PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general conditions, Division 26, and Basic Electrical Materials and Methods (Section 260500) are part of this section and the contract for this work and apply to this section as fully as if repeated herein.

B. Reference to other sections: The applicable requirements from other Division 26 sections required for a complete and operational system shall form a part of the electrical work and each section shall be thoroughly reviewed by the Contractor for application to all other sections.

1.2 SUMMARY

A. Section includes cables and related cable splices, terminations, and accessories for medium-voltage (2001 to 35,000 V) electrical distribution systems.

1.3 QUALITY ASSURANCE AND STANDARDS

A. All work, material or equipment shall comply with the codes, ordinances and regulations of the local government having jurisdiction, including the regulations of serving utilities and any participating government agencies having jurisdiction.

B. Test and inspect cables according to ICEA S-97-682 before shipping.

C. Installer: Engage a cable splicer, trained and certified by splice material manufacturer, to install, splice, and terminate medium-voltage cable.

D. Information Submittal - Qualification Data: For Installer.

1.4 SUBMITTALS

A. Submit shop drawings per Section 260500 for review including the following:
   1. Conductor materials
   2. Connector and fitting materials
   3. Installation materials and methods
   4. Termination materials and methods

B. Complete data sheet for cable construction, shielding, insulation material, insulation rating, thickness of insulation, jacket cable stranding, voltage rating, and total amount of order in feet.

C. Certified test reports for:
   1. Sample test on insulation: physical properties, solvent extraction, heat distortion, and accelerated water absorption.
   2. Insulation resistance, power factor corona level, AC dielectric.
   3. Certified Factory Test Report including the results of the test plus cable identification, factory order number, cable length and all cable specifications. No cable shall be installed in any duct or conduit until a related test report has been accepted by the Owner’s Representative.
   4. Field Test Report.

5. Submit a certification for the approval of the Owner's Representative containing the names and the qualifications of persons recommended to perform the splicing and termination of medium voltage cables approved for installation. Refer to Section 01400 including Exhibit A for certification requirements and information regarding cable installation termination and testing.
6. A complete test shall be done on each length of cable at the factory in accordance with ICEA S-68-516, and UL-1072. In addition, a corona test shall be done per AEIC CS6-97, Section E.
7. Complete cable pull-tension study. Study shall model the route of each conductor in 3-dimensions and shall indicate pull-tensions, conduit sidewall pressures, pulling rates, minimum bend radius, and suggested pulling directions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Cable manufacturers shall be BICC, Okonite, Pirelli or equal.

B. Cable terminations and splices shall be manufactured by 3M, Elastimold, or equal.

C. Fire-proofing and arc-proofing tape shall be manufactured by Bishop (Model 43A), 3M (Model 7700), or equal.

D. Source Limitations: Obtain cables and accessories from single source from single manufacturer.

E. The manufacturer shall have a minimum of ten years of experience in manufacturing medium voltage EPR power cables and shall submit a certified copy of its AEIC CS 6 qualification.

F. Provide the services of a qualified testing laboratory to perform the specified field tests. Notify the Owner's Representative 7 days in advance of performance of work requiring testing. Refer to Section 260500 regarding additional requirements.

2.2 MATERIALS

A. 15kV, ungrounded, shielded, single copper conductor, UL listed Type MV, with ethylene-propylene (EPR) insulation, jacketed, with ratings per the project requirements. Manufactured within one year of installation.

B. Suitable for installation in conduit, subject to alternately wet and dry conditions.

C. To operate satisfactorily, both electrically and mechanically, at conductor temperatures not exceeding 90 degrees C continuous for normal loading; 130 degrees C for emergency loading, emergency of 36 hours; 250 degrees C for short circuit loading assuming a short circuit duration of two seconds. Emergency overload operation may occur for periods up to 100 hours per year and with as many as five (5) such 100-hour periods within the lifetime of the cable.

D. Cable to meet the specifications and the minimum requirements of the latest revisions of ICEA and AEIC Standards.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.

F. Soft, annealed copper, concentric Class B stranded per ASTM B-8.

G. Thermoset EPR based material or a material extruded over the conductors with thermal characteristics equal to or better than those of the insulation; chemically compatible with the conductor and the cable insulation; firmly and continuously bonded to the overlaying insulation; easily removable from the conductors; not less than 25 mils or more than 50 mils thick. Compatibility of material shall be demonstrated by laboratory test results.

