READ THIS FIRST

Notice to the Design Engineer, please refer to the Port of Seattle, Facilities and Infrastructure standards for reference before editing this specification.

This Project Spec Document may need additional modifications to suit your project. It is recommended that you proofread each section, paying attention to any “Notes” boxes such as this one--you should remove these “Notes” sections as you go. Also, do a search for all bracket characters “ [ ] “ as they are used to show you areas containing options or project specific details (you can use Microsoft Word’s Find feature {Ctrl-F} to jump to an open bracket “ [ “ character quickly). Again, these bracket characters should be removed.

It is important that every paragraph be numbered to allow for easy referencing. If you use the document’s built in styles and formatting your outline should be fine (turn on the formatting toolbar by going to View > Toolbars > Formatting). Most paragraphs will use the style “Numbered Material” and can be promoted (Shift) or demoted (Shift-Tab).

You should not have to manually enter extra spaces, carriage returns or outline characters such as A, B, C, or 1.01, 1.02; the formatting will do this for you. The entire document is 11 pt. Arial. If you paste items in, you may need to reapply the “Numbered Material” format.

1. GENERAL
   1. SUMMARY OF WORK

Edit voltage in paragraph below to reflect Project conditions.

* + 1. The extent and location of “Medium-Voltage Cables” Work is shown in the Contract Documents. This Section includes requirements for single-conductor 5 kV and 15 kV shielded power cables suitable for use in wet or dry locations, in conduit, cable tray and underground ducts.

Include the following paragraph for all Work to be conducted at Sea-Tac Airport.

* + 1. All or a portion of the work covered by this Section is to be conducted within the Air Operations Area (AOA) at Sea-Tac International Airport. Restrictions and conditions necessary to maintain airfield and aircraft safety as required by FAA regulations, and as required to maintain efficient airport operations, may impose limitations upon the Contractor’s methods and procedures. Section 01 35 13.13 - Operational Safety On Airports During Construction lists the applicable conditions, limitations and regulations.
    2. It is desirable to provide a service loop of MV cable in all vaults and manholes to provide slack cable in the event of future splices. However, some manholes and vaults have space restrictions that prevent the ability to provide a full 360 degree loop. The designer should evaluate the space in each vault or manhole during design and include a service loop in the design in all vaults and manholes where possible.
  1. GOVERNING CODES, STANDARDS AND REFERENCES
     1. ANSI/IEEE C2 National Electrical Safety Code
     2. ASTM (American Society for Testing and Materials) - for components and installation
     3. AEIC (Association of Edison Illuminating Companies) - for components and installation
     4. IEEE 48 - Test Procedures and Requirements for High-Voltage Alternating-Current Cable Terminations.
     5. ANSI/NEMA WC 70 (National Electrical Manufactures Association) – Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy
     6. ANSI/NEMA WC 74 (National Electrical Manufactures Association) – 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy
     7. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association)
     8. NFPA 70 (National Fire Protection Association) - National Electrical Code
  2. SUBMITTALS
     1. Submit materials data in accordance with of Section 01 33 00 - Submittals. Furnish manufacturers’ technical literature, standard details, product specifications, and installation instructions for all products.
     2. Submittals shall include the following:
        1. Product data for cables and cable accessories, including splices and terminations.
        2. Qualifications of Splicer.
           1. Qualified by Elastimold, 3M or Cooper Medium Voltage.
        3. Electrical Contractor Experience.
           1. Provide a list of personnel names including certifications, significant projects they have worked in the past three years, and listing the approximately number and type of termination and connector installations they performed or assisted.
        4. Diagram of set-up area and submittal of pulling product and installation data including, but not limited to:
           1. Shims
           2. Pulleys
           3. Crimping tools
           4. Calibration reports
           5. Take-up reels
           6. Traffic clearance
           7. Dynamometer calculations
           8. Lubricant – type and quantity
           9. Clean-up Plan

Edit voltage in paragraph below to reflect Project conditions.

