an operating test for approval. Equipment shall be demonstrated to operate in accordance with the requirements herein. Tests shall be performed in the presence of the Contracting Officer. The Contractor shall furnish instruments and personnel required for the test and the Government will furnish the necessary electric power.

##### 3.2.4.2 Government Furnished Motor Control Centers and Control Stands

The Contractor shall verify and demonstrate that all features of the Government-furnished motor control centers and control stands are properly wired and fully operational. Contractor shall make any corrections or adjustments required.

##### 3.2.4.3 Ground-Resistance Measurements

The existing ground plates do not have to be tested. Ground-resistance measurements of each ground rod shall be taken and certified by the Contractor to the Contracting Officer. No part of the electrical distribution system shall be energized prior to the resistance testing of that system's ground rods and submission of test results to the Contracting Officer. Test reports shall indicate the location of the ground rod and the resistance and the soil conditions at the time the test was performed. When the building water service is used as a ground or part of the grounding system, ground-resistance measurements shall also be made of this connection. Ground-resistance measurements shall be made in normally dry weather, not less than 48 hours after rainfall, and with the ground under test isolated from other grounds. The resistance to ground shall be measured using the fall-of-potential method described in the IEEE 142 Standard.

### 3.2.5 Painting and Finishing

#### 3.2.5.1 Factory Coating

Outdoor 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 125 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with Table 1 (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel, mill galvanized sheet steel or rigid conduit with field cut threads shall be coated with a zinc rich paint.

#### 3.2.5.2 Field Painting

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory, shall be as specified in SECTION: PAINTING, GENERAL.

-- End of Section --

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SECTION 16530

LIGHTING SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO) PUBLICATIONS

AASHTO HB-16	(1997, 16th Ed.) Standard Specifications for Highway Bridges
AASHTO LTS-3	(1994) Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARDS

ANSI A687	(1992) High-Strength Nonheaded Steel Bolts and Studs
ANSI A780	(1992) Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ANSI C2	(1993) National Electrical Safety Code
ANSI C78.380	(1984) Method for the Designation of High-Intensity Discharge Lamps
ANSI C82.1	(1985; C82.1a; C82.1b; C82.1c; R 1992) Ballasts for Fluorescent Lamps Specifications
ANSI C82.4	(1992) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)
ANSI C136.2	(1985) Luminaries Voltage Classification
ANSI C136.3	(1989) Luminaire Attachments - for Roadway Lighting Equipment
ANSI C136.6	(1990) Roadway Lighting Equipment - Metal Heads and Reflector Assemblies - Mechanical and Optical Interchangeability
ANSI C136.9	(1990) Roadway Lighting Equipment - Socket Support Assemblies for Metal Heads - Mechanical Interchangeability

ANSI C136.10	(1988) Locking-type Photocontrol Devices and Mating Receptacles - Physical and electrical Interchangeability and Testing for Roadway Lighting Equipment
ANSI C136.11	(1988) Multiple Sockets for Roadway Lighting Equipment
ANSI C136.13	(1992) Metal Brackets for Wood Poles
ANSI C136.15	(1986) High-Intensity-Discharge and Low-Pressure Sodium Lamps in Luminaries - Field Identification

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) PUBLICATIONS

ASTM A 36	(1994a) Carbon Structural Steel
ASTM A 48	(1994a) Gray Iron Castings
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	(1982; R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 575	(1989) Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A 576	(1990b) Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM B 2	(1988) Medium-Hard-Drawn Copper Wire
ASTM B 8	(1993) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 117	(1994) Operating Salt Spray (Fog) Testing Apparatus
ASTM C 478	(1993) Precast Reinforced Concrete Manhole Sections
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environment

FACTORY MUTUAL SYSTEM (FM) PUBLICATION

Approval Guide (Equipment, Materials, Services for Conservation of Property) 1986 with Quarterly Supplements

ILLUMINATION ENGINEERING SOCIETY (IES) PUBLICATION

IESNA ARP-8	(1983) Roadway Lighting
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA) STANDARDS

NEMA LA 1 (1992) Surge Arresters  
NEMA LE 4 (1987) Recessed Luminaries, Ceiling

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) PUBLICATIONS

NFPA 70 (1996) National Electrical Code

UNDERWRITERS' LABORATORIES, INC. (UL) PUBLICATIONS

UL 03 (1996) Electrical Construction Materials Directory  
UL 542 (1994) Lampholders, Starters, and Starter Holders for Fluorescent Lamps  
UL 844 (1995) Electric Lighting Fixtures for Use in Hazardous (Classified) Locations  
UL 924 (1995) Emergency Lighting and Power Equipment  
UL 935 (1995; Rev Jun 1995) Fluorescent-Lamp Ballasts  
UL 1029 (1994; Rev Oct 1994) High-Intensity-Discharge Lamp Ballasts  
UL 1570 (1988; Rev thru Mar 1995) Fluorescent Lighting Fixtures  
UL 1571 (1991; Rev thru Mar 1995) Incandescent Lighting Fixtures  
UL 1572 (1991; Rev thru Mar 1995) High Intensity Discharge Lighting Fixtures

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Shop Drawings; GA.

Shop drawings shall be submitted for approval and shall consist of a complete list of equipment and materials, including manufacturer's descriptive and technical data (statement and certification of light pole vibration and strength characteristics); catalog cuts; and any special installation instructions that may be required. Shop drawings shall be submitted for all materials and equipment specified.

SD-13 Certificates

UL Publications; FIO.

The label or listing of the Underwriters Laboratories Inc., will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this label or listing, the Contractor shall submit a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements. However, materials and equipment installed in hazardous locations must bear the UL label unless the data submitted from other testing agency is specifically approved in writing by the Contracting Officer.

Non-UL Publications; FIO.

For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable standard of ASTM, NEMA, or other commercial standard, is acceptable.

GUARANTEE; FIO.

The equipment furnished under this section shall be guaranteed against defective material, design, and workmanship for the period of one (1) year from the date of acceptance. Upon receipt of notice from the government of failure of any part of the guaranteed equipment during the guarantee period, new replacement parts shall be furnished and installed promptly by the Contractor at no cost to Government.

## PART 2 PRODUCTS

### 2.1 GENERAL

Items of the same classification shall be identical including equipment, assemblies, parts, and components.

#### 2.1.1 Standard Product

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

#### 2.1.2 Prevention of Corrosion

a. Metallic materials shall be protected against corrosion as specified. Aluminum shall not be used in contact with earth or concrete.

b. Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 123 and ASTM A 153.

c. Luminaries fabricated from ferrous metals, unless hot-dip galvanized or of porcelain enamel finish, shall be factory finished with a weather-resistant finish in accordance with paragraph: Painting and Finishing, except exposure shall be 200 hours. Finish color shall be the manufacturer's standard, unless otherwise indicated.

#### 2.1.3 Hazardous Locations

Wiring in locations indicated shall conform to the NFPA 70 for Class I, Division 2 hazardous locations. Equipment shall be suitable for Group D, operating temperature of 536 F. Wiring and equipment in locations indicated shall be of the classes, groups, divisions, and suitable for the operating temperature; all as indicated.

#### 2.1.4 Verification of Dimensions

The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

### 2.2 MATERIALS

#### 2.2.1 Workmanship

Materials and equipment shall be installed in accordance with recommendations of the manufacturer and as shown.

#### 2.2.2 Publications

Materials and equipment shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this Section.

#### 2.2.3 Lamps

##### 2.2.3.1 Fluorescent Lamps

Fluorescent lamps for electronic ballasts shall be as indicated.

##### 2.2.3.2 High-Intensity-Discharge Lamps

ANSI C78.380.

##### 2.2.3.3 Incandescent Lamps, Large

Shall be rated rough service unless otherwise specified.

#### 2.2.4 Ballasts

Ballasts shall conform to the lamp the ballast supplies, shall be rated for the voltage indicated and shall have a power factor of not less than 90 percent, a crest factor of 2.0 or less and a voltage range of not less than plus or minus 10 percent. Exterior type ballasts shall be suitable for operating at  $-40^{\circ}\text{F}$  and above.

##### 2.2.4.1 Fluorescent Lamp Ballast

Shall be the electronic type conforming to ANSI C82.1 and UL 935.

##### 2.2.4.2 Electronic Ballast

Electronic ballasts shall consist of a rectifier, high frequency inverter, and power control and regulation circuitry. The ballasts shall be UL listed, Class P, with a Class A sound rating and shall contain no PCBs. Ballasts shall meet 47 CFR 18 for electromagnetic interference and shall

not interfere with the operation of other electrical equipment. Design shall withstand line transients per IEEE C62.41, Category A. Unless otherwise indicated, the minimum number of ballasts shall be used to serve each individual fixture, using one, two, three or four lamp ballasts. A single ballast may be used to serve multiple fixtures if they are continuous mounted, factory manufactured for that installation with an integral wireway and are identically controlled.

- (a) Light output regulation shall be plus or minus 10 percent.
- (b) Voltage input regulation shall be plus or minus 10 percent.
- (c) Lamp current crest factor shall be no more than 1.7.
- (d) Ballast factor shall be not less than 85 percent nor more than 100 percent, unless otherwise indicated.
- (e) A 60 Hz filter shall be provided. Flicker shall be no more than 15 percent with any lamp suitable for the ballast.
- (f) Ballast case temperature shall not exceed 25 degree Celsius rise above 40 degree Celsius ambient, when tested in accordance with UL 935.
- (g) Input current third harmonic shall not exceed 32 percent total harmonic distortion or 27.5 percent of the third triplens.
- (h) Power factor shall not be less than 0.9.
- (i) Ballasts shall operate at a frequency of 20 KHz or more.
- (j) Operating filament voltage shall be 2.5 to 4.5 volts.
- (k) Warranty. Three year full warranty including a \$10 labor allowance.
- (l) Ballast Efficacy Factor (BEF) shall be in accordance with the following Table - Electronic Fluorescent Ballast Efficacy Factors. Ballasts and lamps shall be matching rapid start or instant start as indicated on the following Table. If 32W-F32-T8 lamps and ballasts are used, they must be either all rapid start or all instant start.

ELECTRONIC FLUORESCENT BALLAST EFFICACY FACTORS\*

LAMP TYPE	TYPE OF STARTER & LAMP	NOMINAL OPERATIONAL INPUT VOLTAGE	NUMBER OF LAMPS	MIN. BALLAST EFFICACY FACTOR
40W F40 T12	rapid start	120 or 277 V	1	2.3
			2	1.2
			3	0.8
			4	0.6
34W F40 T12	rapid start	120 or 277 V	1	2.6
			2	1.3
			3	1.0
			4	0.7
40W F40 T10	rapid start	120 or 277 V	1	2.2
			2	1.1
			3	0.8
32W F32 T8	rapid or instant start	120 or 277 V	1	2.4
			2	1.4
			3	1.0
			4	0.8

\*For ballasts not specifically designed for use with dimming controls

The BEF is calculated using the formula:

BEF = Ballast Factor (in percent) / Power Input

where Power Input = Total Wattage of Combined Lamps and Ballasts

2.2.4.3 High-Intensity-Discharge Lamp Ballast

UL 1029 and ANSI C82.4 for multiple supply type.

2.2.5 Fixtures

Fixtures shall be as shown and shall conform to UL Standards and the following specifications and shall be as detailed on Standard Drawing No. 40-06-04. Illustrations shown on these sheets are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar designs and equivalent energy efficiency, light-distribution and brightness characteristics, and of equal finish and quality shall be submitted for approval.