H. High quality, ethylene-propylene base, thermosetting compound of high dielectric strength with heat, moisture, ozone, and corona resistant properties, homogenous, solid, and applied with good workmanship. Insulation thickness shall be 220 mils minimum average, and 200 mils minimum at any point; meet or exceed the latest editions of Standards ICEA S-68-516, AEIC CS-6 for 133% insulation level. EPR insulation compound shall be free from polyethylene.

I. Insulated conductor to have a suitable layer of semi-conducting, extruded, thermosetting, polyethylene insulation shielding applied directly over the insulation; 50 mils average thickness; 45 mils minimum thickness; impervious to sunlight, the elements and acid or alkaline soils.

J. Uncoated copper tape shield, helically applied over insulation 0.0005 inch thick with minimum 25% overlap. Minimum ampacity of shield to be one-third that of phase wire.

K. 80 mil, minimum average thickness polyvinyl chloride jacket extruded over the shielding tape; smooth, of uniform composition and free of holes, cracks and imperfections; longitudinal shrinkage relative to the insulation less than five percent.

L. Tape for First Course on Metal Objects: 10-mil- thick, corrosion-protective, moisture-resistant, PVC pipe-wrapping tape.

M. Arc-Proofing Tape: Fireproof tape, flexible, conformable, intumescent to 0.3 inch thick, and compatible with cable jacket.

N. Glass-Cloth Tape: Pressure-sensitive adhesive type, 1 inch wide.

O. Strand shielding insulation and semi-conducting insulation shield shall be applied in a continuous triple-tandem extrusion process.

P. Provide durable lifetime identification printed, embossed, or engraved on outer surface of the jacket including manufacturer's name, year of manufacture, place of manufacture, conductor type and size, insulation thickness in mils, and the rated voltage, all on 3 foot center maximum spacing.

Q. Seal ends of cable with mastic material and tight fitting plastic end cap to prevent entrance of moisture.

2.3 CABLE TERMINATIONS

A. IEEE 48; Class 1, shrinkable rubber or polymeric cable termination in kit form with ground clamp, non-tracking skirts, moisture-blocked ground braid and auxiliary materials; rated for voltage class of cable being terminated.

2.4 CABLE SPLICES

A. 15kV splices shall consist of a 600 ampere separable insulated connection T-Bolt system rated for continuous operation at 15kV for single-conductor shielded power cables. The system components shall be designed according to the specifications listed in ANSI/IEEE Standard 386-1985 for 15kV 600A dead-break interfaces, sealed against moisture, and include test point on termination body that is capacitance coupled. The system shall be made up of specific kits designed for splicing, tapping (adding-on) dead-ending, and 600A equipment connecting. Each kit shall contain all the components necessary for its intended application. The connector cable sizing adapter and shield adapter shall be contained in a separate adapter kit. The system shall be capable of making dead-end, 2-way, 3-way or multiple tap splices, and of making connections to 15kV 600A apparatus bushings. All hand-wrapped splices shall be reviewed and approved by the Owner prior to acceptance.

PART 3 - EXECUTION

3.1 FIELD CONDITIONS

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
   1. Notify Construction Manager and Owner no fewer than five days in advance of proposed interruption of electric service.
   2. Do not proceed with interruption of electric service without Construction Manager's and Owner's written permission.

3.2 PREPARATION

A. Proof conduits prior to conductor installation by passing a wire brush mandrel and then a rubber duct swab through the conduit. Separate the wire brush and the rubber swab by 48 to 72 inches on the pull rope.
   1. Wire Brush Mandrel: Consists of a length of brush approximately the size of the conduit inner diameter with stiff steel bristles and an eye on each end for attaching the pull ropes. If an obstruction is felt, pull the brush back and forth repeatedly to break up the obstruction.
   2. Rubber Duct Swab: Consists of a series of rubber discs approximately the size of the conduit inner diameter on a length of steel cable with an eye on each end for attaching the pull ropes. Pull the rubber duct swab through the duct to extract loose debris from the duct.

3.3 INSTALLATION

A. Install cable and accessories in accordance with manufacturer’s instructions and IEEE 576.

B. Avoid abrasion and other damage to cables during installation.

C. Pull Conductors:
   1. Where necessary, use manufacturer-approved pulling compound or lubricant that does not deteriorate conductor or insulation.
   2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips, that do not damage cables and raceways. Do not use rope hitches for pulling attachment to cable.
   3. Use pull-in guides, cable feeders, and draw-in protectors as required to protect cables during installation.
   4. Do not pull cables with ends unsealed. Seal cable ends with rubber tape.