* + - 1. Submit switchover and outage plan.
         1. Ductwork and cable must be installed before switch to new cable. Outage for switchover must be kept to a minimum (4 hour outage is the minimum that STIA has experienced for cable cutover).
      2. Schedule of inspection during Work, witnessed by POS electrical shop. Items inspected include the following:
         1. Die crimp to connector
         2. Megger Readings
         3. Dynamometer Red Line before reset.
      3. Product certificate signed by Manufacturer that its products comply with the specified requirements.
      4. Qualification data for firms and persons specified in “Quality Assurance” Article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Engineers and Owners, and other information specified.
      5. Product Test Reports: Certified reports of Manufacturers’ design and production tests indicating compliance of cable and accessories with referenced standards. Cables with the manufacturing date exceeding 12 months prior to the date of delivery to the Project site will not be accepted.
      6. Schedule of cable pulls showing calculated pulling tension and sidewall pressure values.
      7. Field test reports indicating and interpreting test results relative to compliance with performance requirements specified. Include certified copies of field test records.
      8. Operations and Maintainence Data: shall comply with requirements specified in Division 1.
  1. QUALITY ASSURANCE
     1. Single-Source Responsibility: All medium-voltage cable and accessories shall be the product of a single manufacturer.
     2. Manufacturer Qualifications: Firm with 10 years experience in manufacturing medium-voltage cable [with triple extrusion EPR insulation] and accessories similar to those indicated for this Project, with a record of successful in-service performance and having ISO-9000 approval certification.
     3. Manufacturer Warranty: Provide 40-year design service life statement.
     4. Listing and Labeling: Provide medium-voltage cable and accessories that are Listed and Labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the Authority Having Jurisdiction, and marked for intended use for the location and environment in which they are installed.
        1. Cable shall comply with UL Standard 1072 for Type MV-105.
     5. Comply with the following standards:
        1. NFPA 70, as adopted and administered by the Authority Having Jurisdiction.
        2. ANSI C2 “National Electrical Safety Code” for components and installation.
        3. Insulated Cable Engineers Association (ICEA) for components and installation.
        4. Association of Edison Illuminating Companies (AEIC) for components and installation.
        5. ASTM for components and installation.
     6. Installer: Engage an experienced and certified cable splicer to install terminations and connectors for medium voltage cable. Provide a list of personnel names including certifications. Significant projects they have worked in the past three years, and listing the approximate number and type of termination and connector installations they performed or assisted.
        1. Cable splicer shall have manufacturer’s certification on specific cables used on project and shall have Puget Sound Electrical Joint Apprenticeship and Training Committee (PSE JATC) medium voltage cable splicing certification.
     7. Pulling Crew: Engage an experienced cable pulling crew to install medium voltage cable.
        1. Provide a list of personnel names and roles including significant projects they have worked in the past three years and listing the approximate number of pulls along with cable type and size and conduit size and length they have worked on.
     8. Testing Agency Qualifications: Member Company of NETA (National Electrical Testing Association) or an NRTL (Nationally Recognized Testing Laboratory).
        1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
     9. Identification: Cable shall be new and of recent manufacture (no more than 12 months old) and shall have label showing the name of cable manufacturer, size, plant location, insulation type, insulation thickness, voltage rating, insulation level, [sequential footage,] year of manufacture and UL designations.
     10. In additional to the requirement of Section 26 05 13 - 1.03.B.2, qualified splicer/terminator shall meet the following:
         1. Cable splicer shall have manufacturer’s certification on specific cables used on project and shall have Puget Sound Electrical Joint Apprenticeship and Training Committee (PSE JATC) medium voltage cable splicing certification.
         2. All medium voltage splicing and terminations shall be performed by certified medium voltage splicer who has completed a two year certification course with the following curriculum.
            1. Proper use of tools and materials.
            2. Cable preparation.
            3. 5 and 15kV straight splice.
            4. 5 and 15V terminations.
            5. Stress relief theory and practice.
            6. Heat shrink terminations and splices.
            7. Molded rubber splice.
            8. Modular splicing systems.
         3. Along with terminations with individual should be schooled in:
            1. Electrical safety and effects of electrical shock.
            2. Basis use of meters.
            3. High voltage testing.
            4. Insulation testing.
            5. Acceptance and maintenance.
            6. Dielectric and IR testing.
            7. Protective grounding.
  2. DELIVERY, STORAGE, AND HANDLING
     1. Deliver medium-voltage cable on factory reels conforming to NEMA WC 26.
     2. Store cables on reels on elevated platforms in a dry location.
     3. Provide [end-caps] [and/or end-seals] for all cable ends.
  3. SOURCE QUALITY CONTROL
     1. Test and inspect cables according to NEMA WC 74 (ICEA S-93-639-2012) before shipping.

