PART 1: GENERAL

1.01 REFERENCES

A. ICEA S-68-516/NEMA WC-8 Ethylene-Propylene Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

B. AEIC CS-6 Specifications for Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 through 69KV.

C. UL 1072 Medium-Voltage Power Cables.

D. IEEE 48 Standard Test Procedures and Requirements for High-Voltage Alternating-Current Cable Termination.

1.02 SUBMITTALS

A. Submittals Package: Submit the data specified below for preliminary approval at the same time as a package. After preliminary approval, submit the data and samples specified below for final approval at the same time as a package.

B. Submit the following for preliminary approval:

1. Complete manufacturer’s construction details and specifications for the cables, including physical and electrical characteristics of insulation, shields and jackets.
2. Overall dimension and ampacity of cable.
3. Splicing and termination data, including the following:
   a. List of materials.
   b. Method of connecting conductors.
   c. Details of cable preparation.
   d. Method of applying materials (including quantities and recommended tools).
   e. Precautionary measures.
   f. Drawings showing method of splicing complete with dimensions.
4. Furnish cable manufacturer’s certified copies of the AEIC qualification test for the cable being proposed.
C. **Final Approval:** After preliminary approval, submit the following for final approval:

1. Cable manufacturer’s certified test data from tests performed on the completed cable.
   a. For ethylene-propylene rubber insulated cable, furnish cable manufacturer’s certified copies of AEIC electrical tests required for completed cables (ac and dc voltage withstand, partial discharge, jacket spark test, and insulation resistance). Plot results of partial discharge test (apparent discharge characteristics and partial discharge extinction voltage) on an x-y recording.

2. Two foot samples of each cable, taken from reel at jobsite prior to installation. Reseal cable on reel. Include the following additional information on the sample labels:
   a. The maximum voltage at which the conductor is designed to be used.
   b. Date of manufacture.

3. Samples of splicing and termination materials if requested (complete kits will be returned and, if approved, may be used in the Work). Include:
   a. Full roll of all tapes in original box or container, with the date of manufacture indicated thereon.
   b. Other materials in sufficient quantity to construct a complete splice and labeled for identification.
   c. Entire factory packaged kit if splice or termination is of the kit type.

4. Written statement from cable manufacturer indicating recommended pulling compounds.

5. Resume of each cable splicer’s experience. Include:
   a. Details of type of high voltage splicing and terminations performed.
   b. Types of cables which were spliced.
   c. Job locations.
   d. Number of years performing splices and terminations.
   e. Certificate of training from the splice/termination manufacturer for heat-shrinkable products, if used.

6. Catalog sheets, specifications and installation instructions for all products.

D. **Contract Closeout Submittals:**

1. **Test Report:** High voltage after installation test report.
1.03 QUALITY ASSURANCE

A. List of Completed Installations for EPR Insulated Cables: If cable brand names other than those specified are proposed for use, furnish the name, address, and telephone number of at least five comparable installations which can prove the proposed products have operated satisfactorily for 10 years. Pay travel expenses for the Owner’s Representatives to inspect two of these installations. Include proof that the installed cables:

1. Have the same rating and construction as the proposed cable.
2. Have the same insulation compound as the proposed cable.

B. Company Field Advisor: If cable brand names other than those specified are proposed for use, secure the services of the cable manufacturer’s Company Field Advisor for a minimum of 16 working hours for the following:

1. Render advice regarding method of installing cable.
2. Inspection of equipment for installing cable.
3. Witness representative amount of cable pulling.
4. Witness construction of at least one splice and one termination by each cable splicer who will be doing the actual cable splicing.
5. Witness high voltage after installation test.
6. Certify with an affidavit that the aforementioned particulars are satisfactory and the cable is installed in accordance with cable manufacturer’s recommendations.

C. Testing Company: Secure the services of an approved testing company, such as one of those listed below, for a high voltage after installation test:

1. Advanced Testing Systems Inc., P.O. Box 27, Carmel, NY 10512, (914) 225-3110.
4. H.V.E.S. Electrical Contracting Inc., 477 75th St., Niagara Falls, NY 14304, (716) 283-3679.

D. Factory Inspection of Ethylene-Propylene Insulated Cables (for brand names other than those specified):

1. An inspector from an independent cable testing laboratory designated by the Owner shall witness AEIC electrical tests required for completed cables (AC and DC voltage withstand, partial discharge, jacket spark test, and insulation resistance).
2. Have applicable AEIC qualification tests available for use by the cable inspector to evaluate the tests being made on the completed cable.