D. Install sufficient cable length to remove cable ends under pulling grips. Remove length of conductor damaged during pulling.

E. Ground cable shield at each termination and splice. Conductor shield continuity must be maintained at all splices.

F. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

G. Support cables according to Section 260529 "Supports and Hangers for Electrical Systems."

H. Install cables in manholes such that cables loop around the complete the interior of the manholes and have sufficient slack for addition of minimum one set of T-bolt splices. Attach all cables to vertical cable racks installed in all manholes. Coordinate exact attachment requirements with Owner prior to rough-in.

I. All cable taps shall be made with tap conductors of equal size to the circuit conductors.

J. Arrange cable in manholes to avoid interference with duct entrances and future splicing.

K. Fireproof cables in manholes using fireproofing tape in half-lapped wrapping. Extend fireproofing one inch into duct.

L. Spiral wrap fireproofing tape with glass tape 3M number 27 or equal.

M. Seal around cables passing through fire-rated elements according to Section 078413 "Penetration Firestopping."

N. Arc Proofing: Unless otherwise indicated, arc proof medium-voltage cable at locations not protected by conduit, cable tray, direct burial, or termination materials. In addition to arc-proofing tape manufacturer's written instructions, apply arc proofing as follows:
   1. Clean cable sheath.
   2. Wrap metallic cable components with 10-mil pipe-wrapping tape.
   3. Smooth surface contours with electrical insulation putty.
   4. Apply arc-proofing tape in one half-lapped layer with coated side toward cable.

5. Band arc-proofing tape with two layers of 1-inch- wide half-lapped, adhesive, glass-cloth tape at each end of the arc-proof tape.

O. Keep splices to a minimum. Pull cable in directions indicated by the pull-tension study from central manhole wherever possible.

P. Install cable splices at pull points and elsewhere as indicated; use standard kits. Use dead-front separable watertight connectors in manholes and other locations subject to water infiltration.

Q. All cables shall be tagged with laminated Micrata type nameplates engraved with 5/32-inch high white letters on black background, showing the size of the cable, what the cable feeds and the date it was first energized. The tags shall be attached to the cables with heavy duty nylon ties and shall be located in every pullbox, junction box, etc., and at every splice and termination. The cables shall also be phase marked “A”, “B”, and “C”.

R. Arrange identification so that it is unnecessary to move the cable or conductor to read the identification.

S. The cables shall be terminated, and spliced as shown on drawings with self-vulcanizing tapes in accordance with the printed instructions of the manufacturer of the cable supplied. All self-vulcanizing tapes used to provide the cable insulation shall have an EPR base. All cable splices shall be 15kV, 133% rated. Cable splices shall be constructed per IEEE #404 1986 standard.

T. Single conductor cables in gutters or wireways, or racks in vaults, shall have the three conductors or each circuit bound together with plastic cable ties at points not over three feet apart.

U. Stress cones shall be made on all cable splices and terminations, and shall be made in accordance with the printed recommendations of the cable manufacturer.

V. The conductor shields shall be grounded at each termination of the cable run, and on both sides of all splices, using a stranded, #6 bare copper wire to the nearest grounding electrode system. Conductor shield continuity must be maintained at all splices. The ground wire shall be protected from mechanical injury by enclosing it in a metal protective covering or by placing it where it will not be subject to damage.

W. Provide one #4/0 bare copper ground conductor in each conduit with phase conductors.

PART 4 - TESTING

4.1 FIELD TESTS

A. Perform tests and inspections as stipulated in Section 260400 “Acceptance Testing”.

B. Testing of cables shall be performed by an independent testing agency at the Contractor’s expense. The testing agency shall have a minimum of 5 years experience. Each person engaged in the testing procedures shall also meet the experience requirements. Provide to Owner’s Representative, documentation,

including references, of the testing agency's, and agency's personnel experience for approval.

C. Perform DC high potential test of each conductor in accordance with NEMA WC 74.

D. Connect untested conductors in circuit to ground during test.

E. Apply test voltage in at least eight equal increments to maximum test voltage.

F. Record leakage current at each increment, allowing for charging current decay.

G. Hold maximum test voltage for fifteen minutes. Record current at 30 seconds and every 60 seconds thereafter. Plot results on X-Y axis.

H. Each insulated conductor provided under this section of the specification shall be tested in accordance with Section E of AEIC CS6.

4.2 PROTECTION

A. Protect installed cables from entrance of moisture. Provide heat shrink caps per Cable Manufacturer's recommendations for cables to be energized at a later date.

END OF SECTION