1. PRODUCTS

A. If only one product is acceptable (single or sole source product), obtain an approved Competition Waiver and submit to the CPO Construction, Contract Administrator. The language shall read as: “Manufacturer Name, Product # XXXXX, No Equal.” Refer to CPO-6 Competition Waiver Policy for more information.

B. If a Competition Waiver is not approved or more than one product is acceptable, this section must list a minimum of 2 products plus the language “Or Approved Equal,” along with salient characteristics. Refer to CPO Construction’s Salient Characteristics Guidelines for more information.

* 1. MANUFACTURERS
     1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        1. Cables:
           1. The Okonite Co.
           2. General Cable.
           3. Kerite.
           4. Or Approved Equal.
        2. Cable Splicing and Terminating Products and Accessories:
           1. Elastimold.
           2. 3M Company; Electrical Products Division.
           3. Cooper Power Systems.
           4. Or Approved Equal.
     2. Source Limitations:
        1. Cables: All cables in single run shall be from the same manufacturer.
        2. Terminations and Accessories: Each type of cable termination or accessory product shall be of a single manufacturer.
  2. CABLES
     1. Type: MV-105 (UL Standard 1072).
     2. Conductor: Copper single-conductor.
     3. Conductor Stranding: Compact Class B conductor stranding.

Both insulation standards below specify materials and ratings applicable to Port Projects.

* + 1. Insulation: Ethylene-propylene rubber (EPR) conforming to AEIC CS8. Manufacturer to specify maximum percent by weight of ethylene in the elastomer. Insulation compound shall not contain any polyethylene EPR semi-conducting insulation screen
    2. Insulation: Ethylene propylene rubber (EPR) conforming to NEMA WC 74 (ICEA S-93-639-2012).

Select 1 of 2 voltage ratings below. These are cable voltage ratings, not system voltages.

* + - 1. Voltage Rating: 5 kV.
      2. Voltage Rating: 15 kV.
      3. Insulation Thickness: 133 percent insulation level with thickness per manufacturer’s standard.

Note to Design Engineer: Selected 25% overlap in paragraph below eliminates Okonite. Facilities and Infrastructure specifies minimum 25% overlap.

* + 1. Shielding: 5-mil uncoated copper tape, helically applied over semiconducting insulation shield with minimum [25%] overlap.
    2. Cable Jacket: Chlorinated Polyethylene (CPE).
    3. Cable Pulling Eyes: on 15 kV pulls greater than 250 linear feet. Factory installed, one per phase.
    4. End Seals: Factory sealed ends.
    5. Lengths: add a minimum of 5% to True Tape measurements when ordering cable.

Armored cable is not allowed without Facilities and Infrastructure approval.

* 1. SPLICE KITS
     1. Connectors: IEEE 404, compression type, as recommended by cable or splicing kit manufacturer for application.
     2. Splicing Products: As recommended in writing by the splicing kit manufacturer for the specific sizes, ratings, and configurations of cable conductors and splices specified. Include all components required for complete splice, with detailed instructions.