- a. Fluorescent, Industrial-Type Fixtures: UL 1570.
- b. Fluorescent, General-Purpose Fixtures: UL 542 and UL 1570.
- c. Hazardous Location Fixtures: UL 844.
- d. High-Intensity-Discharge Fixtures: UL 1572.
- e. Incandescent Lighting Fixtures: UL 1571.
- f. Luminaries, Floodlighting: UL 1571 and UL 1572.

- g. Luminaries, Roadway Lighting:
  - Attachments, ANSI C136.3.
  - Classification, ANSI C136.2.
  - Field identification marking, ANSI C136.15.
  - Interchangeability, ANSI C136.6 for metal heads and reflectors, and  
ANSI C136.9 for sockets.
  - Luminaries, side-mounted, ANSI C136.14.
  - Sockets, ANSI C136.11.
  - Photo-Control Devices, ANSI C136.10.

#### 2.2.6 Light Sets

UL 924.

#### 2.2.7 Poles

Poles shall be steel.

#### 2.2.8 Surge Arresters

NEMA LA 1 of the zinc-oxide type.

### 2.3 OTHER PRODUCTS

#### 2.3.1 Interior Lighting

##### 2.3.1.1 Lamps and Lighting Fixtures

Fixtures may be provided with No. 18 AWG stranded copper conductors in 3/8-inch flexible metal conduits not over 6 feet long where flexible metal conduits are permitted by NFPA 70. Ballasted fixtures shall have ballasts which are compatible with the specific type and rating of lamps indicated and shall comply with the applicable provisions of the publications referenced.

##### 2.3.1.2 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed in the fixtures just prior to the completion of the project.

- a. Incandescent lamps: 120 volt ac operation unless otherwise indicated.
- b. Fluorescent lamps shall be as indicated in the fixture schedule shown on the drawings.
- c. High-intensity-discharge lamps shall be the high-pressure-sodium type unless otherwise indicated.

##### 2.3.1.3 Fixtures

Fixtures shall be as shown and described herein and shall conform to the following specifications.

- (a) Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation.
- (b) Suspended fixtures shall be provided with swivel hangers in order to insure a plumb installation. Pendants 4 feet or longer shall be

braced to limit swinging. Single-unit suspended fluorescent fixtures shall have two hangers. Multipole-unit or continuous-row fluorescent units shall have a tube, a hanger wire with separate cord, or a stem for wiring at one or both ends as indicated on the drawings. Hangar rods shall not be less than 3/16-inch diameter.

(c) Ceiling fixtures shall be coordinated with and suitable for installation in, on, or from the suspended ceiling provided under other sections of these specifications. Installation and support of fixtures shall be in accordance with the NFPA 70 and manufacturer's recommendations. Where seismic requirements are specified herein, fixtures shall be supported as shown or specified. Recessed fixtures shall have adjustable fittings to permit alignment with ceiling panels. Recessed fixtures installed in fire-resistive type of suspended ceiling construction shall have the same fire rating as the ceiling or shall be provided with fireproofing boxes having materials of the same fire rating as the ceiling panels, in conformance with the Building Materials Directory of Underwriters Laboratories Inc. Surface-mounted fixtures shall be suitable for fastening to the structural support for ceiling panels.

(d) Sockets of industrial, strip, and other open type fluorescent fixtures shall be of the type requiring a forced movement along the longitudinal axis of the lamp for insertion and removal of the lamp.

### 2.3.2 Exterior Lighting

#### 2.3.2.1 Floodlights

Floodlights shall be of the enclosed heavy-duty type having indicated beam spreads and adjustable support brackets suitable for required mountings. Where indicated, floodlights shall be equipped with weatherproof plug-in or twist-lock receptacles to receive photo-control elements. Lamps shall be of the sizes and types indicated and provided with appropriate ballasts.

#### 2.3.2.2 Roadway, Area and Lock Lighting Luminaries

Roadway, area and lock lighting luminaries shall be of the enclosed type each consisting of a cast aluminum housing, a finished aluminum reflector for corrosion protection, an enclosing glass refractor or globe providing the indicated IES RP 8 type light distributions, and a slip-fitter capable of adapting to 1-1/4 inch through 2-inch mounting brackets. Luminaire heads shall have standard dimensions suitable for interchangeable, standard optical assemblies. Heads shall be internally wired and rated 600 volts. Lamps shall be of the sizes and types indicated and provided with appropriate ballasts.

#### 2.3.2.3 Vandal-Resistant Construction

Where indicated, luminaries shall be provided with vandal-resistant construction. Exposed diffusers, reflectors, or refractors shall be of a polycarbonate resin, except that other material may be used if protected by a polycarbonate resin shield or cast metal guard. Luminaries mounted 15 feet and less above grade shall have exposed screws of the tamper-resistant type.

#### 2.3.2.4 Photo-Control

Each photo-control element shall have an adjustable operating range of

approximately 0.5 to 5.0 footcandles and shall be mounted in a replaceable, weatherproof twist-lock assembly. Where indicated, luminaries shall be individually controlled by a photo-control element mounted on the Luminaire.

#### 2.3.2.5 Fusing

Each pole mounted Luminaire shall be fused at pole base. Fuse holder shall be in-line weatherproof type. Fuse size shall be coordinated with fixture rating. See SECTION: LOCK ELECTRICAL WORK for fuse specifications.

#### 2.3.2.6 Poles

Lighting poles shall be of nominal length as shown on the fixture schedule. Poles shall be suitable for use with underground supply conductors. Poles shall be designed for a wind velocity of 100 mph at the base of the pole, for a wind gust factor of 1.3, and for the height and drag factors recommended by AASHTO. The effective projected area of luminaries and other pole-mounted devices shall be taken into account in pole design. Poles shall have grounding provisions. Bases shall be of the anchor-bolt-mounted type.

(a) Brackets: Brackets for area lighting shall be of the indicated types. Brackets for floodlights shall have the number of tenons indicated. Brackets for roadway luminaries shall correctly position luminaries not less than 2 feet from poles, at not less than the mounting heights indicated, but in no case less than 24 feet above any roadway. Brackets for guide wall lighting shall correctly position center of lamp on face of guide wall. Slip-fitter brackets shall be coordinated with the luminaries provided, and brackets used with one type of luminaire shall be identical. On metal poles, brackets shall be of the same metal.

(b) Steel Poles: Steel poles and steel brackets shall be hot-dip galvanized in accordance with ASTM A 123 and shall not be painted.

(c) Pole Setting: Poles shall be mounted on cast-in-place foundations or on existing anchors where noted. Conduit ells shall be provided for cable entrances into pole interiors.

(d) Cast-In-Place Foundations: Concrete foundations, sized as indicated, shall have anchor bolts accurately set in foundations using templates supplied by the pole manufacturer. After the concrete has cured, pole anchor bases shall be set on foundations and leveled by shimming between anchor bases and foundations or by setting anchor bases on leveling nuts and grouting. Poles shall be set plumb. Anchor bolts shall be the manufacturers' standard, and not less than necessary to meet the pole wind loading specified herein and other design requirements.

#### 2.3.2.7 Lighting Pole Grounding

Bases of lighting poles shall be connected to an adjacent ground rod by means of an 8 AWG wire. A ground connection from poles back to neutral ground points shall also be provided utilizing either metal raceways or ground wires.

#### 2.3.2.8 Existing Lighting Equipment

Where indicated, existing lighting equipment shall be removed, salvaged and

reinstalled. Equipment shall be stored in a suitable building under control of the Contractor, until the time it is to be reinstalled.

#### 2.3.2.9 Salvaged Equipment

Salvaging equipment shall consist of removing all dirt and checking the parts in general. Any defective parts shall be called to the attention of the Contracting Officer. The Contractor shall remove the defective part or parts when so directed by the Contracting Officer. All finished surfaces shall be sand blasted and all dents, chips or holes filled with epoxy and sanded smooth. Painting shall be in accordance with paragraph: Painting and Finishing. The Contractor shall furnish and install new lamps and any additional hardware required, such as screws, bolts, washers, nuts, etc.

#### 2.3.3 High Mast Lighting

##### 2.3.3.1 Fixtures

Fixtures shall be TYPE 404E2, as detailed on sheet 54 of Corps of Engineers Drawing No. 40-06-04 which accompany and form a part of this specification.

The fixture shall have an Symmetric, full cutoff cutoff light distribution pattern. The illustration shown on this sheet is indicative of the general type desired and is not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar design, equivalent light distribution and brightness characteristics, and equal finish and quality will be acceptable. Fixtures shall be similar or equal to the existing high mast light as indicated on the drawings. A total of seven (7) 1,000 watt luminaries shall be supplied. Six fixtures shall be installed on the high mast pole, and one shall be given to the Lockmaster in the original packing carton. All accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation.

##### 2.3.3.2 Lamps

Lamps of the proper type, wattage, and voltage rating shall be delivered to the project in the original containers, and installed in the fixtures just before completion of the project. Four spare lamps shall be provided. High-pressure sodium lamps shall be clear.

##### 2.3.3.3 Poles

Steel poles shall be the pole manufacturer's standard design for supporting six 1000 watt fixtures. Poles shall be similar or equal to the existing high mast poles. Poles lengths shall provide a 100 foot luminaire mounting height. All poles shall be made of tapered steel tubes. All shaft steel shall be full gage, without laminations. All sections shall maintain a uniform taper from top to bottom. The overall height dimension shall be achieved by a combination of shop welding and/or field telescoping of one section onto another. Sections shall not exceed in length that which commercial type motor freight can handle. Pole shafts shall be secured to the concrete foundation by a steel base plate welded to the shaft. All poles shall have a weatherproof, hinged, padlockable access door in the base. Grounding connection shall be provided near the bottom of each metal pole. All steel materials furnished for high mast pole shall be hot-dipped galvanized. Prior to hot-dip galvanizing, the surfaces to be coated shall be blast cleaned. Scratched, stained, chipped, or dented poles shall not be installed.

(a) Design Criteria. Pole and all mounted accessories shall be

designed to withstand a 100 mph wind load. Pole design, base plate and selection computations shall be submitted for approval prior to installation. All structures shall be designed to withstand pressures created by wind velocities and projected area, as shown on the shop drawings. Pressures shall be calculated by the formula  $P = 0.0025 \cdot (V)^2$ . The following shall be considered when computing forces.

- (1) Gust factor of 1.3.
- (2) Height coefficient of: 50-100 feet - 1.25
- (3) Drag coefficient on pole per AASHTO Standards.
- (4) Effective projected area of luminaries, as suggested by manufacturer.
- (5) Deflection induced loads.

The design of the highmast pole shall be according to AASHTO Publications, AASHTO LTS-3, Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals and AASHTO HB-16, Standard Specifications for Highway Bridges. The design shall check fatigue and deflection acceptance criteria per these AASHTO Publications. The Contractor shall submit all design criteria and computations.

(b) Welding. All welding shall conform to the latest revision of the American Welding Society specification. All transverse welds (those joining one section to another) shall be 100 percent penetration. Longitudinal welds shall have a minimum penetration of 60 percent. That portion of the longitudinal weld which make up the slip joint area, plus 1 foot on each side of all transverse welds, shall be 100 percent penetration. Inspection shall consist of ultrasonics for all 100 percent welds, and visual and/or magnetic particle for all others.

(c) Pole Setting. All poles shall be set straight and plumb. Conduits shall be provided at all poles.

(d) Lightning Arresters. Each high mast lighting fixture pole shall be provided with the manufacturer's standard lightning arresters rated 600 volts ac, secondary service. General Electric Co. Thyrite type, or approved equal. The arresters shall be mounted in the lighting poles and connected to the load side of the pole service wiring. The pole base shall be connected to the bare copper ground wire.

