



SECTION 16300
ELECTRICAL UNDERGROUND DISTRIBUTION

PART 1 GENERAL

- 1.1 These general conditions shall apply to all parts of the Work and are included as part of the Contract or Agreement, unless otherwise noted.
- 1.2 Unless otherwise noted, the OWNER shall furnish the primary materials for the performance of the Contract or Agreement. When the CONTRACTOR agrees to furnish the primary materials required for performance of the Contract Agreement, the OWNER shall provide the CONTRACTOR with written guidance and specifications for the material to be used.
- 1.3 The CONTRACTOR shall furnish all necessary supervision, labor, transportation, equipment, tools, and supplies as required for the performance of the Work.
- 1.4 The Work of CONTRACTOR shall be in accordance with the Contract Documents, Project Plans and Drawings. All Work performed by CONTRACTOR shall be subject to the inspection of OWNER and Resident Project Representative and at the direction of OWNER. A reasonable amount of the Project's total cost will be withheld for any Work not complying with the Contract Documents until defects are corrected.
- 1.5 Wherever and whenever the term "Work" or "Works" is used in the Contract Documents, it shall be understood to include all supervision, supplies, labor, transportation, and equipment. With particular reference to CONTRACTOR, "Work" or "Works" refers to everything that is agreed to be done and furnished by him.
- 1.6 The words, "as directed", "as required", "as permitted", "as allowed", or phrases of the effect or import, as used herein shall mean that the direction, requirement, permission, or allowance of OWNER is intended, and similarly the words "approved", "reasonable", "suitable", "properly", "satisfactorily", or words of like effect and import, unless otherwise particularly specified herein shall mean approved, reasonable, suitable, proper, or satisfactory in the judgment of OWNER.
- 1.7 CONTRACTOR shall in a workmanlike manner furnish all necessary supervision, labor, transportation, equipment, tools, and supplies as required to complete the Underground Electrical Distribution Work.
- 1.8 CONTRACTOR shall be responsible for attaining all the necessary permits, Tennessee One Calls (TOC), and Traffic Control Plans (TCP) required to complete the Underground Electrical Distribution Work.



- 1.9 DELIVERY, STORAGE, AND HANDLING: The CONTRACTOR shall visually inspect all materials and electrical equipment before accepting and removing such from the OWNER's warehouse facility. The CONTRACTOR shall alert OWNER's warehouse personnel of any damage or suspected damage to such material before moving or transporting to the Project Site. The CONTRACTOR shall handle and store all material and equipment in a manner, which prohibits damage, defacing, or theft. Stored items shall be protected from the environment in accordance with the manufacturer's requirements. Materials and/or equipment damaged, mishandled, or stolen by/from the CONTRACTOR personnel shall be replaced at the CONTRACTOR's expense.
- 1.10 The as-built drawings shall be a record of the Work as it is installed by the CONTRACTOR. The drawings shall include all the information as shown on the Project Drawings as well as any deviations, modifications, and changes to the Project Drawings, however minor. CONTRACTOR shall submit one full-sized set of marked up prints fully detailing the as-built conditions.

PART 2 PRODUCTS

- 2.1 All materials, equipment and appurtenances used in Work for the OWNER shall conform to those acceptable by standard publications used in overhead power distribution line construction, and shall be supplied new and free from defect. All materials, equipment and appurtenances used in Work for the OWNER shall carry a minimum one (1) year warranty from the Project's completion date.
- 2.2 All items of a given type shall be the products of the same Manufacturer.
- 2.3 All electrical material required for the Work specified herein shall be supplied by the OWNER unless otherwise specifically indicated. CONTRACTOR shall supply all incidental electrical supplies required by his labor forces and their equipment to support installation of the materials.
- 2.4 All materials shall be installed in accordance with manufacturer's instructions and guidance. If OWNER is providing the materials required for performance of the Contract or Agreement, then OWNER shall ensure the CONTRACTOR receives copies of the required relevant installation and storage instructions of the manufacturers.
- 2.5 ACCESSORIES
- A. End Bells: Provide plastic end bells as required to provide a smooth and rounded surface at cut edges of the conduit to prevent damage to the cable during installation and normal movement. End bells shall also be provided where conduit enters



handholes. End bells shall be compatible with the type conduit and as recommended by the conduit manufacturer.