3. Request name of independent testing laboratory at least two weeks before cable is to be tested. Arrange directly with the testing laboratory for the cable inspector’s visit to factory. Pay all expenses.

1.04 DELIVERY, STORAGE AND HANDLING

A. Cable Delivery:

1. No insulated cable over one year old when delivered to the site will be acceptable.

2. Keep ends of cables sealed at all times, except when making splices or terminations. Use heat shrinkable plastic end caps with sealant as produced by Raychem Corp., or Thomas & Betts Corp., or other methods approved by cable manufacturer.

3. Include the following data durably marked on each reel:

   a. Contractor’s name.
   b. Project title and number.
   c. Date of manufacturer.
   d. Cable size and voltage rating.
   e. Manufacturer’s name.
   f. Linear feet of cable.
   g. Location where cable is to be installed. Example: between manholes #E-101 and E-102.

B. Cable Storage: Store where cable will be at optimum workability temperature recommended by cable manufacturer.

1.05 MAINTENANCE

A. Special Tools: Furnish one set of special tools for the assembly of premolded splices (if used). Store them at the site where directed.

PART 2 PRODUCTS

2.01 CABLES

A. Conductors: Annealed uncoated copper or annealed coated copper in conformance with the applicable standards for the type of insulation on the conductor.

B. 15kV Cable Ratings:

1. Compact stranded.

2. 133% (220mils) ethylene-propylene rubber insulation meeting electrical and physical requirements of ICEA S-68-516, AEIC CS6, and UL 1072.
3. Shield: 5 mil bare copper tape helically applied with 25% nominal overlap.
4. Jacket: PVC, UL listed as type MV-105.
5. Temperature ratings: 105°C continuous operating, 140°C emergency rating, 250°C short circuit rating.
6. Conductor size: #2/0 AWG.

C. 2.4kV Cable Ratings:

1. Compact stranded.
2. Ethylene-propylene rubber insulation meeting electrical and physical requirements of ICEA S-68-516 and UL 1072.
3. Non-shielded.
4. Jacket: PVC, UL listed as type MV-90.
5. Temperature ratings: 90°C continuous operating, 130°C emergency rating, 250°C short circuit rating.
6. Conductor size: #2 AWG.

2.02 AIR TERMINATIONS

A. Materials: All materials required for a complete termination shall be the standard product of one manufacturer, designed specifically for the type of cable and conductor to be terminated.

B. Ampere Rating: Not less than ampere rating of cable.

C. Voltage Rating: Not less than voltage rating of cable.

D. Manufacturer: Furnish terminations by one of the manufacturers listed below, if acceptable to the cable manufacturer.

1. IEEE 48 Class 1 Terminations: Elastimold’s 16THG, or 35MTG, with cable shield adapter, Kerite Co.’s Outdoor Terminal OT, Minnesota Mining & Mfg. Co.’s 3M Cold-Shrink Terminations, or Raychem Corp.’s Heat-Shrinkable High Voltage Termination System. Equip terminations with or without skirts as recommended by manufacturer.

2.03 15kV DEAD BREAK ELBOW TERMINATIONS

A. Materials: All materials required for a complete termination shall be the standard product of one manufacturer, designed specifically for the type of cable and conductor to be terminated.

B. Ampere Rating: 600 amp continuous.

C. Voltage Rating: Not less than voltage rating of cable.
D. **Manufacturer:** Elastimold. Provide a 600 Series dead-break elbow kit with insulating plug, cap, compression lug, and cable adapter per each phase.

### 2.04 SPLICES: 2.4kV AND 15kV

A. **Materials:** All materials required for a complete splice of the standard product of one manufacturer, designed specifically for the type of cable and conductor to be spliced.

B. **Ampere Rating:** Not less than ampere rating of cable.

C. **Voltage Rating:** Not less than voltage rating of cable.

D. **Splices Installed in Wet Locations (i.e. manholes):** Waterproof and submersible.

E. **Manufacturer:** Furnish splices by the manufacturers listed below, if acceptable to the cable manufacturer (field made epoxy-resin unit not acceptable):
   1. **Heat-Shrinkable Splices:** Raychem Corp.’s High Voltage Splices HVS.