(e) Fusing for highmast. The highmast luminaries existing and new shall be fused at pole base. Fuse holder shall be custom installed fuse blocks as described below. Fuse size shall be coordinated with fixture rating. See SECTION: LOCK ELECTRICAL WORK for fuse specifications.

- (1) The Contractor shall provide two(2) - 2 pole fuse holders, one(1) - 8"x6"x3.5" continuous hinge clamp cover NEMA 4X junction box and panel, and wet location, CGB type cord connectors for cable connections in the top and bottom of the box.

- (2) The junction box/fuse holder assembly shall be installed on the inside of the pole's handhole door. Mounting screws or bolts shall not penetrate the outside of this door.

#### 2.3.3.4 Lowering Device

The lowering device shall consist of three basic parts: a head assembly,

ring assembly, and a drive assembly.

(a) Head Assembly. The head assembly shall be made of 2-inch minimum A 36 steel and hot-dipped galvanized conforming to ASTM A 123 and A 153. The suspension cable sheaves shall be of durable material and provide free movement of the cables. Each sheave shall have a bushing of similar material. Onto the end of the suspension sheave arms, there shall be bolted a latching device. The latches shall contain no moving parts, and shall remove all loading from the suspension and drive cables. The latches shall be ASTM A 36 steel. Latches and hardware shall be galvanized. Each sheave shall utilize a keeper bolt arrangement to prevent cables from jumping the sheave. The main power conductor sheave shall be approximately 18 inches in pitch diameter and made of A 36 steel. It shall be shop painted and shall have bearings the same as the suspension cable sheaves. All suspension cables shall be pre-strung in the factory through the head assembly. Lowering cable length shall be adjusted to prevent the ring assembly from hitting obstructions such as hand railings in the lowered position. The entire assembly shall be covered by a hood. The hood shall fit the conductor sheave in such a manner as to prevent the conductor cable from jumping the sheave.

(b) Ring Assembly. The ring assembly shall be made of ASTM A 36 hot-dipped galvanized steel. The luminaire ring shall have attached a NEMA 3R junction box. The ring assembly shall be supplied with 6 luminaire tenons symmetrically spaced. Each luminaire tenon shall be prewired with wires running from the tenons to a terminal block in the ring mounted junction box. Wiring to unused tenon shall not be energized at the time of final acceptance and exposed wire ends shall be taped. The ring shall have three or more steel locating pins or other similar hardware to prevent the ring assembly from twisting as it is raised and lowered. The ring assembly shall be equipped with free moving rollers to avoid snagging when raising or lowering the luminaries. Each pole shall be furnished with the necessary length of manufacturer's recommended copper conductor cable, with one male plug and one female plug connector, and one weatherproof receptacle mounted in the junction box on the ring for testing the lights in the lowered position. Plugs, connectors and receptacles shall conform with NEMA Standards.

(c) Drive Assembly. A lowering winch shall be located in the pole base. It shall be a worm-gear, self-locking type, properly sized for the load. The necessary length of 1/4-inch galvanized steel cable shall be pre-wound onto the winch drum at the factory. Operation of the lowering winch shall be by a heavy-duty reversing brake motor with torque limiter and coupling for connection to the lowering winch drive shaft. There shall be a minimum of 15 feet of cable between the motor and a remote operator. The remote operator and the motor shall be mounted on a 2-wheel push cart. The motor and remote operator shall be suitable for use on a 120 volt, single-phase, 20 ampere circuits. Drive shall be interchangeable with existing high mast drive assembly or existing drive assemblies shall be replaced with same type as provided under this Section.

#### 2.3.3.5 Anchor Bolts

Anchor bolts shall be designed and provided by the pole manufacturer. Anchor bolts shall be threaded bar. The top ten inches shall be cold-dip galvanized. The nuts shall be galvanized. The cold-dip galvanizing shall

conform to ASTM A 780 and shall be zinc-rich paints. Prior to application of the zinc-rich paint, the surfaces to be coated shall be blast cleaned to white metal in accordance with SSPC-SP5. After installation of the nuts, all damaged surfaces shall be touched-up with compatible zinc-rich paint.

### PART 3 EXECUTION

#### 3.1 GENERAL

##### 3.1.1 Code Compliance

The installation shall comply with the requirements and recommendations of NFPA 70 and ANSI C2.

##### 3.1.2 Coordination

The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment will be properly located and readily accessible. Lighting fixtures, outlets, and other equipment and materials shall be located to avoid interference with mechanical or structural features; otherwise, lighting fixtures shall be symmetrically located according to the room arrangement when uniform illumination is required, or asymmetrically located to suit conditions fixed by design and shown. Raceways, junction and outlet boxes, and lighting fixtures shall not be supported from sheet metal roof decks. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change.

#### 3.2 INSTALLATION

##### 3.2.1 Painting and Finishing

###### 3.2.1.1 Factory Coating

Outdoor 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 125 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with Table 1 (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint.

###### 3.2.1.2 Field Painting

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory, shall be as specified in SECTION: PAINTING, GENERAL.

##### 3.2.2 Tests

After the building and lock lighting system installation is completed, and at such time as the Contracting Officer may direct, the Contractor shall

conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements of this specification. The test shall be performed in the presence of the Contracting Officer. The Contractor shall furnish all instruments and personnel required for the tests, and the Government will furnish the necessary electric power.

### 3.2.3 Spare Parts

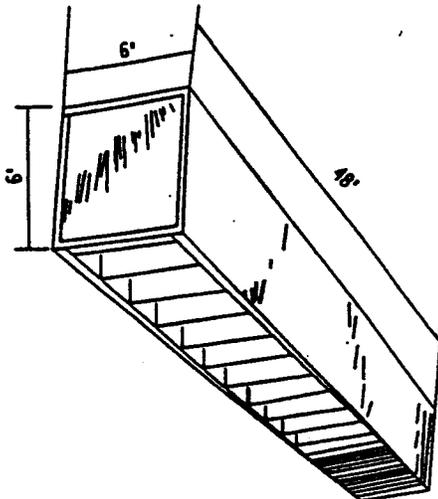
Provide a complete set of accessories and special tools required to erect, handle, dismantle, test, and maintain lighting system apparatus. Spare parts shall be identical in all respects to corresponding original equipment provided. Spare parts required include:

- (1) One complete set of fuses, each type and size.
- (2) One fixture of each type provided.
- (3) Four lamps of each type provided.
- (4) Twelve one-quart containers of finish paint for outdoor equipment.

### 3.3 ATTACHMENTS

STD. DETAIL NO. 40-06-04 SHEET 3  
STD. DETAIL NO. 40-06-04 SHEET 6  
STD. DETAIL NO. 40-06-04 SHEET 36  
STD. DETAIL NO. 40-06-04 SHEET 51  
STD. DETAIL NO. 40-06-04 SHEET 54  
STD. DETAIL NO. 40-06-04 SHEET 60  
STD. DETAIL NO. 40-06-04 SHEET 67  
DETAIL IDENTIFICATION D502225E

-- End of Section --



LUMINAIRE REQUIREMENTS

1. HOUSING SHALL BE MINIMUM 0.026 THICK STEEL, OR STEEL AND ALUMINUM CONSTRUCTION, AND SHALL BE CHEMICALLY TREATED FOR RUST PREVENTION AND PAINT ADHESION. HOUSING SHALL BE ASSEMBLED WITH SCREWS OR BY WELDED JOINTS.
2. INTERIOR OF HOUSING SHALL BE PAINTED WITH MINIMUM 85% REFLECTANCE HIGH GLOSS WHITE ENAMEL.
3. REFLECTOR SHALL BE SEMI-SPECULAR NATURAL ANODIZED ALUMINUM.
4. PARABOLIC LOUVER SHALL BE ANODIZED NATURAL ALUMINUM AND SHALL HAVE POSITIVE ACTION SPRING LOADED LATCHES AND SAFETY HINGES.

5. PROVIDE INTERNAL GREEN GROUNDING SCREW.

6. BALLAST: HIGH POWER FACTOR ( .95ETL, CBM APPROVED RAPID START CLASS P ENERGY SAVING BALLAST WITH SOUND RATING OF "A". SECURE BALLASTS TO HOUSING WITH AT LEAST ONE SCREW AND SLIP ON BRACKET OR TWO SCREWS - ONE AT EACH END.

7. PROVIDE COLORS AS INDICATED.

TYPE A - DIRECT - 1 LIGHT  
TYPE B - DIRECT - 2 LIGHT

TYPE C - INDIRECT - 1 LIGHT  
TYPE D - INDIRECT - 2 LIGHT

TYPE E - DIRECT/INDIRECT - 1 LIGHT  
TYPE F - DIRECT/INDIRECT - 2 LIGHT

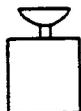
TYPE G - DIRECT ASYMMETRIC

NOTE: TYPES C, D, E & F MAY ONLY BE PENDANT OR BRACKET MOUNTED.

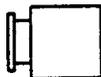
SURFACE, PENDANT OR  
BRACKET MOUNTED PARABOLIC LUMINAIRE



SURFACE



PENDANT



BRACKET

RESPONSIBILITY:

ELECTRICAL

DESCRIPTION:

GENERAL NOTES:

1. DETAILS SHOWN NOT TO SCALE.

ACCURACY:

.dgn	MU	SU	PU
	1"	1/2"	8000

.dwg

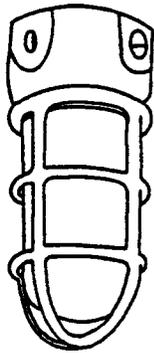
\*4 ARCHITECTURAL

DATE CREATED:

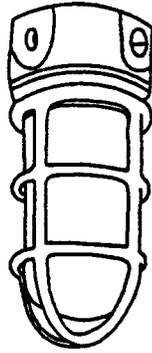
AUG 93

ORIGIN (INSERTION POINT)

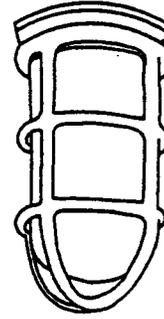
DETAILS SHOWN WITHOUT LINE THICKNESS FOR CLARITY



**TYPE 106**  
Integral Outlet Box



**TYPE 107**  
Exposed Gasketed  
Outlet Box



**TYPE 108**  
Concealed Standard  
Outlet Box

**Enclosed and Gasketed (Vapor-tight) Industrial Incandescent Fixtures**

**Suffix**

**Description**

A  
B  
C

Ceiling mounted  
Wall mounted  
Pendant mounted

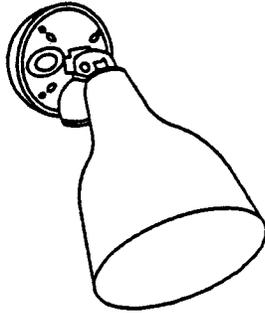
Type 106 fixture body shall be constructed with an enclosed and gasketed chamber as an integral part of the body which shall serve as an outlet box. Fixture shall be suitable for wet locations.

Type 107 fixture shall be suitable for mounting on an exposed, enclosed, and gasketed conduit outlet box. Fixture shall be suitable for wet locations.

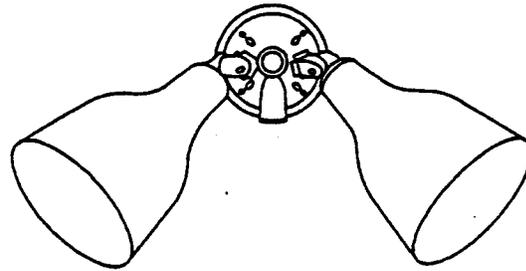
Type 108 fixture shall be suitable for mounting on a concealed standard outlet box. Fixture shall be suitable for wet locations.