- B. Duct Spacers: Provide non-metallic, prefabricated, interlocking, plastic duct spacers as manufactured by S-P Products, Underground Devices, or equal.
- C. Conduit Sealing Compound: Compounds for sealing conduit shall be compatible with the insulation of the cable as recommended by the cable manufacturer. The compound shall adhere to plastic conduit, metallic conduit, concrete, masonry, cable sheaths, jackets, covers, etc. Compounds shall provide a moisture resistant seal.
- D. Sump Hole Frame and Cover: Metal grille-type frame and cover shall be furnished by CONTRACTOR as provided by the manhole manufacturer.
- E. A metal framing system shall be installed around the interior perimeter walls of manholes to support electrical cables. The framing system shall have channels 1-5/8" square with 9/16 diameter holes 1-7/8" on center. Approved product manufacturers include:
 - 1. Unistrut #P1000-HS
 - 2. American Electric #A-1200-P
 - 3. B-Line #B-22-1 7/8H
 - 4. Kin Line #4112-PO.

Insulated cable clamps shall be used for attaching cable to the metal framing system.

2.6 CONCRETE

- A. All concrete used for conduit encasement shall meet the requirements of Section 03303 and shall be consolidated in accordance with ACI 309R-05 or latest revision thereof.

2.7 Conductors and Appurtenances: overhead conductors that are suitable for use on the underground distribution system include:

- A. 1000 kcmil, 61 strand Copper, 133% EPR insulation, 1/6 neutral, OWNER item No. 140004
- B. 750 kcmil, 61 strand Aluminum, 100% EPR Insulation, 1/3 neutral, OWNER item No. 182535.
- C. 500 kcmil, 37 strand Copper, 100% EPR Insulation, 1/3 neutral, OWNER item No. 182725.
- D. 4/0 AWG, 19 strand Aluminum, 100% EPR Insulation, OWNER item No. 189183.
- E. 1/0 AWG, 19 strand Aluminum, 100% EPR Insulation, OWNER item No. 168815.



PART 3 EXECUTION

3.1 GENERAL

- A. Electric Line Work will be scheduled only by OWNER's Manager of Electric Overhead Construction, or his designated representative.
- B. CONTRACTOR shall furnish video, DVD, or pictures of the construction area before the start of the Work to the OWNER Resident Project Representative.
- C. CONTRACTOR shall contact and coordinate with OWNER's Systems Operation's Dispatching (865/558-2600) for Hold Orders and Caution Orders. CONTRACTOR must receive a Hold Order from the OWNER's System Operations personnel before connecting or disconnecting any electrical component. OWNER's System Operation's Dispatching must be informed of any change in cabling or open points as soon as possible.
- D. CONTRACTOR shall notify OWNER's Systems Operation's Dispatching of any abnormal system configurations when terminating work at the end of the work day prior to the CONTRACTOR leaving the Work site. Systems Operation's Dispatching shall determine whether the abnormal configuration is acceptable under current operating conditions.
- D. CONTRACTOR shall not "open" or "close" any switch or other device except upon the order of OWNER's Systems Operation's Dispatching.
- E. CONTRACTOR shall be responsible for all traffic control permits, plans, signage, flagging, etc.
- F. The location of transformers, cables, services, and other utilities shown on Project Drawings are approximate only. CONTRACTOR shall verify actual locations in the Project area.
- G. CONTRACTOR shall, if possible, notify OWNER's Customer Support Department 3 days in advance of clearances needed.
- H. CONTRACTOR shall use a vacuum truck to clean up any spoils, spills, or drill fluids resulting from horizontal directional drilling activities. CONTRACTOR shall remove scrap materials and debris from the job site each day.
- I. CONTRACTOR shall notify OWNER's Systems Operation's Dispatching immediately of any incidental contact with energized equipment resulting in an arc, flash, blown fuse or a momentary interruption of electric service.
- J. CONTRACTOR shall maintain radio communication with OWNER's Systems Operation's Dispatching while performing Work under this Agreement. OWNER will furnish one radio for each of the CONTRACTOR's trucks.



- K. CONTRACTOR shall furnish and install grass seed, straw, sod, concrete, asphalt, mulch, landscape material, etc. as required to restore the grounds to its original or better condition.

3.2 GENERAL SPECIFICATIONS

- A. The Work shall be completed in a thorough and workmanlike manner and shall conform to the applicable requirements of the National Electric Safety Code. Where local regulations are more stringent or in excess of the NESC minimum requirements the local regulation shall be followed.
- B. The OWNER's Construction Standard Drawings – Underground Construction Section are intended to establish a standard of construction and to indicate required clearances. Field installation may vary materially and dimensionally from those shown on the assembly and guide drawings and construction shall be modified, as required, to accommodate the field conditions involved.

3.3 Equipment, materials, and devices shall be installed and energized in accordance with the manufacturer's published instruction and the requirements of the Contract Documents. Except as covered herein excavation, trenching, and backfilling shall conform to the requirements of Section 02321. The CONTRACTOR shall become familiar with the details of the Work, shall verify dimensions in the field, and shall advise the OWNER of any discrepancy before performing the Work.

3.4 CABLE INSTALLATION: The CONTRACTOR shall obtain the manufacturer's installation instructions which addresses all aspects of the cable installation including cable construction, insulation type, cable diameter, maximum allowable bending radius, allowable pulling lubricants, coefficient of friction, required method of conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, etc.

- A. Cable shall be installed in strict accordance with the cable manufacturer's recommendations. Each circuit or run shall be identified with a non-ferrous metal tag in each manhole, handhole, junction box, and terminal. All cables shall have phasing labeled.
- B. The cable reel shall be inspected for correct storage position, signs of physical damage, and broken end seals. If the end seal is broken, moisture shall be removed from the cable in accordance with the cable manufacturer's recommendations. Cable ends shall be kept sealed at all times until final termination is made. The OWNER shall be notified of any cable contaminated with moisture.
- C. Duct Cleaning: Prior to pulling cable all duct shall be cleaned with an assembly that consists of a flexible mandrel that is ¼ inch less than the size of the duct, two wire

- brushes, and a rag. The cleaning assembly shall be pulled through the conduit a minimum of two times or until all dirt and debris is sufficiently removed.
- D. Cable Lubrication: Lubricants shall be used as necessary to lower pulling tensions and minimize stress on cables. The cable lubricant shall be compatible with the cable jacket for the specific cable being installed. Application of lubricant shall be in accordance with cable and lubricant manufacturer's recommendations. Lubricant material shall not harden with age.
 - E. The CONTRACTOR shall provide a cable feeding truck or trailer and a cable-pulling winch. The CONTRACTOR shall provide a pulling grip or pulling eye in accordance with the cable manufacturer's recommendation. The pulling grip or pulling eye shall be attached to polypropylene or manila rope followed by lubricant front end packs and then by power cables. A dynamometer or other tension measuring device shall be used to monitor pulling tension. Pulling tension shall not exceed cable manufacturer's recommendations. CONTRACTOR shall not allow cables to cross over while cables are being feed into the duct. Cable shall not be installed when ambient air temperatures fall below the manufacturer's limits. Do not subject cable to an inside bending radius less than those recommended by the cable manufacturer. Cable shall be installed continuously, when practically possible, between termination points without intermediate splices or taps. The Owner will provide cold shrink splices for the underground cable installation. The CONTRACTOR may install intermediate splices only as indicated or as required to avoid subjecting cable to excessive pulling tension or sidewall pressures. Cable splicing locations shall be approved by OWNER or Resident Project Representative prior to cable installation.
 - F. CONTRACTOR shall supply all labor and material required to provide and install cable identification markers as directed and approved by the OWNER. Cables shall be tagged at each termination point and within each handhole and manhole.
 - G. Cables shall be inserted in duct lines where indicated. Cable splices shall be made in manholes or approved handholes only. Neutral and grounding wires shall be installed in accordance with the OWNER's details and instructions.
 - H. Electric Manholes: Cables shall be routed around the perimeter of the interior wall and securely supported from walls on a framing system provided by the CONTRACTOR. The OWNER will supply insulated cable clamps for attaching cable to the unistrut channel. Permanent supports shall be installed at all cable joints and terminations so that any strain will not be transferred to the connection or termination. Cable routing shall minimize cable crossover, provide access space for maintenance and installation of future expansion. Maintain cable separation in accordance with ANSI C2.
 - I. Upon completion of the installation, 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.

3.5 CABLE JOINT/TERMINATIONS:

- A. Medium-voltage cable joints shall be made in manholes only.
- B. Cable joints shall be made at 4-point junction racks inside manholes using loadbreak elbows and protective caps with insulation equivalent to that of associated cable. All materials for cable joining will be supplied by the OWNER. Connections shall be clean and tight to assure a low-resistance joint. Connectors shall be installed with the proper tools as recommended by the connector manufacturer.
- C. Terminations shall be in accordance with IEEE Standard 48, Class 1 requirements.

