

# Electrical - Standard Specifications

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## MV WIRE, CABLE AND TERMINATIONS

### STANDARD SPECIFICATIONS

This standard specification is intended to be integrated into the project specifications. The Consultant shall write the specifications to meet the project requirements in consultation with the Owner.

#### **PART 1 - GENERAL**

##### 1.01 DESCRIPTION

###### A. Purpose

1. This section covers medium voltage (MV) cable and terminations for use in the University's primary and secondary power distribution systems.

##### 1.02 WORK SCOPE

- A. A site walk needs to be scheduled with the Electric Utility Manager to define a project's work scope.
- B. Sections of the MV armored cable have reached the end of life and need replacement.
- C. Link boxes are being replaced with dead break elbows mounted on a junction box or cable hangers depending on safe working clearances.

##### 1.03 QUALIFICATIONS

###### A. Approved manufacturers

1. Medium voltage 5 and 15kV wire and cables
  - a. 5 and 15kV single conductor: Pirelli, Aetna, and Okonite
  - b. 5 and 15kV armored cable: Pirelli, Aetna, and Okonite
    - i. Service Wire for short lengths of interlock armored cable (< 500 feet)
  - c. All other manufacturers shall be approved during the design prior to bidding.

#### 1.04 RELATED SECTIONS

- A. The work under this section is subject to requirements of the Contract Documents, including the General Conditions, Supplemental Conditions, and sections under Division 01 General Requirements.
- B. Electrical Identification
- C. Inspection, Calibration and Testing

#### 1.05 REFERENCES

- A. Applicable codes, standards, and references codes, regulations and standards
  - 1. National Electrical Testing Association – NETA
  - 2. National Fire Protection Association – NFPA
  - 3. National Electrical Code - NEC
  - 4. AEIC CS6-96 (ethylene propylene rubber)
  - 5. ICEA S-93-639 (ethylene propylene rubber)
  - 6. IEEE STD 400-1991 (DC Testing)
  - 7. IEEE STD 48
  - 8. UL 1072 for physical requirements for the armor
  - 9. UL 1008 – Automatic Transfer Switches
  - 10. State and local codes and ordinances

#### 1.06 COORDINATION

- A. Coordinate Operations and Maintenance training times with the University.

#### 1.07 SUBMITTALS

- A. General
  - 1. Submittals shall be in accordance with Conditions of the Contract and Division 01 Specification Sections.
  - 2. Submit detailed maintenance manuals and drawings, which include catalog information indicating the complete electrical and mechanical characteristics.
  - 3. Submit current manufacturer's AEIC pre-qualification data.
  - 4. Submit dimensioned cross-sectional drawings (manufacturer's data sheets are acceptable).
  - 5. Submit finished cable tests – Manufacturer's Certified Test Reports showing compliance with ICEA S-68-516, Part 3, and UL 1072 for physical requirements of the armor and all AEIC final tests, including x-y plots of corona discharge for the actual cable furnished.
  - 6. Submit pulling calculations and plan for each medium voltage cable length.
  - 7. Submit data sheet on crimping tools to be used.
  - 8. Submit for approval the résumés of the medium voltage cable splicers. Qualifications should include certification, recent work history on similar splice type and knowledge of the "Safety Standards for Electrical Workers" (WAC 296-45).

## 1.08 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. Operations and Maintenance Manuals shall be in accordance with Conditions of the Contract and Division 01 Specification Sections.
- B. Operations and Maintenance Manuals shall include but not be limited to pull calculations and catalog information indicating complete electrical and mechanical characteristics.
- C. Manufacturer's Certified Test Reports.
- D. Manufacturer's AEIC Pre-qualification Data.

## 1.09 MEETINGS

- A. Pre-installation conference
  - 1. The Contractor shall request a pre-installation conference with the University's Engineering Services and University's Physical Plant High Voltage Shop for projects with medium and high voltage work.
- B. Attend meetings with the Owner and/or Owner's Representative as required to resolve any installation or functional problems.
- C. Within one (1) month after "Notice to Proceed," schedule a meeting with UW Representatives to review electrical identification requirements.

## **PART 2 - PRODUCTS**

### 2.01 GENERAL

- A. These cable and terminations specifications are in accord with the University's policy to construct permanent installations with long life, coupled with maximum reliability and safety. It is intended that the best available materials be used and new and better materials adopted as they become available and are approved by the University.