Type 106, 107, and 108 fixtures shall conform to UL 1571 and shall be provided with a cast aluminum guard of adequate rigidity and strength. A guard shall be attached to the fixture so that its permanence of position is assured. Wattage rating of the fixture shall be as indicated on contract documents.

Fixture types indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.



**TYPE 112**  
Single



**TYPE 113**  
Double

**Exterior Incandescent Floodlight for  
Soffitt or Wall Outlet Box Mounting**

**Suffix**

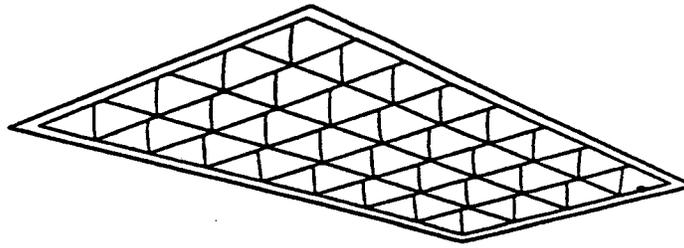
A  
B

**Description**

Satin aluminum finish  
Textured black finish

Fixture shall conform to UL 1571. Fixture shall be suitable for use in wet locations. The fixture shall consist of the indicated number of lampholder housing units with adjustable attachment arm and box canopy. The housing, attachment arm, and canopy shall be cast aluminum and shall be finished as specified. Satin aluminum finish shall have clear acrylic lacquer protective coating. The housing arm shall attach to the box canopy with 1/2-inch connection. A locknut shall be provided to secure the arm in the desired position. The housing arm shall be provided with a calibrated swivel with serrated locking teeth and compression screw to hold the fixture housing in the desired position. Housing shall be large enough to provide ample finger room for ease of lamp replacement. Fixture shall be rated for PAR-38 standard lamps of 52 to 165 watts. Lampholder shall be medium base glazed porcelain. Fixture shall be furnished with weatherproof gasket. Fixture shall be prewired.

Fixture types indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.



**TYPE 234**  
Static Troffer

**TYPE 235**  
Air Handling Troffer

**TYPE 236**  
Heat Removal/  
Transfer Troffer

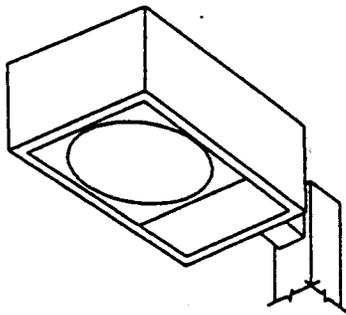
4

**Recessed Fluorescent Fixture, 2-foot by 2-foot, With Parabolic Louver**

First Suffix	Second Suffix	Description
A		Two-lamp, 12-cell louver
B		Three-lamp, 18-cell louver
C		Four-lamp, 32-cell louver
	1	Type 200 emergency unit

Fixture shall conform to UL 1570. Housing, trim flanges if any, and end fittings shall be die-formed, cold-rolled steel embossed if necessary to ensure structural rigidity. End fittings shall be removable if required to permit end-to-end mounting of fixtures in a continuous row. Metal parts to be painted shall receive one or more rust inhibitive coatings before application of the finish coat. Reflective surfaces shall be finished to provide an initial and minimum reflectance of not less than 85 percent. The louver shall be the anodized or semi-specular finished aluminum type consisting of interconnected cellular baffles not less than three nor more than four inches in depth. The louver shall be hinged on both longitudinal sides using die-formed steel hinges, and shall be held securely in place by the hinges and spring-steel latches that are inconspicuous or concealed from view when louver is in place and latches are closed. Securing the louver in place shall prevent light leakage and movement of the louver when subjected to normal vibrations. The ballast(s) and fixture wiring shall be concealed by a snap-in type of metal cover which can be removed and replaced without the use of tools. Standard ballast(s) shall be of the Class P, high power factor type that has been approved by the Certified Ballast Manufacturers for the application. Ballast(s), lampholders, louver and the wireway cover shall be removable and replaceable without removal of the fixture from the ceiling. Fixture shall be prewired.

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.



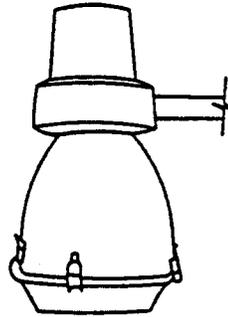
TYPE 401

Enclosed, Integrally Ballasted, Rectangular Shaped,  
Side Mounted, High Intensity Discharge Lighting Fixture

First Suffix	Second Suffix	Description
A		Rated for mercury vapor lamp
B		Rated for metal halide lamp
C		Rated for high pressure sodium lamp
	1	IES type II medium light distribution
	2	IES type III medium light distribution
	3	IES type V medium light distribution.

Fixture shall conform to UL 1572. Fixture housing shall have sides and doorframe of one-piece extruded aluminum with welded joints and top of crowned sheet aluminum. The top shall be spot welded and sealed watertight. The housing shall be rigidly attached to a square shaped mounting arm of extruded aluminum. The fixture door shall have a flat heat and impact resistant lens of 3/16-inch nominal, tempered glass, and shall be hinged and held in place with captive screws of the same finish as the door. The lens and door shall enclose the lamp compartment. The reflector shall be aluminum of the manufacturer's standard commercial product finish suitable for the lamp type and rating. The ballast shall be of the high power factor type. The ballast and power components shall be mounted on a single bracket and shall be removable. The fixture, including the mounting arm, shall be gasketed to allow air movement but prevent the entry of dust and insects. Ballast shall be of the constant wattage autotransformer type for mercury vapor lamps, lead-peak autotransformer type for metal halide lamps, and regulating type for high pressure sodium lamps. Ballast shall be capable of starting and operating the lamp at ambient temperatures ranging from minus 20 degrees F to 105 degrees F. A square extruded aluminum pole including anchor type base, anchor bolts and mounting hardware shall be provided by the fixture manufacturer and shall be the manufacturer's standard commercial product for the number of fixtures and wind load indicated or specified. The fixture housing mounting arm shall have a dark duranodic bronze finish. The fixture shall be prewired and shall have a mogul base glazed porcelain lampholder.

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.



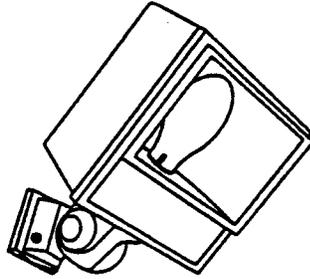
TYPE 404

**Enclosed, High Mast, Integrally Ballasted,  
High Intensity Discharge Fixture**

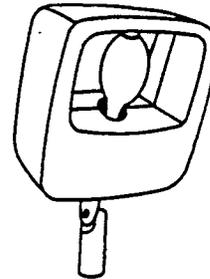
First Suffix	Second Suffix	Description
A		Rated for:
B		1000 watt mercury vapor lamp
C		400 watt metal halide lamp
D		1000 watt metal halide lamp
E		400 watt highpressure sodium lamp
		1000 watt high pressure sodium lamp
	1	Asymmetrical light distribution
	2	Symmetrical light distribution

Fixture shall conform to UL 1572. Fixture shall consist of an enclosed aluminum optical housing, an integral ballast, and a cast aluminum support designed for a 2-inch tenon. Fixture shall be side mounted. The lampholder shall be mogul base glazed porcelain and shall be installed with lamp support and vibration stabilizer for vertical base-up operations of the lamp. The lampholder shall be field adjustable. The lens shall be tempered, thermal-shock and impact resistant glass and shall be held securely in a die-cast aluminum or stainless steel door frame hinged to the optical housing and held closed with stainless steel clamps. Gaskets shall be provided to seal the optical housing. Air entering or leaving the optical housing as a result of expansion shall be filtered. All ferrous metals shall receive a rust inhibitive coating before application of finish coat. Interior of optical housing shall have the manufacturer's standard commercial product finish suitable for the type and rating of the lamp. Exterior finish shall be the manufacturer's standard commercial product finish. Ballast shall be of the high power factor type. Ballast shall be of the constant wattage autotransformer type for mercury vapor lamps, the lead-peak regulating type for metal halide lamps, and the regulated type for high pressure sodium lamps. Ballast shall be capable of starting and operating the lamp at ambient temperatures ranging from minus 20 degrees F to 105 degrees F.

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.



**TYPE 506**  
Wall Bracket Mounting



**TYPE 507**  
Slip Fitter Mounting

**High Intensity Discharge Floodlight with Asymmetrical Light Distribution**

First Suffix	Second Suffix	Third Suffix	Description
A			Rated for metal halide lamp
B			Rated for high pressure sodium (HPS) lamp
	1		NEMA type 6 x 5 light distribution
	2		NEMA type 7 x 7 light distribution
	3		NEMA type 7 x 6 light distribution
		A	Fixture with instant restrike feature
		B	Type 300 emergency unit

Fixture shall conform to UL 1572 and NEMA FA 1, and shall be the heavy-duty, enclosed type. Fixture shall consist of a cast aluminum housing and a cast aluminum door assembly and shall be integrally ballasted unless otherwise shown or approved. The door assembly shall be hinged and gasketed and held in a closed position with screws of finish to match fixture or recessed stainless steel latches. The lens shall be thermal shock and impact resistant tempered glass and shall be held securely in the door frame. Reflector shall be aluminum with manufacturer's standard commercial product finish suitable for light source provided. All metallic parts of the fixture shall receive one or more rust-inhibitive coatings prior to the application of interior and exterior finishes in accordance with the standard practice of the manufacturer for commercially available exterior lighting fixtures. Ballast shall be of the high power factor type capable of starting and operating the lamp in an ambient temperature of minus 20 degrees F to 105 degrees F. Ballast shall be of the lead-peak autotransformer type for metal halide lamps and the regulating type for high pressure sodium lamps. If an instant restrike feature is specified, the fixture shall be equipped to permit restarting of the lamp to full lumen output within 5 seconds following restoration of power after each momentary power interruption. The fixture shall be prewired and shall include a mogul base glazed porcelain lampholder. Mounting hardware for the fixture shall be adjustable, and shall be the cast aluminum type unless otherwise approved.

Fixture types indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.

CORPS OF ENGINEERS

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**TYPE 605**  
**Stencil Face Exit Light**

First Suffix	Second Suffix	Third Suffix	Description
A			Single face
B			Double Face
	1		Incandescent
	2		Fluorescent
		A	End mounted
		B	Top mounted
		C	Back mounted
		D	Stem Mounted

Incandescent fixtures shall conform to UL 924, UL 1571, and NFPA 101. Fluorescent fixtures shall conform to UL 924, UL 1570, and NFPA 101. Units shall conform to UL 924, and shall meet or exceed the NFPA 70 time and voltage requirements. The unit shall be dual-rated for use on either 120-Volt or 277-Volt alternating current power supply.

Mounting brackets or shelf shall be provided, complete with all mounting hardware, all with a finish to match the finish or color of the cabinet. Fixture shall be prewired with wiring concealed in the illuminated portion of the fixture housing. The transilluminated letters will be red except where state or country standards mandate green. The contrast level of the letters shall be symmetrical with not less than a 0.7 value, plus or minus 3 percent. The luminance output for normal and emergency mode will not be less than 70 cd/sq m. The surface finish shall have a mat texture.

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.

