PART 1   GENERAL

1.1 SCOPE

A. Work included in this Section: Medium Voltage Cable (4 kV and 12 kV) Installation and Termination. Removal and return of old cable is included in cable replacement work.

B. Medium voltage cable, to be furnished by Stanford. The Contractor provides all other materials including all labor for a complete and fully functioning installation.

C. Related Sections:
   1. Section 33 71 19 – Underground Ducts and Manholes.
   2. Section 33 71 49 – Medium Voltage Power Cable.
   3. Section 26 12 19 – Pad Mounted Transformers.
   4. Sections 33 77 00.1, 33 77 00.2 and 33 77 00.3 – Pad Mounted and Submersible Switches and Fault Interrupters.

1.2 REFERENCES

A. California Electrical Code, most recent edition.

B. Cal/OSHA regulations, especially lock-out requirements and requirements for work in vaults and manholes.

C. Code compliance is mandatory. Nothing in the Drawings and Specifications implies acceptance of work that does not comply with Codes.

D. AEIC CG5 2005, Underground Extruded Power Cable Pulling Guide

1.3 CLOSEOUT SUBMITTALS

A. Provide as-built drawings showing location of splices complete with updated manhole butterflies Section 33 71 19 – Underground Ducts and Manholes.

B. Provide Santa Clara County Permit with final sign-off date.

1.4 QUALIFICATIONS

Cable splices and terminations shall be made by certified cable splicers with a minimum of five (5) years experience in splicing cables of the type being provided under the Contract.
Provide qualifications to the Project Manager prior to splicing or termination of cables. Splicing and terminating shall be in strict accordance with manufacturer’s recommendations, utilizing factory furnished materials in kit form, or as specifically shown on the Drawings.

1.5 COORDINATION

A. Contractor shall conform to the safety requirements in Stanford ESOP-1017 and applicable OSHA/CalOSHA rules and regulations.

B. Provide OSHA approved air monitor with current calibration sticker.

C. All switching of Stanford circuits shall be performed by Stanford Utilities High-Volt Shop Electricians. High-Volt shop personnel, along with the Contractor, shall personally verify that circuits are de-energized and perform LOTO jointly with Stanford High-Volt Shop prior to work.

D. All scheduled outages required to complete the work shall be arranged by the Project Manager and the High-Volt shop supervisor.

PART 2 PRODUCTS

2.1 CABLE

A. Unless otherwise noted, medium voltage cables are to be furnished by Stanford and be made available in the High-Volt Yard located at 506 Oak Road for pickup by the Contractor with prior notice. All cable reels picked up by the Contractor must be logged by Stanford High-Volt Shop personnel with initial footage and final footage, if any left, upon their return.

B. Contractor to furnish and install 600 V THHN AWG # 4 ground conductor for 15 kV # 2 or 1/0 cables installations and 4/0 THHN for 15 kV 350 MCM or 500 MCM cable installations.

C. Whenever old cables are pulled out, they shall be returned to the Stanford High-Yard for scrap, unless otherwise specified in the job scope.

2.2 TERMINATIONS

A. Stress cone kits: Premolded, heatshrink, or cold shrink; Elastimold, Raychem or equal.

B. Elbows: 200 Amp load-break and 600 Amp non load-break elbows shall be Elastimold, see Section 16122.
2.3 SPLICES

A. Splices shall be made by pre-manufactured splicing kits. Splices shall be rated for continuous submersion in water.

B. Splices shall be made in strict compliance with the cable manufacturer’s and the splicing materials manufacturer’s instructions. All splicing materials shall be compatible with the cables.

C. Use only copper compression sleeves for splicing copper cables. Do not use sleeves containing aluminum.

2.4 CABLE RACKS AND SUPPORTS

Provide galvanized steel racks with porcelain insulators or non-metallic racks.

PART 3 EXECUTION

3.1 INSTALLATION OF MEDIUM VOLTAGE POWER CABLE:

A. Test conduits with a mandrel and clean with a brush to remove foreign material prior to cable installation.

B. Cable Pulling installation equipment shall be complete with instruments for reading pulling tension.

C. Pulling tensions and bending radii shall in no case exceed maximum values recommended by cable manufacturer. Long pulls require pulling tension calculations and measurement. Consult with Stanford High Volt Shop for details.

D. Use only lubricants approved by the manufacturer for cable pulling.

E. Install cables along those walls providing the longest route and the maximum spare cable lengths. The bending radius of trained cables shall be not less than twelve (12) times the outside diameter of the cable.

