

## SECTION 33 70 02.00 10

ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND  
10/07

## PART 1 GENERAL

## 1.1 REFERENCES

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

## ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M (2008) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 153/A 153M (2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2007; Errata 2007) National Electrical Safety Code

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA C119.1 (2006) Sealed Insulated Underground Connector Systems Rated 600 Volts

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2007; AMD 1 2008) National Electrical Code - 2008 Edition

NFPA 70E (2004) Electrical Safety in the Workplace

## UNDERWRITERS LABORATORIES (UL)

UL 486A-486B (2003; Rev thru Aug 2006) Standard for Wire Connectors

## 1.2 SYSTEM DESCRIPTION

Items provided under this section shall be specifically suitable for the following service conditions. Seismic details shall be as required in Section 26 05 48.00 10 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT.

- a. Altitude 450 feet.
- b. Ambient Temperature range of 29 degrees to 104 degrees F.
- c. Frequency 60 Hz.

d. Corrosive Areas as shown on the drawings.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

#### SD-02 Shop Drawings

As-Built Drawings; G

#### SD-03 Product Data

Nameplates; G

Catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material and Equipment; G

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

Installation Requirements; G

As a minimum, installation procedures for switchgear. Procedures shall include cable pulling plans, diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment.

#### SD-06 Test Reports

##### Cable and Conductor Installation

Six copies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Sections shall be separated by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

- a. Site layout drawing with all power assisted cable pulls numerically identified.
- b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.
- c. The cable manufacturer and type of cable.
- d. The dates of cable pulls, time of day, and ambient temperature.
- e. The length of cable pull and calculated cable pulling

tensions.

f. The actual cable pulling tensions encountered during pull.

#### SD-07 Certificates

##### Material and Equipment

Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), submit proof that the items provided conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform.

##### Installation Engineer

Provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. A resume shall be provided showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers.

#### 1.4 QUALITY ASSURANCE

##### 1.4.1 Detail Drawings

Submit detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings.

a. If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the detail drawings. Approved departures shall be made at no additional cost to the Government.

b. Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:

1. Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. All optional items shall be clearly identified as included or excluded.

2. Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.

3. Detail drawings shall as a minimum depict the installation of the following items:

(a) Cables conductors and accessories including cable installation plan for all duct bank runs.

(b) Switchgear.

(c) Surge arresters.

#### 1.4.2 As-Built Drawings

The as-built drawings shall be a record of the construction as installed. The drawings shall include the information shown on the contract drawings as well as deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be a full sized set of prints marked to reflect deviations, modifications, and changes. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, provide three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. Correct and return the as-built drawings to the Contracting Officer for approval within 10 calendar days from the time the drawings are returned to the Contractor.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

Visually inspect devices and equipment when received and prior to acceptance from conveyance. Protect stored items from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced.

### PART 2 PRODUCTS

#### 2.1 STANDARD PRODUCT

Provide **material and equipment** which are the standard product of a manufacturer regularly engaged in the manufacture of the product and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

#### 2.2 NAMEPLATES

##### 2.2.1 General

Each major component of this specification shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Nameplates shall be made

of noncorrosive metal. As a minimum, nameplates shall be provided for circuit breakers, meters, switches, and switchgear.

### 2.2.2 Conduit Tags

All conduits in manholes, handholes and pullboxes shall have an engraved name tag on the sidewall where it terminates. Conduit tag names shall be the names used in the Circuit and Raceway Schedule provided by the Contractor. Name tags shall be engraved phenolic with white letters on a black background. All letters shall be minimum 3/16-inch high. Name tags shall be applied to sidewalls with 2-part epoxy.

All control cables, instrumentation cables and power cables in manholes, handholes and pullboxes shall have a name tag attached. Multi-conductor power and control circuits shall be bundled with black ty-wraps and name tagged as well. Brass or stainless steel tags, stamped with the circuit identification information shall be used.

All manhole, handhole and pullbox covers shall be hot-dip galvanized after fabrication and AASHTO H-20 traffic rated and shall be marked with the cover inscriptions as shown on the drawings. Covers shall be as shown in Southern California Edison UGS standards unless approved by the Engineer. Covers shall have holddown bolts that are penta-head type.

## 2.3 CORROSION PROTECTION

### 2.3.1 Aluminum Materials

Aluminum shall not be used in contact with earth or concrete. Where aluminum conduit is indicated below grade or above grade where indicated, PVC-Coated aluminum shall be used.