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SECTION 16721

FIRE DETECTION AND ALARM SYSTEM

PART 1 GENERAL

1.1 RELATED WORK OF OTHER SECTIONS

The following items of related work are covered under other sections:

1) Duct detectors: SECTION: HEATING, VENTILATION, AND AIR CONDITIONING CONTROL SYSTEMS.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C135.30 (1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825 (1994; Supple 1) Approval Guide

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41 (1991) Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

NFPA 72 (1993) National Fire Alarm Code

NFPA 90A (1993) Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL-04 (1994) Fire Protection Equipment Directory

UL 6 (1993) Rigid Metal Conduit

UL 38 (1994; Rev Jan 1994) Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems

UL 228 (1993) Door Closers-Holders, with or without Integral Smoke Detectors

UL 268 (1989; Rev May 1989) Smoke Detectors for

Fire Protective Signaling Systems

UL 464	(1990) Audible Signal Appliances
UL 467	(1993) Grounding and Bonding Equipment
UL 521	(1993) Heat Detectors for Fire Protective Signaling Systems
UL 797	(1993) Electrical Metallic Tubing
UL 864	(1991; Rev thru May 1994) Control Units for Fire-Protective Signaling Systems
UL 1242	(1983; Rev thru Jul 1993) Intermediate Metal Conduit

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Battery Data; FIO.

Substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component, and the battery recharging period shall be included.

Voltage Drop Data; FIO.

Voltage drop calculations for signaling appliance circuits to indicate that sufficient voltage is available for proper appliance operation.

Spare Parts Data; FIO.

Spare parts data for each different item of material and equipment specified, not later than 1 months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies with the current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced after 2 year of service.

Training Data; FIO.

Lesson plans and training data, in manual format, for the training courses.

SD-04 Drawings

Fire Alarm Reporting System; GA.

Detail drawings, signed by the Registered Professional Engineer, consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Note that the contract drawings show layouts based on typical detectors. The contractor shall check the layout based on the actual detectors to be installed and make any necessary revisions in the

detail drawings. The detail drawings shall also contain complete wiring and schematic diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Detailed point-to-point wiring diagram, signed by the Registered Professional Engineer, showing all points of connection. Diagram shall include connections between system devices, appliances, control panels, supervised devices, and all equipment that is activated or controlled by the panel.

#### SD-08 Statements

Professional Engineer Qualifications Data; FIO

Qualifications, with verification of experience and license number, of a Registered Professional Engineer with at least 4 years of current experience in the design of the fire protection and detection systems. This engineer must perform the various specification items required by this section to be performed by a registered Professional Engineer.

Installer Certificates; FIO.

The Contractor shall provide documentation demonstrating that its fire detection and alarm system installer has been regularly engaged in the installation of fire detection and alarm systems meeting NFPA standards for a minimum of three years immediately preceding commencement of this contract. Such documentation shall specifically include proof of satisfactory performance on at least three projects similar to that required by these specifications, including the names and telephone numbers of using agency points of contact for each of these projects. Documentation shall indicate the type of each system installed and include a written certificate that each system has performed satisfactorily in the manner specified for a period of not less than 12 months following completion. All such data shall be submitted 30 days prior to commencement of installation for approval of the Contracting Officer. Listing of the installer under "Protective Signaling Services - Local, Auxiliary, Remote Station Proprietary (UUJS)" of UL-04 shall be accepted as equivalent proof of compliance with the foregoing experience requirements.

Test Procedure Statements; FIO.

Detailed test procedures, signed by the Registered Professional Engineer, for the fire detection and alarm system 60 days prior to performing system tests.

#### SD-09 Reports

Testing Reports; FIO.

Test reports in booklet form showing all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall document all readings, test results and indicate the final position of controls.

#### SD-13 Certificates

Equipment Certificates; FIO.

Certified copies of current approvals or listings issued by UL, FM or other nationally recognized testing laboratory, showing compliance with specified

NFPA standards.

#### SD-19 Operation and Maintenance Manuals

Fire Alarm Reporting System Instructions; FIO.

Six copies of operating instructions outlining step-by-step procedures required for system startup, operation, and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The instructions shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed. Instructions shall be approved prior to training.

## PART 2 PRODUCTS

### 2.1 CONTROL PANEL

Control Panel shall comply with all the applicable requirements of UL 864. The Control Panel shall be Style D, Class A in accordance with NFPA 72. Addressable system shall be microcomputer based with a minimum word size of eight bits. Panel shall be modular, installed in a flush mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a clean, uncluttered, and orderly assembled panel containing all components and equipment required to provide the specified operating and supervisory functions of the system. The panel shall have prominent rigid plastic, phenolic or metal identification plates for all lamps, controls, meters, fuses, and switches. Nameplates for fuses shall also include ampere rating. Separate alarm and trouble lamp shall be provided for each zone alarm located on exterior of cabinet door or be visible through the cabinet door. Control panel switches shall be within the locked cabinet. A suitable means shall be provided for testing the control panel visual indicating devices (meters or lamps). Meters and lamps shall be plainly visible when the cabinet door is closed. Signals shall be provided to indicate supervisory or trouble condition on the system. Loss of power, including any or all batteries, shall not require the reloading of a program. Upon restoration of power, startup shall be automatic, and shall not require any manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals. Cabinets shall be provided with ample gutter space to allow proper clearance between the cabinet and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in a single cabinet large enough to accommodate all units.

#### 2.1.1 Remote System Trouble Audible/Visual Appliance

Audible appliance shall have a minimum sound level output rating of 85 dBA at 3.048 m (10 feet) and operate in conjunction with the panel's integral trouble signal. The audible device shall be silenced by the system trouble silence switch. A rigid plastic, phenolic or metal identification sign which reads "Fire Alarm System Trouble" shall be provided at the audible appliance. The visual appliance located with the audible appliance shall not be extinguished until the trouble has been cleared.

#### 2.1.2 Circuit Connections

Circuit conductors entering or leaving the panel shall be connected to screw-type terminals with each terminal marked for identification.

## 2.2 MANUAL FIRE ALARM STATIONS

Manual fire alarm stations shall conform to the applicable requirements of UL 38. Manual stations shall be connected into alarm-initiating circuits. Stations shall be installed on surface or semi-flush mounted outlet boxes as indicated. Stations shall be single action type. Stations shall be finished in red, with raised letter operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable. Stations employing glass rods are not acceptable. The use of a key or wrench shall be required to reset the station. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the voltage and current upon which they operate. Stations shall have a separate screw terminal for each conductor. Surface mounted boxes shall be painted the same color as the fire alarm manual stations.

## 2.3 FIRE DETECTING DEVICES

Fire detecting devices shall comply with the applicable requirements of NFPA 72, NFPA 90A, UL 268, and UL 521. Alarm initiating devices shall be Style D, Class A in accordance with NFPA 72. The detectors shall be provided as indicated. Detector base shall have screw terminals for making connections. No solder connections will be allowed. Detectors shall be connected into alarm initiating circuits. Detectors located in concealed locations (above ceiling, etc.) shall have a remote visible indicator lamp. Installed devices shall conform to the classification of the area.

### 2.3.1 Heat Detectors

Heat detectors shall be designed for detection of fire by fixed temperature. Heat detectors shall be rated for a minimum of 15.2 m (50 foot) spacing (smooth-ceiling rated) in accordance with UL 521. Detectors located in areas subject to moisture, exterior atmospheric conditions or hazardous locations as defined by NFPA 70, shall be types approved for such locations. Heat detectors located in attic spaces or similar concealed spaces below the roof shall be intermediate temperature rated.

#### 2.3.1.1 Fixed Temperature Detectors

Detectors shall be compatible with the outlet box mounting and supported independently of wiring connections. Detectors are designed to detect high heat. The detectors shall have a specific temperature setting of 57.2 degrees C (135 degrees F).

### 2.3.2 Smoke Detectors

Detectors shall be designed for detection of abnormal smoke densities. Smoke detectors shall be ionization, photoelectric, or projected beam type. Detectors shall contain a visible indicator lamp that shows when the unit is in alarm condition. Detectors shall not be adversely affected by vibration or pressure. Detectors shall be the plug-in type in which the detector base contains terminals for making all wiring connections. Detectors that are in concealed (above false ceilings, etc.) locations shall have a remote visible indicator lamp.

#### 2.3.2.1 Ionization Detectors

Ionization detectors with a dual chamber shall be responsive to both invisible and visible particles of combustion. One chamber shall be a reference chamber and the second a sampling chamber. Detectors containing radium shall not be provided. Detectors shall not cause an alarm condition due to anticipated fluctuations in relative humidity. The sensitivity of the detector shall be field adjustable to compensate for operating conditions. Detector shall require no replacement or readjustment to restore it to normal operation after an alarm condition. Each detector shall be capable of withstanding ambient air velocity up to 1.5 meters per second (300 fpm) in accordance with UL 268. Detectors shall have at least a two-stage sensitivity setting, with detectors initially set for normal sensitivity. A lower sensitivity shall be available for each detector. The lower sensitivity shall be within the limits established for that detector by UL or FM.

#### 2.3.2.2 Photoelectric Detectors

Detectors shall operate on a light scattering concept using an LED light source. Failure of the LED shall not cause an alarm condition. Detectors shall be factory set for sensitivity and shall require no field adjustments of any kind. Detectors shall have an obscuration rating between 1.9 and 2.4 percent per foot when tested in accordance with UL 268.

#### 2.3.2.3 Projected Beam Smoke Detectors

Detectors shall be designed for detection of abnormal smoke densities. Detectors shall consist of separate transmitter and receiver units. The transmitter unit shall emit an infrared beam to the receiver unit. When the signal at the receiver falls below a preset sensitivity, the detector shall initiate an alarm. The receiver shall contain an LED which is powered upon an alarm condition. Long-term changes to the received signal caused by environmental variations shall be automatically compensated. Detectors shall incorporate features to assure that they are operational; a trouble signal shall be initiated if the beam is obstructed, the limits of the compensation circuit are reached, or the housing cover is removed. Detectors shall have multiple sensitivity settings in order to meet UL listings for the different distances covered by the beam. In the event of beam interference for more than three seconds a trouble alarm shall be transmitted.

#### 2.3.2.4 Duct Detectors

Duct detectors are provided under SECTION: HEATING, VENTILATION, AND AIR CONDITIONING CONTROL SYSTEMS.

#### 2.3.3 Combination Smoke and Heat Detectors

Combination smoke and heat detectors shall have an audible device (self-contained) and be designed for detection of abnormal smoke densities by the photoelectric principle and abnormal heat by a fixed temperature sensor. Smoke detectors shall be provided with an LED light source. Failure of the LED shall not cause an alarm condition and the sensitivity shall be factory set at a nominal 3 percent and require no field adjustments of any kind. Heat detector portion shall be fixed temperature sensor rated at 57 degrees C (135 degrees F). The audible appliances shall have a minimum sound output of at least 85 dBA at 3.048 m (10 feet). Detectors shall contain a visible indicator lamp that shows when the unit

is in alarm condition. Detectors shall not be adversely affected by vibration or pressure. Each detector shall be reverse polarity whereby, when connected to the signaling appliance circuit, and in the event of a building alarm, the audible device shall sound.

## 2.4 NOTIFICATION APPLIANCES

Audible appliances shall be heavy duty and conform to the applicable requirements of UL 464. Alarm indicating appliances shall be connected to indicating appliance circuits (IAC), Style Z, Class A in accordance with NFPA 72. All textual, audible, and visual appliances and systems shall comply with NFPA 72. Devices shall be connected into alarm indicating circuits. All devices shall have a separate screw terminal for each conductor. All shall be painted red.

### 2.4.1 Alarm Bells

Bells shall be surface mounted with the matching mounting back box. Bells shall be suitable for use in an electrically supervised circuit. Bells shall be the underdome type producing a minimum output rating of 85 dBA at 3.1 m (10 feet). Bells used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grilles. Single stroke, electrically operated, supervised, solenoid bells shall be used for coded applications.