### 2.02 MEDIUM VOLTAGE WIRE AND CABLE

- A. The following shall apply to both 5kV and 15kV medium voltage power conductors used as single conductors or assembled into 3/c armored cable:
  - 1. Single conductors
    - a. Conductors: Class B stranded, concentric, soft or annealed copper per Part 2 of ICEA S-68-516.
    - b. Strand screen: Extruded semi-conducting thermosetting compound applied over the conductor. The material shall be compatible with the conductor metal, shall be uniformly and firmly bonded to the overlying insulation, and be free of stripping from the conductor.
    - c. Insulation: High quality heat, moisture, ozone and corona resistant Ethylene Propylene Rubber (EPR) compound

- i. The insulation shall contrast in color with the strand screen and insulation shield per AEIC CS 6.
    - ii. Insulation level shall be 133% (115 mils for 5KV, 220 mils for 15KV).
    - iii. The minimum thickness of the insulation at any point shall not be less than 90% of the specified nominal thickness.
    - iv. The insulation shall contain no more than 2% polyethylene.
  - d. Insulation shield: Extruded semi-conducting thermosetting compound applied directly over the insulation. The material shall be compatible with the insulation and overlying metallic shield. The insulation shield shall be clean and free of stripping from the insulation and comply with Paragraph D.1 of AEIC CS 6.
  - e. Manufacturing process: The strand screen, insulation, and insulation shield shall be applied with a triple-tandem process providing a virtual corona-free core. The EPR insulation system shall not be exposed to the atmosphere during manufacture.
  - f. Metallic shield and individual jacket: .005 inch thickness of copper tape helically applied over the insulation shield material with a 20% overlap, covered with an extruded PVC outer jacket meeting the requirements of ICEA S-68-516 Paragraph 4.4.10.
  - g. Identification: The following information shall be surface-printed on the overall jacket: Manufacturer's name, cable size, cable type, year of manufacture and voltage rating.
2. Armored cable
  - a. Single conductors: Per the section above. **(Note: Individual PVC jacket shall be required for each single conductor).**
  - b. Grounding conductors: Bare copper, stranded in accordance with ICEA S-68-516, Part 2. Minimum size shall be in accordance with UL 1072, Table 11A. **(Note to designer: Provide a larger size, if required, to handle calculated fault current.)**

***IMPORTANT: In the University of Washington primary distribution system the size of main primary feeders are 500 KCM. In instances where #2/0 cable is tapped from 500 KCM cable, to subfeed a facility or load, provide ground conductors in #2/0 cable equal to the ground conductor of 500KCM cable. Ground conductors shall be factory installed with the phase conductors and shall be an integral component of the cable. This is not an industry standard and shall be clearly indicated in the design documents. Supplemental grounding conductor external to the interlock armored cable is not acceptable by the AHJ.***
  - c. Filler material: Non-hygroscopic material, fine fiber, completely filling center and peripheral interstices.
  - d. Binder tape: Applied over assembly to provide a solid core.
  - e. Armor: Galvanized steel or aluminum, interlocked armor in accordance with ICEA S-68-516, Part 4 and UL 1072, Part 25.11.

- f. Overall jacket: Polyvinyl Chloride (PVC) in accordance with ICEA S-68-516 paragraph 4.4.10. Industry standard color by voltage class (15kV cable – red; 5kV cable – yellow).
  - g. Identification: The following information shall be surface printed on the overall jacket: Manufacturer's name, cable size, cable type, year of manufacture and voltage rating.
  - h. Listings: Finished cable shall be UL listed as Type MC, MV-90 and "For CT USE".
  - i. Color for outer jacket shall be consistent with industry standards.
3. Cable rejection
    - a. Cable shall be subject to inspection by the University at delivery and installation and subject to rejection for shipping and/or installation damage including, but not limited to, jacket penetration, armor denting, or other indications that cable integrity has been compromised.
    - b. Hi-pot and Megger testing will not be the sole determining factor in the Owner accepting or rejecting damaged cable.

## 2.03 SPLICES AND TERMINATIONS

### A. Medium voltage

1. Medium voltage connections and terminations (armored cable and single conductor) - Long barrel, 2-hole hydraulic crimp lugs, with Raychem "HVT" or 3M "Quick Term" series 5600 termination kits
2. Existing link box are to be replaced with MV junction boxes with deadbreak elbows. Grounding drain wires to be long enough that elbows can be removed and replaced without resplicing the connection.
3. Splices other than cold shrink are to be housed in a listed enclosure: OZ Gedney Series SPKJR, G&W #E74 or Adalet 3AS manufactured by PLM, with fittings to suit cable.