### 2.3.2 Ferrous Metal Materials

#### 2.3.2 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with [ASTM A 153/A 153M](#) and [ASTM A 123/A 123M](#).

### 2.3.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall be as specified in Section [09 90 00.00 40 PAINTING AND COATING](#).

## 2.4 CABLES

Cables shall be single conductor type unless otherwise indicated.

### 2.4.1 Low-Voltage Wire and Cables

Wire and Cables shall be rated 600 volts and shall conform to the requirements of [NFPA 70](#) and [NFPA 70E](#), and must be UL listed for the application or meet the applicable section of either ICEA or NEMA standards. Wire and cable for underground and outdoor applications shall be as specified in Section [26 20 00](#), INTERIOR DISTRIBUTION SYSTEM, unless otherwise noted.

## 2.5 CABLE JOINTS, TERMINATIONS, AND CONNECTORS

### 2.5.1 Low-Voltage Cable Splices

Low-voltage cable splices and terminations shall be rated at not less than 600 Volts. Splices in conductors No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, conforming to the applicable requirements of [UL 486A-486B](#). Splices in conductors No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type connector, conforming to the applicable requirements of [UL 486A-486B](#). Splices shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket. Splices below grade or in wet locations shall be sealed type conforming to [NEMA C119.1](#) or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors. Splices require written permission from the Engineer.

## 2.6 CONDUIT AND DUCTS

Conduit for below grade and outdoor applications shall be as specified in Section [26 20 00](#), INTERIOR DISTRIBUTION SYSTEM, unless noted otherwise. All spare conduits and ducts shall have a pull rope installed and anchored for easy access for future use.

### 2.6.1 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as [35 degrees F](#), shall neither slump at a temperature of [300 degrees F](#), nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

### 2.6.2 Duct Lubrication

Provide water-based pulling lubricant for all outside underground runs, whether hand or power pulled. Nontoxic, noncorrosive, noncombustible, nonflammable, water-based lubricant; UL listed. Suitable for rubber, neoprene, PVC, polyethylene, hypalon, CPE, and lead-covered wire and cable. Approved for intended use by cable manufacturer. Suitable for zinc-coated steel, aluminum, PVC and fiberglass raceways.

## 2.7 PRECAST HANDHOLES, AND PULLBOXES

Manholes, handholes, and pullboxes shall be as indicated. Strength of manholes, handholes, and pullboxes and their frames and covers shall conform to the requirements of Southern California Edison (SCE). Precast-concrete manholes shall have the required strength as shown in SCE UGS Standards. Pullbox and handhole covers shall be traffic-rated. Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and galvanized steel, traffic-rated covers.

## 2.8 GROUNDING AND BONDING

Grounding and bonding shall be as specified in Section [28 05 26.00 40](#),

## GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY.

## 2.9 CONCRETE AND REINFORCEMENT

Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete reinforcing shall be as specified in Section 03 20 01.00 10 CONCRETE REINFORCEMENT and installed where indicated. All electrical shall be colored red.

## PART 3 EXECUTION

## 3.1 EXAMINATION

After becoming familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

## 3.2 INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Conduits installed underground shall be installed and protected from corrosion in conformance with the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section 31 00 00 EARTHWORK. Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE.

## 3.2.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70, NFPA 70E and IEEE C2 as applicable.

## 3.3 CABLE AND CONDUCTOR INSTALLATION

Obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, etc. And then perform pulling calculations and prepare a pulling plan which shall be submitted along with the manufacturers instructions in accordance with SUBMITTALS.

## 3.3.1 Cable Installation Plan and Procedure

Cables and conductors shall be installed strictly in accordance with the cable manufacturer's recommendations. Each circuit shall be identified by means of non-ferrous metal tags, or approved equal, in each manhole, handhole, pullbox and each terminal. Each tag shall contain the following information; circuit number, circuit voltage, destination and phase identification, unless otherwise approved.

## 3.3.1.1 Inspection

The cable and conductor reels shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable in accordance with the cable manufacturer's recommendations.

### 3.3.1.2 Duct Cleaning

Duct shall be cleaned with an assembly that consists of a flexible mandrel (manufacturers standard product in lengths recommended for the specific size and type of duct) that is 1/4 inch less than inside diameter of duct, 2 wire brushes, and a rag. The cleaning assembly shall be pulled through conduit a minimum of 2 times or until less than a volume of 8 cubic inches of debris is expelled from the duct. Standing water shall be removed and duct shall be retested to prove it is dry.