### 2.4.2 Alarm Horns

Horns shall be surface mounted, with the matching mounting back box vibrating type suitable for use in an electrically supervised circuit. Horns shall produce a minimum sound rating of at least 85 dBA at 3.048 m (10 feet). Horns used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grills.

## 2.5 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

### 2.5.1 Conduit

Conduit and fittings shall comply with UL 6, UL 1242 and UL 797.

### 2.5.2 Wiring

Wiring for 120V ac power shall be No. 12 AWG minimum. Wiring for low voltage dc circuits shall be No. 14 AWG minimum. Power wiring (over 28 volts) and control wiring shall be isolated. All wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing, except rigid plastic conduit may be used under slab-on-grade. All conductors shall be color coded. Conductors used for the same functions shall be similarly color coded. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to alarm initiating, supervisory circuits, and alarm indicating circuits are prohibited. T-tapping using screw terminal blocks is allowed for addressable systems.

### 2.5.3 Special Tools and Spare Parts

Special tools necessary for the maintenance of the equipment shall be furnished. Two spare fuses of each type and size required and five spare lamps and LED's of each type shall be furnished. Two percent of the total

number of each different type of detector, but no less than two each, shall be furnished. Fuses and lamps shall be mounted in the fire alarm panel.

### PART 3 EXECUTION

#### 3.1 GENERAL REQUIREMENTS

##### 3.1.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that can provide service within 24 hours.

##### 3.1.2 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat-sensitive plate which is securely attached to the equipment.

##### 3.1.3 Keys and Locks

Locks shall be keyed alike.

##### 3.1.4 Tags

Tags with stamped identification number shall be furnished for keys and locks.

##### 3.1.5 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

##### 3.1.6 Compliance

The fire detection and internal alarm system and the central reporting system shall be configured in accordance with NFPA 72. The equipment furnished shall be compatible and be UL listed or FM approved or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards.

##### 3.1.7 Manufacturer's Services

Services of a manufacturer's representative who is experienced in the installation, adjustment, testing, and operation of the equipment specified shall be provided. The representative shall supervise the installation, adjustment, and testing of the equipment.

#### 3.2 SYSTEM DESIGN

##### 3.2.1 Operation

The fire alarm and detection system shall be a complete, supervised fire alarm system. The system shall be activated into the alarm mode by

actuation of any alarm initiating device. The system shall remain in the alarm mode until initiating device is reset and the fire alarm control panel is reset and restored to normal. Alarm initiating devices shall be connected to initiating device circuits (IDC), Style D, Class A in accordance with NFPA 72. Alarm indicating appliances shall be connected to indicating appliance circuits (IAC), Style Z, Class A in accordance with NFPA 72. All textual, audible, and visual appliances and systems shall comply with NFPA 72. Addressable system shall be microcomputer based with a minimum word size of eight bits.

a. Sufficient memory shall be provided to perform as specified and as shown for addressable system.

b. Individual identity of each addressable device shall be provided for the following conditions:

- alarm
- trouble
- open
- short
- appliances missing/failed
- remote detector - sensitivity adjustment from the panel for smoke detectors

c. All addressable devices shall have the capability of individually being disabled or enabled from the panel.

### 3.2.2 Operational Features

The system shall have the following operating features:

a. Smoke detectors shall have combined alarm initiating and power circuits.

b. Electrical supervision of the primary power (ac) supply, battery voltage, placement of alarm zone module (card, PC board) within the control panel, and transmitter tripping circuit integrity.

c. Trouble buzzer and trouble lamp (light emitting diode or neon light) to activate upon a single break, open, or ground fault condition which prevents the required normal operation of the system. The trouble signal shall also operate upon loss of primary power (ac) supply, low battery voltage, removal of alarm zone module (card, PC board), and disconnection of the circuit used for transmitting alarm signals off-premises. A trouble alarm silence switch shall be provided which will silence the trouble buzzer, but will not extinguish the trouble indicator lamp. After the system returns to normal operating conditions, the trouble buzzer shall again sound until the silencing switch returns to normal position, unless automatic trouble reset is provided.

d. One person test mode - Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.

e. Evacuation alarm silencing switch or switches which, when activated, will silence alarm devices, but will not affect the zone indicating lamp nor the operation of the transmitter. This switch shall be over-ridden upon activation of a subsequent alarm from an unalarmed zone and the alarm devices will be activated.

f. Electrical supervision of circuits used for supervisory signal services. Supervision shall detect any open, short, or ground.

g. Confirmation or verification modules used on smoke detection initiating circuits. The modules shall interrupt the transmission of an alarm signal to the system control panel for a factory set period. This interruption period shall be adjustable from 1 to 60 seconds and be factory set at 20 seconds. Immediately following the interruption period, a confirmation period shall be in effect during which time an alarm signal if present will be sent immediately to the control panel. All fire alarm devices other than smoke detectors shall be prohibited on circuits controlled by confirmation or verification modules.

### 3.2.3 Alarm Functions

An alarm condition on a circuit shall automatically initiate the following functions:

- (a) Transmission of a signal over the station fire reporting system.
- (b) Visual indications of the alarmed zones on the fire alarm panel.
- (c) Deactivation of the air handling units

### 3.2.4 Primary Power

Operating power shall be provided as required by paragraph Power Supply for the System. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and not cause transmission of a false alarm. Loss of ac power shall not prevent transmission of a signal via the fire reporting system upon operation of any initiating circuit.

## 3.3 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, and any other contaminants.

## 3.4 INSTALLATION

All work shall be installed as shown and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified. Smoke detectors shall not be installed until the building has been thoroughly cleaned.

### 3.4.1 Power Supply for the System

A single dedicated circuit connection for supplying power to each building fire alarm system shall be provided. The primary power shall be supplied as shown on the drawings. The power supply shall be equipped with a locking mechanism and marked "FIRE ALARM CIRCUIT CONTROL".

### 3.4.2 Wiring

Conduit size for wiring shall be in accordance with NFPA 70. Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. No more than one conductor shall be installed under any screw terminal. All circuit conductors entering or leaving any mounting box, outlet box enclosure or cabinet shall be connected to screw terminals with each

terminal marked in accordance with the wiring diagram. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors are prohibited in the system. Wiring within any control equipment shall be readily accessible without removing any component parts.

The fire alarm equipment manufacturer's representative shall be present for the connection of wiring to the control panel.

#### 3.4.3 Control Panel

The control panel and its assorted components shall be mounted so that no part of the enclosing cabinet is less than 300 mm (12 inches) nor more than 2 m (78 inches) above the finished floor. All manually operable controls shall be between 900 mm (36 inches) to 1.1 m (42 inches) above the finished floor. Panel shall be installed to comply with the requirements of UL 864.

#### 3.4.4 Detectors

Detectors shall be installed in accordance with NFPA 72. Detectors shall be at least 300 mm (12 inches) from any part of any lighting fixture. Detectors shall be located at least 900 mm (3 feet) from diffusers of air handling systems. Each detector shall be provided with appropriate mounting hardware as required by its mounting location. Detectors which mount in free space shall be mounted directly to the end of the stubbed down rigid conduit drop. Conduit drops shall be firmly secured to minimize detector sway. Where length of conduit drop from ceiling or wall surface exceeds 900 mm, (3 feet,) sway bracing shall be provided.

#### 3.4.5 Notification Appliances

Notification appliances shall be mounted a minimum of 2.4 m (8 feet) above the finished floor unless limited by ceiling height or otherwise indicated.

#### 3.4.6 Annunciator Equipment

Annunciator equipment provided shall be mounted where indicated.

### 3.5 OVERVOLTAGE AND SURGE PROTECTION

All equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 and NFPA 70. All cables and conductors which serve as communications links, except fiber optics, shall have surge protection circuits installed at each end. Fuses shall not be used for surge protection.

### 3.6 GROUNDING

Grounding shall be provided to building ground or ground rods shall be driven. Maximum impedance to ground shall be 25 ohms.

### 3.7 TESTING

The Contractor shall notify the Contracting Officer 30 days before the preliminary and acceptance tests are to be conducted. The tests shall be performed in accordance with the approved test procedures in the presence of the Contracting Officer. The control panel manufacturer's representative shall be present to supervise all tests. The Contractor shall furnish all instruments and personnel required for the tests.

#### 3.7.1 Preliminary Tests

Upon completion of the installation, the system shall be subjected to functional and operational performance tests including tests of each installed initiating and notification appliance. Tests shall include the meggering of all system conductors to determine that the system is free from grounded, shorted, or open circuits. The megger test shall be conducted prior to the installation of fire alarm equipment. If deficiencies are found, corrections shall be made and the system shall be retested to assure that it is functional.

### 3.7.2 Acceptance Test

Testing shall be in accordance with NFPA 72. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that all previous deficiencies have been corrected. The test shall include the following:

- (a) Test of each function of the control panel.
- (b) Test of each circuit in both trouble and normal modes.
- (c) Tests of alarm initiating devices in both normal and trouble conditions.
- (d) Tests of each control circuit and device.
- (e) Tests of each alarm notification appliance.
- (f) Complete operational tests under emergency power supply.
- (g) Visual inspection of all wiring connections.
- (h) Opening the circuit at each alarm initiating device and notification appliance to test the wiring supervisory feature.
- (i) Ground fault
- (j) Short circuit faults
- (k) Stray voltage
- (l) Loop resistance

### 3.8 TRAINING

Training course shall be provided for the operations and maintenance staff. The course shall be conducted in the building where the system is installed or as designated by the Contracting Officer. The training period shall consist of 4 training hours and shall start after the system is functionally completed but prior to final acceptance tests. The instructions shall cover all of the items contained in the operating and maintenance instructions.

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SECTION 16760

COMMUNICATION SYSTEM

PART 1 GENERAL

1.1 COMMUNICATION SYSTEMS

The lock will remain in operation during reconstruction. The Contractor shall make provision for maintaining the existing communication system in operation until the new communication system is functioning, by extending temporary wiring while old wiring is removed, and by temporarily relocating existing equipment, etc. The work covered by this section includes the furnishing, installation, and wiring, for communication systems consisting of the following:

1.1.1 Telephone System

The Government will furnish and install the digital telephone switch and ancillary equipment, including power supply, punch-down block frame, audio amplifiers and telephone instruments (stations). The Contractor shall furnish and install wiring and conduit between the communication interface terminal box (CITB) and the location of each telephone jack, or outdoor instruments.

1.1.2 Intercom System

The Contractor shall furnish and install talk-back speakers, mounting, wire and conduit from each talk-back speaker back to the CITB, as shown on the plans.

1.1.3 Paging System

The Contractor shall furnish and install all speakers including talk-back speakers, mounting, wire and conduit back to the CITB as shown on the plans.

1.1.4 Radio System

The Government will furnish and install the VHF FM radio and the Marine radio, including audio amplifier, and antennas.

a. The Contractor shall furnish mounts for radio antennas on the Central Control Station roof, and for antenna on the Downstream Control Stand house, as shown on the plans. In addition, within the Central Control Station, the Contractor shall install conduit runs from the radio pull box (RPB) to the roof located antenna pedestals and to various offices as shown on the plans.

b. The Contractor shall furnish and install outdoor and indoor speakers, with wire and conduit back to the CITB as shown on the plans.

c. The Contractor shall provide empty conduit from each telephone location back to the RPB, as shown on the plans. These conduits will be used by the Government for Marine radio antenna cables.

d. The Contractor shall furnish and install 120 volt receptacles and the

required circuits adjacent to each telephone outlet, to provide power for radio remote control units. They shall be as shown on the plans and be provided as part of the power and receptacle specification.