### 2.05 ACCESSORIES

A. **Pulling Compounds:** As recommended by cable manufacturer.

B. **Arc Proofing Tapes:**
   1. **Arc Proofing Tape:** Mac Products Inc.'s AP30-30 or AP, Minnesota Mining & Mfg. Co.’s 3M 77, Plymouth Rubber Co.’s Plymouth Bishop 53 Plyarc, or Quelcor Inc.’s Quelpyre.
   2. **Glass Cloth Tape:** Mac Products Inc.’s TAPGLA 5066, Minnesota Mining & Mfg. Co.’s 3M 69, or Plymouth Rubber Co.’s Plymouth Bishop 77 Plyglas.
   3. **Glass-Fiber Cord:** Mac Products Inc.’s MAC 0527, or Quelcor Inc.’s QTC-250.

C. **Tags:** Precision engrave letters and numbers with uniform margins, character size minimum 3/16 inches high.
   1. **Phenolic:** Two color laminated engraver’s stock, 1/16 inch minimum thickness, machine engraved to expose inner core color (white).
   2. **Aluminum:** Standard aluminum alloy plate stock, minimum .032 inches thick, engraved areas enamel filled or background enameled with natural aluminum engraved characters.
PART 3  EXECUTION

3.01 INSTALLATION

A. Cables:
   1. Install cables in conduit after conduit system is completed.
   2. Keep ends of cables sealed watertight at all times, except when making splices or terminations.
   3. No grease, oil, lubricant other than approved pulling compound may be used to facilitate the pulling-in of cables.
   4. Use pulling eye attached to conductor(s) for pulling-in cables. Cable grip will not be allowed. Seal pulling eye attachment watertight.
   5. Pull all cables with a dynamometer or strain gage incorporated into the pulling equipment. Do not pull cables unless the Owner’s Representative is present to observe readings on the dynamometer or strain gage during the time of actual pulling. Do not exceed manufacturer’s recommended maximum strain on cable for a 3-conductor pull (3-conductor cable or 3-single conductor cables).

B. Terminations and Splices:
   1. General: Splice and terminate cable in accordance with manufacturer’s approved installation instructions, employing specific tools recommended by the manufacturer.
   2. For 15kV Insulated Cables:
      a. Use IEEE 48 Class 1 terminations to terminate cable in wet locations.
      b. Use IEEE 48 Class 1 terminations to terminate cable inside of outdoor equipment which is not equipped with space heaters (pad-mounted switches, pad-mounted transformers, etc). Class 1 terminations shall be used to terminate cable inside of outdoor switchgear cubicles which are equipped with space heaters (metal-clad switchgear, metal-enclosed interrupter switchgear, etc.).
      c. Use IEEE 48 Class 1 terminations to terminate cable in dry locations.
      d. Use dead break elbows for connecting to loop switches.
      e. Ground shield at all terminations. Grounding of the shield is not required at the splice locations. The shield must be bonded through each splice.

C. Arc Proofing: Arc proof feeders installed in a common pullbox or manhole as follows:
   1. Arc proof new feeders.
   2. Arc proof existing feeders that are spliced to new feeders.
3. Arc proof each feeder as a unit with half-lapped layer of 55 mils thick arc proofing tape, random wrapped or laced with glass cloth tape or glass-fiber cord. For arc proofing tape less than 55 mils thick add layers to equivalent of 55 mils thick arc proofing tape.

D. Identification of Feeders: Identify feeders in manholes, pullboxes, and in equipment to which they connect:

1. Install tags on each insulated conductor indicating phase leg. Attach tags with non-ferrous metal wire. Install phase leg tags under arc proofing tapes.
2. Install tags on each feeder indicating feeder number, date installed (month, year), type of cable, voltage rating, size, and manufacturer. Attach tags to feeders with non-ferrous metal wire or brass chain. Install tags so that they are easily read without moving adjacent feeders or require removal of arc proofing tapes.

E. Phase Relationship: Connect feeders to maintain phase relationship through system. Phase legs of feeders shall match bus arrangements in equipment to which the feeders are connected.

3.02 FIELD QUALITY CONTROL

A. High Voltage after Installation Acceptance Test:

1. Have the cable installation tested by a third-party testing company.
2. Perform test on new cable after it has been installed complete with splicing, bonding, etc., but prior to splicing to existing cable. Do not splice new cable to existing cable until new cable test has been completed. Do not perform test on existing cable.
3. Perform acceptance test following all National Electrical Testing Association and IEEE Standard 400 requirements and applicable test methods in ICEA and AEIC Specifications.
4. List results of the tests on form supplied by the testing company and provide three copies to the Owner’s Representative.
5. Perform test in the presence of the Owner’s Representative.
6. Test is not required for transformer vault cables.

END OF SECTION