Delete subparagraphs below to suit Project. (Non-separable splices shall not be used – Facilities and Infrastructure)

* + - 1. Taped splice kit.
      2. Combination tape and cold-shrink rubber sleeve kit with rejacketing by cast-epoxy-resin encasement or other waterproof, abrasion-resistant material.
      3. Heat-shrink splicing kit of uniform cross-section polymeric construction with outer heat-shrink jacket.
      4. Premolded, cold-shrink rubber, inline splicing kit.
      5. Premolded ethylene propylene diene monomer (EPDM) splicing body kit with cable joint sealed by interference fit of mating parts and cable.
      6. Separable multiway splice system with all components for the required splice configuration.
      7. Non-separable splices shall not be used.
  1. SOLID TERMINATIONS
     1. Conductor Terminations: Comply with IEEE 48, as indicated. Insulation class equivalent to that of the cable. Terminations for shielded cables shall include a shield grounding strap.

Select from 5 subparagraphs below or revise to suit project. (Must be Furnished as a kit with shield ground strap and compression type connector – Facilities and Infrastructure))

* + - 1. Class 1 Termination for Shielded Cable: Modular type, furnished as a kit, with stress-relief tube, multiple molded silicone rubber insulator modules, shield ground strap, and compression-type connector.
      2. Class 1 Termination for Shielded Cable: Heat-shrinkable type with heat-shrinkable inner stress control and outer nontracking tubes, multiple molded nontracking skirt modules, and compression-type connector.

Subparagraph below is for indoor Class 1 terminations.

* + - 1. Class 1 Termination for Indoor Shielded Cable: Kit with stress-relief tube, nontracking insulator tube, shield ground strap, compression-type connector, and end seal.

Subparagraph below is for indoor Class 2 terminations.

* + - 1. Class 2 Termination for Shielded Cable: Kit with stress-relief tube, nontracking insulator tube, shield ground strap, and compression-type connector. Include silicone rubber tape, cold-shrink rubber sleeve, or heat-shrink plastic sleeve moisture seal for end of insulation whether or not supplied with kits.
      2. Class 3 Termination for Shielded Cable: Kit with stress cone and compression-type connector.
  1. SEPARABLE INSULATED CONNECTORS

Edit paragraph below to ensure that elbow-type terminations at equipment (such as substations, transformers, switchgear, and pad-mounted switches) mate with bushing terminals in the equipment.

* + 1. Separable Insulated Connectors: Modular system complying with IEEE 386. Disconnecting, single-pole, cable terminators and matching stationary, plug-in, dead-front terminals designed for cable voltage and for sealing against moisture. All mating parts shall be compatible products of the same manufacturer. Conductor materials shall be copper alloy.

Delete paragraph below except where terminations take the place of splices at cable junctions, such as in manholes and cable vaults.

* + - 1. Terminations at Distribution Points: Modular type, consisting of terminators installed on cables and modular, dead-front, terminal junctions for interconnecting cables.

Delete paragraphs below where not required. Delete test point feature for load-break unit where not required.

* + - 1. Load-Break Cable Terminators: Elbow-type units with 200 ampere load make/break and continuous current rating. Coordinate with insulation diameter and conductor size and material of cable being terminated. Include capacitively coupled test point on terminator body.
      2. Dead-Break Cable Terminators: Elbow-type unit with 600 ampere continuous current rating, designed for de-energized disconnecting and connecting. Coordinate with insulation diameter and conductor size and material of cable being terminated. Include capacitively coupled test point on terminator body.
      3. Dead-Front Terminal Junctions: Modular bracket-mounted groups of dead-front stationary terminals that mate and match with above cable terminators. Two-, three-, or four-terminal units as indicated, with fully rated, insulated, watertight conductor connection between terminals. Grounding lug and manufacturer’s standard accessory stands and stainless steel mounting brackets and attaching hardware.
      4. Straight Plug Cable Terminators: In-line type units with 200 and 600 ampere continuous current rating. Dead-break, fully shielded, fully submersible. Pre-molded Ethylene Propylene Diene Monomer (EPDM) splicing body kit with cable joint sealed by interference fit of mating parts and cable.

Delete drain wire below where not desired.

* + - 1. Protective Cap: Insulating, electrostatic-shielding, water-sealing cap with drain wire.
      2. Portable Feed-Through Accessory: Two-terminal dead-front junction arranged for removable mounting on accessory stand of stationary terminal junction.
      3. Grounding Kit: Jumpered elbows, portable feed-through accessory units, protective caps, test rods suitable for concurrently grounding three phases of feeders, and carrying case.
      4. Standoff Insulator: Portable, single dead-front terminal for removable mounting on accessory stand of stationary terminal junction. Insulators suitable for fully insulated isolation of energized cable elbow terminator.

Engineer to add additional approved manufacturer/product number for straight plug cable terminators. A minimum of two items is required otherwise a competition waiver is required.

* + - 1. Straight Plug Cable Terminators: In-line type units with 200 and 600 ampere continuous current rating. Dead-break, fully shielded, fully submersible. Pre-molded ethylene propylene diene monomer (EPDM) splicing body kit with cable joint sealed by interference fit of mating parts and cable. Acceptable model Elastimold 151SP and K656, [ ], Or Approved Equal.

Delete paragraph below where fault indicators are not to be used.

* + - 1. Test Point Fault Indicators: Arranged for installation in test points of load-break separable connectors. Self-resetting indicators capable of being installed with a shotgun hot stick and tested with a test tool. Current trip ratings as indicated.
      2. Tool Set: Shotgun-type hot stick with energized terminal indicator, fault indicator test tool, and carrying case.
  1. ARC-PROOFING MATERIALS

Delete this article where cables are not arc-proofed.

* + 1. Tape for First Course on Metal Objects: 10-mil thick, corrosion-protective, moisture-resistant PVC pipe-wrapping tape.
    2. Arc-Proofing Tape: NRTL-listed fireproofing tape, flexible, conformable, intumescent to 0.3 inch thick, and compatible with the cable jacket on which used. 3M Skotch No. 77, Plymouth 53 Plyarc, Or Approved Equal.
    3. Glass Cloth Tape: Pressure-sensitive adhesive type, 1/2 inch wide.
  1. FAULT INDICATORS

Use only where required and coordinate paragraph below with drawings

* + 1. Fault Indicator
       1. Instrument shall be submersible, self calibrating, made of U.V. stabilized materials, have stainless steel hardware, large remote indicator and auxiliary contact.
       2. Temperature rating shall be -40 degrees C to +85 degrees C.
       3. Indicators shall have auxiliary contacts for remote monitoring and resetting upon current sensing.

Engineer to add additional approved manufacturer/product number for fault indicators. A minimum of two items is required otherwise a competition waiver is required.

* + - 1. Indicator shall be E.O. Schweitzer LINAM 1CRI, [ ], Or Approved Equal.
    1. Indicators: Manual-reset fault indicator, arranged to clamp to cable sheath and provide a display after the cable has faulted.
       1. Instrument immune to heat, moisture, and corrosive conditions and recommended by the manufacturer for the installation conditions.
       2. Indicators have current trip ratings and quantities as indicated.
       3. Indicators shall have spare contacts for remote monitoring.
    2. Resetting Tool: Designed for use with fault indicators, with moisture-resistant carrying case.
  1. HEAT SHRINK PRODUCTS
     1. Furnish heat shrink insulation that meets all manufacturer-published material properties in accordance with applicable ANSI, ASTM and IEEE testing methods.
     2. Sealing End Caps: Raychem Type HVES-1520D, 3M ICEC, Or Approved Equal, sized for the cable furnished.

Engineer to add additional approved manufacturer/product number for Heat Shrink Insulation. A minimum of two items is required otherwise a competition waiver is required.

* + 1. Heat Shrink Insulation: Raychem HVIS sheet insulation, BPTM or BBIT tubing or HVBT tape, [ ], Or Approved Equal, sized appropriately for the insulation of bus bars and attachments.

Engineer to add additional approved manufacturer/product number for Heat Shrink termination seals. A minimum of two items is required otherwise a competition waiver is required.

* + 1. Heat Shrink termination seals: Raychem HVBC kit, [ ] Or Approved Equal, sized for the termination.
  1. FIRE PROOFING PRODUCTS

Engineer to add additional approved manufacturer/product number for fire proofing products. A minimum of two items is required otherwise a competition waiver is required.