#### 1.1.5 Computer System

The Contractor shall furnish and install conduits as shown on the plans.

#### 1.1.6 Vehicle Gate Control Panel

The Contractor shall furnish and install a Vehicle Gate control cables and conduits between the two Vehicle Gate controllers, provided under SECTION: FENCING, and the CITB. The Contractor shall furnish and install the Gate Control Panels, roadway loops, and associated conduit and cables as shown on the plans.

#### 1.1.7 Weather Monitoring System

The Contractor will furnish and install the sensors for the lock water temperature, air temperature, wind speed/wind direction. The Contractor will provide and install the indicators for the water temperature, the wind speed/wind direction and the air temperature. The Contractor will provide the cables to interconnect the air temperature, wind speed/wind direction and water temperature sensors with the indicators. The Contractor shall furnish and install all signal and power supply equipment to make a working system. The Contractor shall furnish and install the conduit system as shown on the plans, the sensor mounting, and the instrument monitoring panels to mount the indicators in the Central Control Station.

#### 1.1.8 Pool Level Monitoring System

The Contractor shall install the Government Furnished pool level equipment as shown on the plans and specified under paragraph MATERIALS AND EQUIPMENT. The Contractor shall connect and adjust the indicators for proper operation. Existing indicators in the existing CCS shall be kept in use during construction as described in SECTION: REMOVALS, TEMPORARY WIRING AND GOVERNMENT-FURNISHED EQUIPMENT. The existing indicators shall be reinstalled as indicated in the plans and specifications.

#### 1.1.9 Small Boat Signal System

The Contractor shall replace the pull cord and pull switch at the Upstream and Downstream small boat stations. The Contractor shall install Government furnished switches. The Contractor shall provide and install lever arms on the Government furnished switches, the lever arm shall be as indicated on the plans. The Contractor shall replace the pull cord, providing the cord as indicated on the plans. The Contractor shall furnish and install relays, tone generator and a rotating signal beacon as shown on the plans.

### 1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ELECTRONICS INDUSTRIES ASSOCIATION (EIA) PUBLICATIONS

EIA RS-160 (Dec 1951, Reprinted Jul 1956) Sound Systems

EIA RS-174 (Dec 1956, R 1982) Audio Transformers for Electronic Equipment

EIA RS-180 (Rev 1982) Power Transformers for Electrical Equipment

EIA SE-103 (Apr 1949; R Mar 1954) Speakers for Sound Equipment

EIA 568 (1991) Commercial Building Telecommunications Wiring Standard

EIA 569 (1990) Commercial Building Standard for Telecommunications Pathways and Spaces

EIA 607 (1994) Grounding and Bonding Requirements for the Telecommunications Infrastructure of Commercial Buildings

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 383 (1974, Rev 1992) Type Test of Class 1E Electrical Cables, Field Splices and Connections

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA) STANDARDS

NEMA PB 1 (1990) Panelboards

NEMA RN 1 (1989) Polyvinyl-Chloride(PVC) Externally Coated Rigid Steel Conduit and Intermediate Metal Conduit

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) PUBLICATIONS

NFPA 70 (1996) National Electrical Code

UNDERWRITERS' LABORATORIES, INC. (UL) PUBLICATIONS

UL 6 (Oct 23, 1993) Rigid Metal Conduit

UL 50 (1995) Cabinets and Boxes (11th Ed.)

UL 797 (1993) Electrical Metallic Tubing (6th Ed.)

UL 1277 (1996) Electrical Power and Control Tray Cables

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Spare Parts Data; FIO.

After approval of the shop drawings, and not later than 2 months prior to the date of beneficial occupancy, the Contractor shall furnish spare parts data for each different item of materials and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

#### SD-04 Drawings

Shop Drawings; GA.

Shop drawings shall be submitted and shall consist of a complete list of equipment and materials, including manufacturer's descriptive and technical literature; performance charts and curves; catalog cuts; and installation instructions. Shop drawings shall also contain complete wiring and schematic diagrams. Drawing shall show proposed layout of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

### 1.4 COORDINATION

The work scope involves removal and installation of Government Furnished Equipment. The switch over to the new communication system shall be made during the non-navigation season. The Contractor shall schedule his work accordingly to allow the Government to remove the existing radio and telephone equipment. The Contractor shall notify and coordinate a time with the Contracting Officer when this work may be done by the Government. The Contractor shall notify and coordinate a time, with the Contracting Officer, when the Government may install the Government furnished equipment. When structures are removed and antenna, antenna leads and other radio equipment are mounted on the structures, the antenna, antenna leads and radio equipment shall be turned over to the Contracting Officer.

### 1.5 GUARANTEE

The equipment furnished under this section shall be guaranteed against defective material, design, and workmanship for a period of one (1) year from the date of acceptance. Upon receipt of notice from the government of failure of any part of the guaranteed equipment during the guarantee period, new replacement parts shall be furnished and installed promptly by the Contractor at no cost to the Government.

## PART 2 PRODUCTS

### 2.1 GENERAL REQUIREMENTS

#### 2.1.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening. The Contractor shall provide all equipment, accessories, and materials complete and in strict accordance with the specifications and drawings as required for an electronic inter-communication system. All material and equipment required for proper operations of the system shall be provided, even though not specifically

specified or described herein. All similar equipment shall be designed and provided by the same manufacturer to ensure compatibility for operation as a complete system. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

#### 2.1.2 Exposure

The equipment and installation shall be designed to provide long-term operation as specified, with the following environmental conditions.

	<u>Outdoor Equipment</u>	<u>Indoor Equipment</u>
Ambient Temperature Range	-40°C to 50°C	0 to 40°C
Relative Humidity Range	0 to 95%	0 to 80%

### 2.2 MATERIALS AND EQUIPMENT

#### 2.2.1 General

Furnish speakers, wire, conduit, terminal boxes, junction boxes, etc. as shown on the plans and as specified below. Manufacturer names are given only to describe what the design is based on, the Contractor may substitute an "equal or better". The work also includes providing and installing mounting poles, brackets, covers, etc., as shown on the plans.

#### 2.2.2 Materials and Equipment Specifications

Equipment placed in storage until installation time shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, and other contaminants. Materials and equipment shall conform to the following requirements.

- (a) Conduits. UL 797 or UL 6, PVC coated type, NEMA RN 1.
- (b) Enclosures. UL 50.
- (c) Loudspeakers. EIA SE-103.
- (d) Panelboards. NEMA PB 1.
- (e) Sound System. EIA RS-160.
- (f) Transformers. EIA RS-174 and EIA RS-180.
- (g) Wiring and Cable. EIA 568

#### 2.2.3 Talk-Back Speakers

Speakers shall be Government furnished and installed.

#### 2.2.4 Outdoor "Paging" and "Marine" Speakers

Speakers shall be weather-resistant high efficiency double re-entrant type with adjustable swivel bracket to allow positioning in the vertical and horizontal planes with a single adjustment. Continuous power input to the driver shall be 30 watts. Dispersion shall be 100 degrees. Sound pressure level shall be 125 Db measured at four feet on axis with 30 watts input at 1 Khz. Frequency range shall be  $\pm 3$  Db from 225 to 14,000 Hz. Furnish a built-in 70.7 volt-line transformer. Manufacturer: Atlas #AP-30T(C), or approved equal.

### 2.2.5 Indoor Wall Speakers

Speaker shall be a high efficiency double re-entrant type with adjustable swivel bracket to allow positioning in the vertical and horizontal planes with a single adjustment. Dispersion shall be 110 degrees. Sound pressure level shall be 121 Db measured at four feet on axis with 15 watts input at 1 Khz. Frequency response shall be  $\pm 3$  Db from 275 Hz to 14 Khz. Furnish the speaker with a built-in 70.7 volt line transformer. Manufacturer: Atlas #AP-15T8 or approved equal.

#### 2.2.5.1 Speaker Mounting

Each speaker shall be mounted at least 8 feet above the finished floor level unless otherwise indicated.

#### 2.2.5.2 L-pad

Provide an L-pad for each indoor wall mounted speaker. This L-pad shall be mounted in a flush box, mounted 4'-6" above finished floor in all finished areas of the building. Surface box shall be used in non-finished areas. L-pad shall be an auto-transformer type for 70.7 volt system, 10 step plus off, 3db per step 10 Watt power rating, with stainless steel plate and black knob. Manufacturer: Atlas #AT-10 or approved equal.

### 2.2.6 Indoor Ceiling Speakers

The reproducer, consisting of an 8" speaker, 70.7 volt line transformer, diffuser faceplate, housing and hardware shall be acoustically-matched and have a minimum frequency range of 200 to 10,000 Hz. The complete reproducer shall contain matched components as follows:

#### 2.2.6.1 Speaker

Speaker shall be ceramic magnet cone type with diameter of 8". Power rating shall be 25 watts with program material. Axial sensitivity with 1 watt input shall be 100 Db at 4' at 1,000 Hz.

#### 2.2.6.2 Line Transformer

A 70.7 volt line transformer shall provide level adjustments of 0.5, 1, 2 and 4 watts.

#### 2.2.6.3 Housing and Baffle

Round backboxes shall have a minimum internal volume of 700 cubic inches. Boxes shall be insulated with fiberglass material for resonance control. Exterior finish shall be baked enamel to match baffle and adjacent surfaces. Wiring shall be through conduit knockouts. The baffles shall be perforated and finished in baked enamel to match adjacent surface. Attachment of the backboxes shall be through the use of torsion spring and shall not be visible. Construction shall be such that no vibration or rattle occurs. Loudspeaker, backbox, and baffle shall be an integrated and complete installation. Manufacturer: Atlas #C10LW/HT87/Q408/T51-8, or approved equal.

#### 2.2.6.4 L-pad

Provide an L-pad for each indoor ceiling speaker. This L-pad shall be mounted in a flush box, mounted 4'-6" above finished floor in all finished

areas of the building. Surface box shall be used in non-finished areas. L-pad shall be an auto-transformer type for 70.7 volt system, 10 step plus off, 3db per step 10 Watt power rating, with stainless steel plate and black knob. Manufacturer: Atlas #AT-10 or approved equal.

#### 2.2.6.5 Installation

Install the speaker assembly in suspended ceiling as shown on the plans. Coordinate the exact location with lighting and HVAC equipment.

#### 2.2.7 Communications Wire and Cable

Communications wire and cable shall be furnished and installed per the Type codes shown on the drawings and as specified below.

Type A Used for telephone stations connections, radio control and computer network: four pair UTP (unshielded twisted pair) cable, 24 AWG solid bare copper, Polyolefin insulated singles, ripcord, flexible PVC jacket. Jacket is sequentially marked at two foot intervals: UL listed, ANSI/TIA/EIA 568-A-5 Category 5E TIA/EIA 568-A Category 5 ICEA 661, Category 5 NEMA WC-63.1 Category 5 Flame Rating and Test: UL Type CM, UL 1581 Vertical Tray C(UL) Type CM, CSA FT1  
Manufacture: Belden 1583A, or approved equal.

Type B Used for loudspeaker connections within Central Control Station: one twisted pair; #16 AWG stranded copper wire; PVC-nylon insulation; overall aluminum-polyester shield with copper drain wire; PVC jacket; 90 degree centigrade, 600 volt rating; UL listed for installations in trays, troughs, channels, conduits, wireways, and for direct burial; complies with UL 1277; complies with IEEE 383 70,000 BTU flame test; maximum O.D. of 0.324 inches. Manufacturer: Alpha #5616B1601, or approved equal.