### 3.3.1.3 Duct Lubrication

The cable lubricant shall be compatible with the cable or conductor jacket that is being installed. Application of lubricant shall be in accordance with lubricant manufacturer's recommendations.

### 3.3.1.4 Cable and Conductor Installation

Provide a cable feeding truck and a cable pulling winch as required. Provide a pulling grip or pulling eye in accordance with cable manufacturer's recommendations. The pulling grip or pulling eye apparatus shall be attached to polypropylene or manilla rope followed by lubricant front end packs and then by power cables. A dynamometer shall be used to monitor pulling tension. Pulling tension shall not exceed cable manufacturer's recommendations. Do not allow cables to cross over while cables are being fed into duct. For cable installation in cold weather, cables shall be kept at 50 degrees F temperature for at least 24 hours before installation.

### 3.3.1.5 Cable and Conductor Installation Plan

Submit an installation plan for all power-assisted pulls in accordance with the detail drawings portion of paragraph SUBMITTALS. Installation plan shall include:

- a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.
- b. List of installation equipment.
- c. Lubricant manufacturer's application instructions.
- d. Procedure for resealing cable ends to prevent moisture from entering cable.
- e. Pulling tension calculations of all power-assisted cable pulls.
- f. Percentage conduit fill.
- g. Sidewall thrust pressure.
- h. Minimum bend radius and minimum diameter of pulling wheels used.
- i. Jam ratio.
- j. Maximum allowable pulling tension on each different type and size of conductor.

k. Maximum allowable pulling tension on pulling device.

### 3.3.2 Duct Line

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 and only with written permission of the Engineer. Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

### 3.3.3 Electric Manholes, Handholes and Pullboxes

Cables and circuit conductors shall be routed around the interior walls and securely supported from walls on cables racks. Routing shall minimize crossover, provide access space for maintenance and installation of additional cables, and conductors and maintain separation in accordance with IEEE C2.

## 3.4 DUCT LINES

### 3.4.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 4 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3 inch diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes.

### 3.4.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

### 3.4.3 Concrete Encasement

Ducts requiring concrete encasements shall comply with NFPA 70, except that electrical duct bank configurations for ducts 6 inches in diameter shall be determined by calculation and as shown on the drawings. The separation between adjacent electric power and communication ducts shall be as shown. Duct line encasements shall be monolithic construction. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 4 feet on centers. Ducts shall be securely anchored to prevent movement during the placement of

concrete and joints shall be staggered at least 6 inches vertically. Ductbank concrete shall be colored red.

#### 3.4.4 Nonencased Direct-Burial

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

#### 3.4.5 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

##### 3.4.5.1 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.

#### 3.4.6 Duct Line Markers

Duct line markers shall be provided as indicated or at the ends of long duct line stubouts or for other ducts whose locations are indeterminate because of duct curvature or terminations at completely below-grade structures. In addition to markers, a 5 mil red colored plastic tape, not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers with a continuous metallic backing and a corrosion-resistant 1 mil metallic foil core to permit easy location of the duct line, shall be placed approximately 12 inches below finished grade levels of such lines.

### 3.5 MANHOLES, HANDHOLES, AND PULLBOXES

#### 3.5.1 General

Manholes, handholes and pullboxes shall be constructed approximately where shown. The exact location shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. The location shall be approved by the Contracting Officer before construction is started. Provide the types noted on the drawings constructed in accordance with the applicable details as indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. The Contractor may, as an option, utilize monolithically constructed precast-concrete having the required strength and inside dimensions as required by the drawings or specifications. In paved areas, frames and covers for entrances in

vehicular traffic areas shall be flush with the finished surface of the paving. In unpaved areas, the top of covers shall be approximately 1/2 inch above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the cover to existing grade level. All duct lines entering manholes, handholes and pullboxes must be installed on compact soil or otherwise supported when entering to prevent shear stress on the duct at the point of entrance. Duct lines entering cast-in-place concrete manholes, handholes and pullboxes shall be cast in-place with the manhole. Duct lines entering precast concrete manholes, handholes and pullboxes through a precast knockout penetration shall be grouted tight with a portland cement mortar. PVC duct lines entering precast manholes, handholes and pullboxes through a PVC endbell shall be solvent welded to the endbell. A cast metal grille-type sump frame and cover shall be installed over the sump. A cable-pulling iron shall be installed in the wall opposite each duct line entrance, as a minimum.