***IMPORTANT: Specifier to add Exact Requirements for Cable***

4. Fireproof any cables outside of cable tray with a non-asbestos liners.
5. Method of crimp termination for #8 awg and larger shall be performed with correctly sized hexacentric die only.
  - a. Approved manufacturers: 3M, Elastimold; all other manufacturers shall be approved prior to bidding.

## **PART 3 - EXECUTION**

### 3.01 REQUIREMENTS

#### A. General installation

1. Identification

- a. Reference section Electrical - Wire, Cable and Terminations
2. Qualification and Training
  - a. Medium voltage cable work shall be performed by qualified and experienced personnel. Cable manufacturer's representative shall provide training and shall oversee the rigging, pulling, installation, and termination of medium voltage cable.
3. Installation
  - a. The installation of cables shall be done with care to avoid damage.
    - i. Cables showing damage after installation shall be replaced.
    - ii. Rollers and spools shall be used in adequate numbers for pulling in cables.
    - iii. The tension limitations, side wall pressure, and minimum bending radius as given by the cable manufacturer shall be observed.
  - b. Cable pulling
    - i. In no case will strands be removed to attach pulling eyes.
    - ii. Tension is limited to 1000 lbs. using basket grips.
    - iii. Lubrication shall be as approved for the insulation and raceway material.
    - iv. Prior to pulling, calculations of pulling tension and side wall pressure shall be submitted.
    - v. A dynamometer shall be used and tension recorded for all MV pulls.
    - vi. Use no mechanical means for pulling #8 and smaller AWG conductors.
  - c. Cable pulling setups and operations shall be witnessed by the University Physical Plant High Voltage Shop and Engineering Services.
  - d. Interlocked armor cable shall be pulled only when both the armor and conductors are gripped. Remove cable similarly.
  - e. All cable that leaves a tray shall be taped/wrapped with Scotch 77, MAC AP30, or Quelcor "Quelpyre" fireproofing tape.
- B. Medium voltage cable terminations
  1. Phase mark each conductor, secure conductors adequately and observe cable bend radius limitations. University will identify the West Receiving Station phase rotation convention.
  2. System Phase Sequence is C-B-A.
  3. MV switch phase terminations shall be A-B-C left to right when facing the front of the switch.
  4. Junction box phase terminations are A-B-C left to right.
  5. Standard link box phase terminations are A-B-C left to right, top to bottom, front to back. Some existing link box phase terminations are not standard, especially on the 2.4kV normal and emergency power system.
  6. The Physical Plant Department High Voltage Shop will identify the phase designation of the existing primary distribution system conductors to which the Contractor is to make a connection.

- a. They will also check the Contractor's work to ensure the accuracy of the connections.
  - b. The Contractor shall arrange with the University for the times when their services will be required, and under no circumstances shall the Contractor connect to the existing system without their knowledge.
  - c. The proper connection of the wires and cables to other systems as specified is entirely the responsibility of the Contractor.
  - d. In the event the connections cannot be made as specified, the Contractor shall make the necessary corrections at his own expense.
7. Install cable terminations per manufacturer's recommendations.
  8. Medium voltage cable splices shall be made only when absolutely necessary. When necessary, splices shall be made only by personnel qualified and experienced in this type of work.
  9. Each high voltage splice or connection shall be permanently labeled with the following information:
    - a. Contract or project designation,
    - b. Contractor doing work,
    - c. Name of splicer and date.
  10. Do not score the conductor when stripping insulation and always pare or pencil when using a blade. Use of a stripping tool is preferable.
  11. All terminations shall be secure and tightened in accordance with the manufacturer's recommendations.
- C. Mounting and electrical connections
1. In accordance with manufacturer's installation instructions.
  2. Coordinate remote control and annunciation with the University representatives.
- D. Training
1. Provide operation and maintenance training for two 2-hour sessions of on-site training for a total of 6 maintenance personnel.
  2. Include troubleshooting, repair and maintenance manuals for each participant.
- E. Testing
1. Provide factory field startup and testing services to assist the ETC (Electrical Testing Contractor) per Electrical [Inspection, Calibration and Testing Standards](#).