3.6 Connections between aerial and underground systems shall be at locations as indicated on the Project drawings. Underground cables shall be extended up poles in conduit to cable terminations. Conduits shall be secured to the poles with 2-hole galvanized straps or other suitable straps as approved by the OWNER or Resident Project Representative and spaced not more than 6 feet apart with one strap not more than 12 inches from any bend or termination. Conduit shall be equipped with bushings to protect cables and minimize water entry. Cables shall be supported by devices separate from conduit, near their point of exit from the conduit. Cable supports shall be wedging plug type or basket grip type. The CONTRACTOR shall supply and install the riser conduit and clamps.

3.7 **GROUNDING:** Enclosed metal equipment frames, and other non-current carrying metal parts such as cable shields, cable sheathes, and metallic conduit shall be grounded. At least two connections shall be provided from a transformer or switchgear ground bus to the ground electrode. Materials for grounding will be supplied by the OWNER.

- A. **Grounding Electrodes:** Grounding electrodes shall be installed at points as required by the appropriate codes and as required by the OWNER. Unless otherwise indicated in a detail drawing, ground rods shall be driven into the earth until the tops of the rods are approximately 1 foot below finished grade. Install rods by driving and not drilling or jetting.
- B. **Grounding and Bonding Conductors:** Grounding and bonding conductors include all conductors used to bond equipment frames to the grounding electrode system. Bends greater than 45 degrees in ground conductors are not permitted. Routing of ground conductors through concrete shall be avoided. When concrete penetration is necessary, nonmetallic conduit sleeves shall be cast flush with the points of entry and

exit so as to provide an opening for the ground conductor, and the opening shall be sealed with a suitable sealant after installation.

- C. **Grounding and Bonding Connections:** Connections above grade shall be made by the fusion welding process or with bolted solderless connectors in compliance with UL 467 and those below grade shall be made by a fusion welding process. When grounding conductors are connected to aluminum composition conductors, specially treated or lined copper to aluminum connectors suitable for this purpose shall be used.
 - D. **Handhole Grounding:** Ground rods installed in manholes and handholes shall be connected to cable racks, cable pulling irons, cable shielding, metallic sheath, and armor at each cable joint or splice by means of a bare copper wire. For a concentric neutral cable, the individual wires shall be twisted together and ground/bonded to a system neutral/ground by use of a connector suitable for the application. Ground rods shall be protected with double wrapping of pressure-sensitive tape for a distance of 2 inches above and 6 inches below concrete penetrations. Grounding electrode conductors shall be neatly and firmly secured to manhole or handhole walls and the amount of exposed bare wire shall be held to a minimum.
 - E. **Riser Pole Grounding:** A single continuous vertical grounding conductor shall be installed on each riser pole and connected directly to grounding electrodes as required by the OWNER and/or Resident Project Representative. All equipment, neutrals, surge arresters, and items required to be grounded shall be connected directly to this vertical conductor. Grounding electrode conductors shall be connected to riser poles at 2-foot intervals.
- 3.8 Concrete pads for pad-mounted electrical equipment may be either pre-fabricated or poured-in-place. Pads shall be constructed as indicated, except that exact pad dimensions and mounting details are equipment specific and are the responsibility of the CONTRACTOR. Tops of concrete pads shall be level and shall project 4 inches above finished grade and sloped to drain. Edges of concrete pads shall have 3/4 inch chamfer. Conduits for primary, secondary, and grounding conductors shall be set in place prior to placement of concrete pads. Where grounding electrode conductors are installed through concrete pads, PVC conduit sleeves shall be installed through the concrete to provide physical protection. To facilitate cable installation and termination, the concrete pad shall be provided with a rectangular hole below the secondary compartments, sized in accordance with the manufacturer's recommended dimensions. Upon completion of equipment installation, the rectangular hole shall be filled with masonry grout.

3.9 ENERGIZING THE CIRCUIT



- A. Safety: The CONTRACTOR shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the vicinity.
- B. Upon completion of the Work, and at such times as the OWNER may request, the CONTRACTOR shall assist OWNER personnel with the energizing of the CONTRACTOR's Work. The CONTRACTOR shall promptly replace any devices or equipment that is damaged due to faults caused by improper installation procedures or material handling.

3.10 AREA RESTORATION

- A. CONTRACTOR shall provide all additional equipment, incidentals, material, and labor required to restore all right-of-way and/or OWNER's customer's properties disturbed by the performance of the Work upon completion of the Work.

END OF SECTION