### 3.5.2 Electric Manholes

Wires and cables shall be securely supported from walls by hot-dip galvanized racks with a plastic coating over the galvanizing and equipped with adjustable hooks and insulators. The number of racks required shall be installed in each manhole and not less than 2 spare hooks shall be installed on each rack. Insulators shall be made of high-glazed porcelain. Insulators will not be required on spare hooks.

### 3.5.3 Communications Manholes

The required number of hot-dip galvanized cable racks with a plastic coating over the galvanizing shall be installed in each telephone manhole. Each cable rack shall be provided with 2 cable hooks. Cables for the telephone and communication systems will be installed by others.

### 3.5.4 Handholes

Handholes shall be of the type noted on the drawings and shall be constructed in accordance with the details shown.

### 3.5.5 Pullboxes

Pullbox tops shall be flush with sidewalks or curbs or placed 1/2 inch above surrounding grades when remote from curbed roadways or sidewalks or as indicated. Covers shall be marked as shown on the Drawings, and provided with lifting eyes and 2 hold-down bolts. Each box shall have a suitable opening for a ground rod. Conduit, cable, ground rod entrances, and unused openings shall be sealed with mortar.

### 3.5.6 Ground Rods

A ground rod shall be installed at the manholes, handholes and pullboxes. Ground rods shall be driven into the earth before the manhole floor is poured so that approximately 4 inches of the ground rod will extend above the manhole floor. When precast concrete manholes, handholes and pullboxes are used, the top of the ground rod may be below the manhole floor and a No. 1/0 AWG ground conductor brought into the manhole through a watertight sleeve in the wall, or it may be exposed for internal connection.

### 3.6 PAD-MOUNTED EQUIPMENT INSTALLATION

Pad-mounted equipment, shall be installed on concrete pads in accordance with the manufacturer's published, standard installation drawings and procedures, except that they shall be modified to meet the requirements of this document. Units shall be installed so that they do not damage equipment or scratch painted or coated surfaces. After installation, surfaces shall be inspected and scratches touched up with a paint or coating provided by the manufacturer especially for this purpose.

#### 3.6.1 Concrete Pads

##### 3.6.1.1 Construction

Concrete pads for pad-mounted electrical equipment shall be poured-in-place. Pads shall be constructed as indicated, except that exact pad dimensions and mounting details are equipment specific and are the responsibility of the Contractor. Tops of concrete pads shall be level and shall project 4 inches above finished paving or grade and sloped to drain. Edges of concrete pads shall have 3/4 inch chamfer. Conduits for conductors shall be set in place prior to placement of concrete pads. Where grounding electrode conductors are installed through concrete pads, PVC conduit sleeves shall be installed through the concrete to provide physical protection. To facilitate cable installation and termination, the concrete pad shall be provided with a rectangular hole sized in accordance with the manufacturer's recommended dimensions. Upon completion of equipment installation the rectangular hole shall be filled with masonry grout.

##### 3.6.1.2 Concrete and Reinforcement

Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete pad reinforcement shall be in accordance with Section 03 20 01.00 10 CONCRETE REINFORCEMENT.

##### 3.6.1.3 Sealing

When the installation is complete, seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

#### 3.6.2 Padlocks

Padlocks shall be provided for pad-mounted equipment. Padlocks shall be keyed alike as directed by the Contracting Officer.

### 3.7 CONNECTIONS TO BUILDINGS

Cables and conductors shall be extended into the various buildings as indicated, and shall be connected to the first applicable termination point in each building. Interfacing with building interior conduit systems shall be at conduit stubouts terminating 5 feet outside of a building and 2 feet below finished grade as specified and provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. After installation of cables and conductors, conduits shall be sealed to prevent entrance of moisture or gases into buildings.

### 3.8 MANUFACTURER'S FIELD SERVICE

#### 3.8.1 Onsite Training

Conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 32 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, and servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations.

#### 3.8.2 Installation Engineer

After delivery of the equipment, furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of the equipment, assist in the performance of the onsite tests, initial operation, and instruct personnel as to the operational and maintenance features of the equipment.

### 3.9 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --