SECTION 33 71 73
ELECTRICAL UTILITY SERVICES

PART 1  GENERAL

1.1 REFERENCES
A. American Association of State Highway Officials (AASHO):
   1. Standard Specifications
B. California Administrative Code (CAC): Title 8
C. Latest applicable California Electrical Code: Title 24, Part 3
D. Institute of Electrical and Electronic Engineers (IEEE):
   1. Standard 48
E. National Electric Code (NEC)
F. National Electrical Manufacturers Association (NEMA)
H. Related Work
   1) Section 31 23 33: Trenching, Backfilling, and Compacting
   2) Section 33 71 19: Underground Power Duct & Sub-Structures Standards
   3) Section 33 71 49: Medium Voltage Power Cable
   4) Section 33 71 49.23: Primary voltage Cable Installation
   5) Section 33 71 83: 600 & 200 Ampere Loadbreak Separable Connectors
   6) Section 26 12 19: Pad Mounted Transformer
I. FDG Drawings
   1) ES-11: Standard Conduit Arrangements for Building Project
   2) ES-15: Pre-Cast Vault Detail
   3) ES-16: Vault Extensions
   4) ES-17: Traffic Covers
   5) ES-20: High Voltage Trench-Typical
   6) ES-21: Manhole Cover Rosette Design
J. Stanford Electrical Safety and Operations Procedures (ESOP)

1.2 SUBMITTALS
A. General: The following information shall be for approval in accordance with Section 26 05 00, “Basic Electrical Materials and Methods”
   1) Conduit
   2) Splice Boxes
   3) Insulating Tape
   4) High Voltage Cables
   5) High Voltage Splice Kits
   6) High Voltage Terminating Kits
   7) Potheads
   8) Terminators
   9) Precast Manholes & Handholes
   10) Manhole Frames & Covers
   11) Handhole Frames & Covers
   12) Cable Lubricants
   13) Poured-In-Place Manholes and Handholes
   14) Duct Plugs

1.3 DELIVERY, STORAGE, AND HANDLING
   A. All wire and cable shall be delivered to the job site in unbroken packages.
   B. All conduit shall be delivered to the job site in the original bundles.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT
   A. Conduit:
      1) Rigid Metal Conduit: UL 6, hot-dip galvanized, threaded couplings and fittings with insulated end bushings. Wrapping shall be 20 mil pipe wrap with 50% overlap.
      2) Rigid Plastic Conduit: Schedule 40 PVC listed for use as electrical conduit: NEMA TC2 and TC3 (fittings). Fittings shall be of the same manufacturer.
   B. Fittings and Outlet Boxes: UL 514. Fittings and outlet boxes for use with steel conduit, rigid or flexible, shall be cast metal with gasketed closures. Running thread will not be accepted.
   C. Power Wire and Cable for Service 600V and Below:
      1) All wire and cable shall be new and UL listed.
      2) Insulation shall be THWN.
      3) Metering & Panel wire shall be SIS Type
D. Phase Colors (600 V and below) shall be:

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<th>208/120</th>
<th>480/277</th>
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<tbody>
<tr>
<td>A Phase</td>
<td>Black</td>
<td>Brown</td>
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<tr>
<td>B Phase</td>
<td>Red</td>
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<td>White</td>
<td>White</td>
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<tr>
<td>Ground</td>
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E. Phase rotation at the transformer secondary terminals is A, B, C.

F. Wire Connectors and Terminals: Wire connectors and terminals shall be solid copper, UL listed.

G. Power Cable for Service over 600V: See Section 16122, Medium Voltage Power Cable.

H. High Voltage Cable Terminations, Interior: Interior high voltage terminations shall comply with the requirements of IEEE Standard 48, Class 3, handwrapped stress cones, tapes, or pennant type, or "slip-on" stress cones rated for use with cable provided.

1) Termination materials shall be the product of one manufacturer and furnished in kit form complete with instructions for fabrication and installation. Termination shall include stress relief cones and shield grounding.

2) Refer also to Section 33 71 83, 600 & 200 Ampere Loadbreak Separable Connectors.

I. High Voltage Cable Splices: Splices shall be made by approved pre-manufactured splicing devices. Craftsmen making splices in high voltage cables shall be qualified and shall be approved by the Project Manager.

J. Grounding: Ground rods shall be copper-clad steel with diameter adequate to permit driving to full length of the rod, but not less than 3/4 inch by ten (10) feet. Connections to ground rods shall be by exothermic welds, or by approved solid copper connectors.

K. Concrete:

Concrete for electrical requirements shall be minimum 2500 psi at twenty-eight (28) days with one-inch maximum aggregate. Concrete encasement shall be red with three (4) pounds red dye per cubic yard. See FDG 33 71 19.

L. Duct Plugs:

Duct plugs shall be removable, reusable, corrosion proof, water/air/gas-tight, provide pull rope attachment. Jackmoon, USA type JMS, or approved equal.
PART 3 EXECUTION

3.1 ACCESS TO FACILITIES

All high voltage (greater than 600 Volt) facilities are under the control of the Stanford High Volt Shop. Contractors may not work in or near any marked high voltage facilities without coordination with the Stanford High Volt Shop.

3.2 UNDERGROUND DUCT INSTALLATION (see Section 33 71 19, Underground Power Duct and Sub-Structures Standards, for additional requirements)

A. General:

1) The term "conduit" refers to the individual tube designed to carry power cable. The term "duct" refers to the complete cable-carrying installation comprised of one or more conduits,

2) The top of the duct shall be not less than thirty-six (36) inches below grade, and shall have a minimum slope of three (3) inches in each one-hundred (100) feet away from buildings and toward manholes and other necessary drainage points where possible, and shall run in straight lines except where a change in direction is necessary.

3) Except at conduit risers, changes in direction of duct runs exceeding a total of ten (10) degrees, either vertical or horizontal, shall be accomplished by long sweep bends. Sweep bends shall be made up of one or more curves or straight sections or combinations thereof. Joint deflection shall not exceed the maximum values recommended by the manufacturer. Manufactured bends shall have a radius of thirty-six (36) inches for conduits less than four (4) inches in diameter and a radius of sixty (60) inches for ducts of four (4) inches in diameter and larger. There shall be no shoulder or unevenness at joints along the duct interior.

4) Conduits shall terminate in bushings or end-bells where duct lines enter manholes, pullboxes, or spliceboxes. The joints of the conduits shall be staggered by rows and layers to provide a duct line having maximum strength.

5) During construction, partially completed duct lines shall be protected from entrance of debris such as mud, sand, and dirt by means of suitable conduit plugs. As each section of duct line is completed, a testing mandrel not less than twelve (12) inches long and with a diameter 1/4 inch less than the size of the conduit shall be drawn through each conduit, after which a brush equipped with stiff bristles and sized to match the diameter of the conduit shall be drawn through until the conduit is clear of all particles of earth, sand, and gravel. A 150-pound test plastic pull rope with at least three (3) feet of spare at each end shall be provided in all conduits. Blank duct plugs shall be provided at building and vault entries.

B. Underground Duct Without Concrete Encasement:
Circuits 600 V and below may be run in conduit without concrete encasement. Conduit for conductors over 600 V shall be encased in concrete. Direct burial of cables is not acceptable.

1) Conduits shall be PVC schedule 40, or rigid galvanized steel, wrapped or PVC coated.

2) There shall be not less than 6-inches clearance from the duct to each side, and 3-inches clearance to the bottom of trenches. The bottom of trenches shall be cleared of rocks and loose dirt and provided with 3-inches of sand.

3) Marking tape 3-inches shall be provided in nonmetallic conduit. Tape shall be installed approximately 12-inches above top of duct. Tape shall be red, and with "CAUTION - ELECTRIC LINE BURIED BELOW" printed continuously.

4) Multiple conduit runs shall be supported by approved spacers at 5-feet maximum separation.

C. Underground Duct with Concrete Encasement:

Underground duct lines for conductors over 600 volts shall be constructed of individual conduits encased in concrete.

1) Conduit shall be PVC Schedule 40.

2) Conduit shall be five 5-inches in diameter for conductors 250 MCM and larger and 4-inches for other conductors. The concrete encasement shall be rectangular in cross-section and shall provide at least 3-inches of concrete cover. Conduits shall be separated by a minimum concrete thickness of 2-inches, except light and power conduits shall be separated from control, signal, and telephone conduits by a minimum concrete thickness of 12-inches.

3) Duct spacers shall be installed on 5-foot centers maximum. Conduits shall be secured prior to pouring of concrete to prevent floating.

4) Ducts shall have 12 inches separation all around from existing or new water lines.

D. Grounding:

In new duct banks of three or more conduits, a #4/0 bare copper ground wire shall be installed in the concrete of the duct bank, near the bottom. The ground wire shall be loosely laid in the duct bank without tension and may be held in place against the bottom of the conduit with tape. The ground wire shall not be supported by or contact steel wires or other metal. The ground wire shall be left long enough in manholes and pullboxes to reach the ground bus. Non-current-carrying metallic parts associated with electrical equipment shall be effectively grounded by a #6 copper wire (minimum).

3.2 MANHOLE AND PULLBOX INSTALLATION

A. Power Manholes:

1) Power manholes shall be precast or poured-in-place, reinforced to withstand H-20 loading in accordance with AASHO Standard Specification for highway bridges. A
6-inch sand or gravel bed shall be provided on well-tamped or undisturbed earth for all manholes.

2) Manholes shall be supplied with knockouts, inserts, pulling irons, risers, sump channels, Hubbard No. 9100 Series Galvanized Steel ladder, and heavy duty traffic frame and cover. Size of manholes shall be 8-feet by 14-feet by 8-feet, 6-inch high inside. The ladder rungs shall be on 12-inch centers and the top rung shall be not more than 12-inches below grade. Utility vault #814-90, Forni 2Q Series, Brooks Products Inc. Series, or Quickset PV 958.

3) All joints in manhole walls, risers, and duct entrances shall be grouted with cement or gasket seal applied between precast sections to provide a waterproof structure.

4) Manholes shall be supplied with one 1-inch diameter by 10-feet long ground rods in opposite corners.

5) Manholes shall be equipped with a submersible pump, Marley #SV25A1, single phase, 120 volt, 60 Hz; no substitutions.
   a) Pump shall be actuated by a float switch control attached to the pump assembly.
   b) Each manhole shall be provided with 1-1/2 inch discharge line, check valve, and union for pump connection. Discharge line shall be copper pipe and fittings or Schedule 40 PVC pipe with approved fittings.
   c) Pumps are not required in pullboxes or spliceboxes.

6) Manhole covers shall be Forni FC-39T with 39-inch clear opening, and shall be marked "SU POWER"; no substitutions. (Standard covers marked "PG& E" will not be accepted). The ring and cover shall be centered over the opening.

7) Manholes shall be provided with separate lighting and sump pump power circuits. Manhole power wiring shall be installed in rigid metallic or nonmetallic conduits. Switches and receptacles shall be installed in nonmetallic enclosures.

B. Power Spliceboxes for Circuits Over 600 Volts:

Precast spliceboxes, complete with pulling inserts, mounting channels, knockouts, and extensions shall be provided.

1) Spliceboxes shall not be located in roadways, unless specifically approved by the Project Engineer.

2) Spliceboxes for 250 MCM cable or larger shall be Utility Vault #577-LA or approved equal. Cover shall be spring-assisted diamond plate with locking latch and removable center tube; Utility Vault #57-TL-2-323P or approved equal. Spliceboxes for smaller conductors shall be standard boxes 3-feet by 5-feet with light vehicle covers; Utility Vault #E35-LYTE or approved equal. Covers shall be marked "POWER" in block letters. Smaller pullboxes that do not contain splices may be used where approved by the Project Manager.

3) Spliceboxes shall be set in 6-inch sand bed. 18-inch by 24-inch drainage area with gravel shall be provided beneath the sump.

C. Splices in High Voltage Cables:
Splices shall be suitable for continuous immersion in water and shall be made only in accessible locations. All materials used in splicing shall be installed in accordance with the manufacturer's instructions.

END OF SECTION