* + 1. Furnish 3M fire proofing wrap E-5A-4 mat, [ ], Or Approved Equal.
  1. MEDIUM-VOLTAGE TAPES
     1. Linerless Rubber Splicing Tape. 3M Scotch 130C. Size per application requirements.
     2. Silicone rubber-based, Scotch 70 self-fusing electrical tape.
     3. Insulating-putty, 3M Scotchfil electrical insulation putty.
  2. PHASE TAPE
     1. Premium grade, 7 mil, flame retardant, cold and weather resistant, ¾ inch minimum width. Meets requirements of UL 510. Recommended for use on PVC jacketed cable.
  3. SOURCE QUALITY CONTROL
     1. Test and inspect cables according to ICEA S-93-639 before shipping.
     2. New Medium Voltage cables will have documentation of VLF and Insulation Resistance testing performed at the factory. Documentation will be delivered to the Port Construction Manager for review and acceptance prior to shipment to the Port.

1. EXECUTION
   1. INSTALLATION
      1. Cables - General
         1. Upon arrival at the Port facility, perform Insulation Resistance Testing on new medium voltage cable while cable is still on the reel.
         2. Verify protocols for shipping and handling of cables were performed. This includes end caps on cables, cable reels stored vertically, no sudden drops or laydowns of cable reels, or other careless handling that could result in damage to cable.
         3. Engage an experienced cable pulling crew to install medium voltage cable.
         4. Install medium-voltage cable as indicated, according to manufacturer’s written instructions and IEEE 576. Observe minimum bending radius of cable.
         5. Proof conduits prior to conductor installation by passing a wire brush mandrel and then a rubber duct swab, separated by 48 to 72 inches on the pull rope, through the conduit.
         6. Perform True-Tape measurement for all installation in concealed and underground conduit. Note distance to elbows and bends as perceived by pulling Resistance.
         7. Perform cable pull tension and side-wall calculations using true-tape measurement results from the Engineer of Record.
            1. For cable pull calculations, us a nominal coefficient of friction (COF) value of 0.5. If a lower COF number is used, provide documentation justifying the lower number.
            2. Include in pulling calculations any bends that the cable must traverse at the pulling location. Bends at the supply end do not normally need to be included in the calculations if the rotation of the cable reels will be assisted to relieve tension.
            3. Submit to the Port a schedule of cable pulls showing calculated pulling tension and sidewall pressure valves. Do not exceed manufacturer’s recommended maximum pulling tensions and sidewall pressure values.
            4. Provide to the Port a summary of pulling calculations including maximum pulling tension that can be used without exceeding cable manufacturer’s tension or sidewall pressure ratings.
            5. Provide to the Port a jamming ration calculation for each combination of cable and conduit size in the project. Indicate compensatory action taken for all results between 2.5 and 3.0.
            6. Pulling calculation and summary sheet shall be present at the time of installation, and shall be made available to the observer.
         8. Pull conductors simultaneously where more than one cable is indicated in same raceway. Do not exceed manufacturer’s recommended maximum pulling tensions and sidewall pressure values.
            1. Where necessary use NRTL-listed and manufacturer-approved pulling compound or lubricant that does not deteriorate conductor or insulation.

Pre lubricate conduit using front-end packs or other means.

Lubricate the cable throughout the pull using, as a minimum, the amount of lubricant recommended by the lubricant manufacturer.

Where cable pull route passes through accessible enclosures, set up additional lubrication stations if calculations have shown a high pull tension (or near maximum sidewall pressure).