Type C Used for small boat pullcord stations and gate control connections: two conductors; #16 AWG stranded copper wire; PVC-nylon insulation; overall aluminum-polyester shield with copper drain wire; PVC jacket; 90 degree centigrade, 600 volt rating; UL listed for installations in trays, troughs, channels, conduits, wireways, and for direct burial; complies with UL 1277; complies with IEEE 383 70,000 BTU flame test; maximum O.D. of 0.325 inches. Manufacturer: Alpha #7616/2, or approved equal.

Type D Used for talk-back speaker connections: four twisted pairs; #18 AWG stranded copper wire; PVC-nylon insulation; overall aluminum-polyester shield with copper drain wire; PVC jacket; 90 degree centigrade, 600 volt rating; UL listed for installations in trays, troughs, channels, conduits, wireways, and for direct burial; complies with UL 1277; complies with IEEE 383 70,000 BTU flame test; maximum O.D. of 0.571 inches. Manufacturer: Alpha #5616B1804, or equal.

Type E Used for loudspeaker connections outside Central Control Station: one twisted pair; #14 AWG stranded copper wire; PVC-nylon insulation; overall aluminum-polyester shield with copper drain wire; PVC jacket; 90 degree centigrade, 600 volt rating; UL listed for installations in trays, troughs,

channels, conduits, wireways, and for direct burial; complies with UL 1277; complies with IEEE 383 70,000 BTU flame test; maximum O.D. of 0.356 inches. Manufacturer: Alpha #5616B1401, or approved equal.

Type F Used for antenna connections, Coaxial 50 ohm Transmission Cable , Low Loss, Transmission and Computer Cable. 10 AWG stranded bare copper conductor with semi-solid polyethylene insulation. Duobond® II plus tinned copper braid, 95% coverage. Black PVC jacket. Temperature Rating : 80°C Voltage Rating : 30 Volts (UL) Suggested Operating Temperature Range (Non-UL): -40°C to +80°C. Maximum Operating Voltage (Non-UL): 3700 Volts RMS. Manufacture: Belden 9914, or approved equal.

Type G Used for future telephone stations connections. 25 pair UTP (unshielded twisted pair) cable, 22 AWG solid bare copper. Insulation: Solid polyolefin color coded in accordance with telephone industry standards. Twisted Pairs: Individual conductors twisted into pairs with varying twists to minimize crosstalk, and specified color combinations to provide pair identification. Core Assembly, Core Wrap: Non-hygroscopic dielectric tape applied longitudinally with an overlap. Filling Compound Flexgel® filling compound - 80° C Expanded Thermal Plastic Rubber. Compatible with most commercially available encapsulents - cleaning conductors not required. Shielding: Corrugated, copolymer coated, .008" thick aluminum tape applied longitudinally with overlapped edges and electrically continuous. A polyolefin based flooding compound applied over the core wrap and over the aluminum tape. Jacket: Black, linear low density, high molecular weight polyethylene. Identification and Length Marking: Manufacturer's cable code, pair size, manufacturing plant location, month and year of manufacture, and sequential length marking every two feet. Manufacture: Belden, Filled Solid Alpeh Cable - PE 39, Cable Code: WG2AR, Product Code: 105 183 743, or approved equal.

## 2.2.8 Telephone Outlets

### 2.2.8.1 Indoors

Provide a telephone outlet assembly at each inside wall location as shown on the plans and as follows. Single modular outlet, 4-wire quick connect terminals, stainless steel plate (with lugs for modular wall phone if so noted on plans) mounted in a single gang extra deep cast aluminum surface mounted box in unfinished area. In finished areas the boxes shall be metal flush mounted boxes with stainless steel plates as specified above. Floor outlets shall have a cast-metal body and be installed in accordance with SECTION: LOCK ELECTRICAL WORK, Paragraph: BOXES AND SUPPORTS. Spare wire pairs shall be tagged, giving its far end location. A minimum of 2 feet of the spare conductors shall be coiled in the box. The ends of the spare conductors shall be taped.

### 2.2.8.2 Outdoors

Provide for weatherproof telephone stations at each outdoor location as shown on the plans. Spare wire pairs shall be tagged, giving its far end location. A minimum of 2 feet of the spare conductors shall be coiled in

the box. The ends of the spare conductors shall be taped.

#### 2.2.9 Vehicle Gate Controller

Provide cable and conduit between the CITB and the Vehicle gate controller, as shown on the plans.

#### 2.2.10 Radio Pull Box

Provide a NEMA Type 1 steel, 14 gauge box 16" wide by 20" high by 8" deep, wall mounted, for the radio cables as shown on the plans. The finish on both interior and exterior steel surfaces of the enclosure shall be thoroughly cleaned and then receive a rust-inhibitive phosphatizing or equivalent treatment prior to painting. Interior surfaces shall receive not less than one coat of corrosion-resisting paint, white in color. Exterior surfaces shall be primed, filled where necessary, and given not less than two coats of quick air-drying lacquer or synthetic enamel with semigloss finish, ANSI indoor LIGHT GRAY NO. 49 or 61. Install box as shown on the plans.

##### 2.2.10.1 Radio Control Cable

Provide empty conduit system only, as shown on plans.

#### 2.2.11 Communication Interface Terminal Box (CITB)

Provide a single terminal box, NEMA Type 1, galvanized steel, 14 gauge, with back panel and door with latch (maximum width of 36 inches), wall mounted, for terminating all the telephone cables, paging and talk-back speaker cables, Marine speaker cables, small boat cables, and vehicle gate control cable & cable to MCC2. The finish on both interior and exterior steel surfaces of the enclosure shall be thoroughly cleaned and then receive a rust-inhibitive phosphatizing or equivalent treatment prior to painting. Interior surfaces shall receive not less than one coat of corrosion-resisting paint, white in color. Exterior surfaces shall be primed, filled where necessary, and given not less than two coats of quick air-drying lacquer or synthetic enamel with semigloss finish, ANSI indoor LIGHT GRAY NO. 49 or 61. The terminal box shall have the following features:

- a. Terminal Blocks. Screw type terminal blocks shall be for speaker cables. Screw terminal block row spacing shall be 5 inches minimum. Terminal blocks are to be arranged per use noted above. Provide and install type 66 or 110 punch down terminal blocks for telephone cable. Terminate and identify all conductors. Each terminal block is to have a TB #, and all terminals are to have a unique number.
- b. Each cable entering the terminal box shall be tagged showing its cable number. This tag shall be on typed adhesive tape, with a clear shrink-wrap over marking. Cables entering box shall be terminated on the left side of the blocks, the right side being left vacant for wiring to radio and telephone equipment, etc., by the Government.
- c. If the cable has a shield, the shield shall be insulated and grounded to a copper ground bar located at the bottom of the box. This copper ground bar shall be drilled and tapped to accept the shield wire from each shielded cable.
- d. The terminal box door shall have a nameplate with the following engraving: COMMUNICATIONS INTERFACE TERMINAL BOX.

#### 2.2.12 Room 202 Instrumentation Monitoring Panel

Provide an enclosure designed to flush mount in a wall as follows:

- a. The enclosure shall be a NEMA 1 unit made of 14 gauge steel and sized as shown on the plans. The finish on both interior and exterior steel surfaces of the enclosure shall be thoroughly cleaned and then receive a rust-inhibitive phosphatizing or equivalent treatment prior to painting. Interior surfaces shall receive not less than one coat of corrosion-resisting paint, white in color. Exterior surfaces shall be primed, filled where necessary, and given not less than two coats of quick air-drying lacquer or synthetic enamel with semigloss finish, ANSI indoor LIGHT GRAY NO. 49 or 61. The front cover shall be a flush cover with a 1.5 inch trim ring and door made of 0.095 inch thick brushed aluminum or stainless steel fastened with stainless steel screws. Door shall have a heavy gage continuous hinge. latch shall be a single point flush drop T handle made of steel and cadmium plated. The Instruments shall be mounted in the front cover, with the required cutouts, supports, trim rings, etc.
- b. The enclosure shall have the instruments mounted to the front panel, instruments shall be as indicated on the drawings.
- c. The enclosure shall have terminal blocks inside to distribute 120 volt, 60 Hertz power and terminal blocks for signal wiring to the various instruments.
- d. The enclosure shall be mounted in the wall at the location shown on the plans. The front cover shall be flush with the finished wall surface.
- e. The sensors for the panel instruments shall be wired to the required equipment to for a complete system. Power shall be obtained from Panel LRP3.

#### 2.2.13 Room 119 Instrumentation Monitoring Panel

The enclosure shall be a NEMA 1 unit made of 14 gauge steel and sized as shown on the plans. The finish on both interior and exterior steel surfaces of the enclosure shall be thoroughly cleaned and then receive a rust-inhibitive phosphatizing or equivalent treatment prior to painting. Interior surfaces shall receive not less than one coat of corrosion-resisting paint, white in color. Exterior surfaces shall be primed, filled where necessary, and given not less than two coats of quick air-drying lacquer or synthetic enamel with semigloss finish, ANSI indoor LIGHT GRAY NO. 49 or 61. The front cover shall be a flush cover with a 1.5 inch trim overlap with double doors that have a heavy gage continuous hinge and made of 0.095 inch thick brushed aluminum or stainless steel, fastened with stainless steel screws. Latch shall be a three point flush drop T handle made of steel and cadmium plated. The Instruments shall be mounted in the front cover, with the required cutouts, supports, trim rings, etc.

- a. The enclosure shall have the instruments mounted to the front panel, instruments shall be as indicated on the drawings.
- b. The enclosure shall have terminal blocks inside to distribute 120 volt, 60 Hertz power and terminal blocks for signal wiring to the various instruments.
- c. The enclosure shall be mounted in the wall at the location shown on the

plans. The front cover shall be flush with the finished wall surface.

d. The sensors for the panel instruments shall be wired to the required equipment to for a complete system. Power shall be obtained from Panel LRP3.

## PART 3 EXECUTION

### 3.1 INSTALLATION

All work shall be installed as shown and in accordance with the manufacturer's recommendations except where otherwise indicated.

#### 3.1.1 Conduit

Conduit shall be provided and installed as specified in SECTION: LOCK ELECTRICAL WORK.

#### 3.1.2 Wire Shielding

All cable shielding shall be continuous throughout the system. The shields shall be connected to a ground bar within the CITB, and from that point a ground wire shall be run to the nearest accessible point of the building grounding system. Grounding connections shall be made in accordance with NFPA 70. Wiring shall be color-coded to facilitate identification. Where splices are made at conductor outlets, the shielding shall be interconnected by a copper conductor.

#### 3.1.3 Weatherproofing

All equipment to be mounted out-of-doors or subject to inclement conditions shall be weatherproofed.

#### 3.1.4 Repairs

Wherever walls, ceilings, or floors are cut for installation, they shall be repaired, restored, and finished to their original appearance.

#### 3.1.5 Test Inspection and Training

The Government will provide electric power required for field tests when available if the facility is turned over to the Government for beneficial use at the time of the test; if not, the Contractor shall provide power.

##### 3.1.5.1 System Tests

An operational system test shall be performed to verify conformance of system to this specification. Because the Government is furnishing amplifiers and the telephone switch, etc, the Contractor shall be present when the operational system tests are performed and assist the Contracting Officer with these tests. Loop continuity and operations shall be verified for each installed wire pair. Tests shall be conducted to verify correct operation and aiming of each speaker.

##### 3.1.5.2 Inspection

Observations shall be made to verify that units and controls are properly labeled, and interconnecting cables, wires, and terminals are identified as

specified.

#### 3.1.5.3 Retesting

Deficiencies indicated by tests shall be rectified and work affected by such deficiencies shall be completely retested at Contractor's expense.

-- End of Section --