F. Provide galvanized steel channels and brackets and porcelain blocks, Unistrut or approved equal, and support cable and splices on maximum 4-ft. centers. Use heavy duty plastic cable ties to secure cables to insulators. Approved non-metallic cable supports are acceptable.

G. Provide Fault Indicators (FCIs) to be installed on each phase at the MV switch and at the MV transformer by Stanford High Volt Shop. Fault indicators shall be current reset type capable of automatically being reset when line current is restored.
3.2 INSTALLATION OF GROUND CONDUCTORS

A. Provide an insulated, 600-Volt THHN copper grounding conductor with all primary cable runs.

B. Size shall be shown on drawings.

C. Splice grounding conductor with “T” connectors and bond leg of “T” to ground bus in each manhole. DO NOT use manhole ground bus as a splice point.

D. All equipment enclosures shall be grounded with code approved fittings.

3.3 CABLE SPLICES AND TERMINATIONS

A. Materials and methods used shall conform to manufacturer’s recommendations.

B. Cable splices and terminations shall be completed without delay once the conductors and insulation are exposed to the atmosphere.

C. The cable shall be installed with the minimum number of splices. Splices are permitted only in accessible locations.

D. Ground the metallic cable shield at splices and terminations.

3.4 CABLES IN MANHOLES

A. Support cables at 4-foot maximum intervals with galvanized steel racks and channels and porcelain insulators or nonmetallic cable racks. Fasten cables to supports with plastic cable ties. Do not allow cable weight to rest on the terminations.

B. Ground metallic non-current carrying components such as cable racks, switches, and transformers. Use a #6 AWG solid copper conductor, minimum.

3.5 PHASING

A. Verify by “hot phase” test that cables on loop and tie circuits are matched phase-to-phase at every splice or termination that occurs at an open point. Use an approved live-line phasing meter and follow safety and switching procedures. This test may only be performed by personnel experienced in and qualified for testing of energized circuits. Do not rely on color markings for assurance of proper phasing.

B. Verify correct phase rotation when cables on radial circuits are replaced. Use approved secondary voltage rotation testers or verify that rotation of existing motors is correct.

C. All hot phasing and Rotation testing shall be witnessed by Stanford High-Volt Shop personnel.

D. Color marking for primary cables shall be:
• Phase A – Yellow
• Phase B – Red
• Phase C – Blue

E. Standard primary phase rotation is counterclockwise – ACB. Changing the order of phases to accommodate desired building rotation will be done at the primary connection to the outdoor padmount transformer or to the indoor primary interrupter switch in the case of a unit substation.

3.6 PRIMARY VOLTAGE CABLE HIGH POTENTIAL TEST

A. All primary cables shall be given D.C. high potential tests after installation. All tests shall be performed in the presence of the High-Volt shop’s representatives and shall be performed to their complete satisfaction. Testing of cables shall be done after all splices and cable terminations are made, but before connections to equipment are made. Open cable ends shall be wrapped with plastic or provided with similar coronal protection. Test each cable with the shields and other cables grounded. A high potential test set shall be used to read the leakage current in microamperes in the cable at two-minute intervals during the test.

B. When new cable segments are to be spliced to existing cable, the new segment shall be tested at the “New Cable” test value. After the final splice is complete, the entire segment shall be tested at the “Existing Cable” value.

C. Raise the test voltage in 5 kV increments from zero (0) to the final test value over a minimum period of 10 minutes. Testing time shall be started when the voltage on the cable has attained final test value and shall be continued for at least 10 minutes thereafter.

**DC TEST VOLTAGE, FINAL TEST VALUE:**

<table>
<thead>
<tr>
<th>Cable Type</th>
<th>New Cable</th>
<th>Existing Cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 kV</td>
<td>25 kV</td>
<td>10 kV</td>
</tr>
<tr>
<td>15 kV</td>
<td>50 kV</td>
<td>25 kV</td>
</tr>
</tbody>
</table>

D. Results of the tests shall be plotted, current against voltage, at each 5 kV increment of rise after 2 minutes minimum or after value has been stabilized, to a maximum test value, and current against time for 10 minutes thereafter in one minute intervals on a separate sheet for each length of cable tests. Curves shall be identified with the cable to which they apply and shall be certified. Time of day, outside temperature and humidity at time of each test shall appear on each curve sheet.
E. EXCEPTION: A “go/no-go” test at the proper test voltage may be accepted by the Project Manager for very short lengths of cable.