* + - * 1. Use pulling means that will not damage cables such as fish tape, cable, rope, and basket-weave/cable grips. Pulling eyes attached to conductors are recommended as they have higher allowed pulling tension then basket-weave/cable grips.
        2. Use pulleys, sheaves, low-stretch rope and pulling equipment intended for medium voltage cable installation. Ensure bend radius limit of cable is not exceeded.
        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.
        5. Routing cable up through manholes and then back in intermediate manholes (looping) in order to obtain slack shall not be permitted.
      1. Train cables around walls of manholes, cable vaults, handholes, pull boxes and junction boxes by the longest route from entry to exit and support cables at intervals adequate to prevent sag. In existing manholes, handholes and vaults with metal racks, install cables on insulated porcelain saddles with no direct contact to metal racks. Metal racks are not allowed in new manholes handholes, vaults and pullboxes.
         1. Arrange cables in manholes to avoid interference with duct entrances.
      2. Ground shields and metal bodies of shielded cable at terminations, splices and separable connectors.
      3. Install exposed cables parallel and perpendicular to sides of exposed structural members.
      4. Install direct-buried cables on leveled and tamped bed of 3-inch-thick, clean sand. Separate cables crossing other cables or piping by a minimum of 2 inches of tamped earth, plus an additional 2 inches of sand. Install permanent markers at ends of cable runs, changes in direction, and buried splices.
      5. Add 1-hour fire protection wrap to emergency cables in manholes also occupied by non-emergency cables.
      6. Install sufficient cable length to remove cable ends under pulling grips. Remove length of conductor damaged during pulling.
      7. Provide fault indicators on every dead-break and load-break separable insulated connector. Fault indicators shall be equipped with dry contacts for remote monitoring on each phase.
      8. Install ‘BURIED CABLE’ warning tape 12 inches above cables.
      9. Megger all cables.
    1. Cable Terminations and Splices
       1. Port electrical inspector will witness the first five terminations of each size and type on the project, or 10% of the project total, whichever is greater. A copy of the Inspection Instruction and Acceptance Criteria form, used by the Port for their inspections, is attached to this specification. After the first termination of each size and type has been inspected the contractor shall not perform any further terminations until written approval has been given by the Port.

Modify below where separable insulated connectors are used.

* + - 1. Install terminations with standard kits.
      2. Install splices at pull points and in manholes through which the cable passes using a standard kit. Use dead-front separable watertight connectors in manholes and other locations subject to water infiltration. Conform to kit manufacturer’s written instructions.
      3. Install terminations at ends of conductors. Conform to manufacturer’s written instructions. Comply with classes of terminations indicated.
      4. Quantities: Provide the following quantities of components:
         1. Protective Cap: Install at each terminal junction, one on each terminal to which no feeder is indicated to be connected.
         2. Portable Feed-Through Accessory: 3.
         3. Standoff Insulator: 3.

Delete items below if not required for Project. Delete paragraph below where cables are not to be arc-proofed.

* + 1. Arc-Proofing: Arc-proof medium-voltage cable at locations not protected by conduit, cable tray, direct burial, or termination materials except where indicated. Apply as follows and as recommended by the manufacturer of the arc-proofing tape.
       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 the coated side toward the cable.
       5. Band the arc-proofing tape with 1-inch-wide bands of half-lapped adhesive glass-cloth tape 2 inches on center.
    2. Fault Indicators: Install fault indicators on each phase where indicated.
    3. Seal around cables passing through fire-rated elements according to Section 07 84 00 – Firestopping. Fire-Proofing: Fire proof emergency medium voltage cables in addition to arc-proofing at location not protected by conduit and requiring a 1 hour separation of normal and emergency circuits.
       1. Wrap 3 phase conductors and ground with 3 layers of fire proofing material.
  1. GROUNDING
     1. Ground equipment in accordance with Section 26 05 26 - Grounding.
     2. Ground shields of shielded cable at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated connector fittings, and hardware according to Manufacturer’s written instructions.
  2. IDENTIFICATION
     1. Identify medium-voltage cables in accordance with Section 26 05 53 - Electrical Identification.
     2. Label cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and at all terminations. Include operating voltage, circuit number and phase designation.
     3. Cable Tags
        1. Cable tags shall display a unique cable number for each phase of each section of cable. See the contract drawings for Cable Tag numbers.
        2. Cable tags shall be located at points of termination, and at least once in each accessible enclosure, i.e. manhole.
        3. Cable tags for each feeder shall be located adjacent to each other.
     4. Circuit Tags:
        1. Circuit tags shall display the feeder number, ex. “FDR 207”.
        2. Circuit tags shall be located at points of termination, on either side of each splice, at the entry/exit of each manhole, and at least once in other accessible enclosures.
        3. Unless otherwise indicated on the drawings, one circuit tag shall be installed for each feeder bundle where feasible. Alternatively, each feeder cable may have a circuit tag installed.
     5. Tap/Load Tags:
        1. Tap/ Load tags shall be used in lieu of circuit tags on all taps from switches. See the drawing set for tap/load tag designations.
     6. Phase Tape:
        1. Apply phase tape to exposed medium-voltage cable at each penetration of each manhole, vault, electrical room, or other enclosure. For utility tunnels and other situations with long runs of exposed medium-voltage cables, apply phase tape no farther than every 30 feet of cable length. Apply phase tape at each medium- voltage cable termination and splice. Helically wrap phase tape with 25% overlap for a length of 12 inches. Phase tape shall be applied over any arc-proofing tape, but not over identification labels.
  3. CONDUCTOR COLOR CODING
     1. A. Comply with the phase color standard in Section 26 05 53 – Electrical Identification.
  4. FIELD QUALITY CONTROL
     1. Coordinate installation and final testing with the Engineer. Notify the Engineer at least 48 hours in advance of testing. Provide the Engineer the opportunity to witness any and all tests. Submit test results to the Engineer within 36 hours of the test.
     2. Testing Agency: Engage a qualified testing agency to perform tests and inspections. Test and inspections shall be performed for all shielded medium voltage cable installed or modified by this project.
     3. Perform the following tests and inspections:
        1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS 7.3.3. Certify compliance with test parameters.
        2. After installing medium-voltage cables and before electrical circuitry has been energized, test for compliance with requirements.
        3. Perform visual and mechanical inspection in accordance with NETA ATS 7.3.3.A and at each end of cable and at any exposed transitional area.
        4. Perform VLF Withstand and VLF Tan-Delta test of each new conductor according to NETA ATS, Ch. 7.3.3. Do not exceed cable manufacturer's recommended maximum test voltage.
           1. VLF test shall be performed per IEEE 400.2.
        5. Perform electrical tests per NETA 7.3.3.B and the following:
           1. For all tests where voltage is applied, after the test set is removed, attach a shorting or drain device for the same duration that the voltage was applied in order to bleed off charge.
        6. Perform a Shield Continuity Test, NETA ATS 7.3.3.B on each power cable.
           1. Jumper the conductor to the shield drawing at the far end of the cable.
           2. At the near end, measure the resistance of the shield drain to the conductor.
           3. Deduct the conductor direct current resistance per NEC Table 8 if desired.
           4. Shielding shall exhibit continuity of less than 10 ohms per 1000 feet of cable.
           5. At the far end, remove the conductor to shield drain jumper.
        7. Where applicable, perform a Bolted Resistance Test on each power cable per NETA ATS 7.3.3.
        8. Perform Partial Discharge test of each new conductor according to NETA ATS, Ch. 7.3.3 and to test equipment manufacturer's recommendations.
        9. Perform Dissipation Factor test of each new conductor according to NETA ATS, Ch. 7.3.3 and to test equipment manufacturer's recommendations.
        10. Tests shall be performed on terminated, unlanded cables only.
        11. Each end of the cable to be tested shall have had the solid termination, separable connector, or designed fitting permanently installed.
        12. Neither end of the cable to be tested shall be connected to any equipment except as required for performing the test.
            1. For cables having terminations with built-in surge protection devices or similar, the protective devices shall be removed during testing to prevent damage.
            2. Placing a plastic bag over a cable termination during testing to reduce corona is a standard testing practice.
        13. Thermographic surveys of bolted connections are to be performed with cables energized and loaded. Where test conditions cannot be achieved, obtain Resident Engineer approval for deviation.
        14. Required calibrated test equipment includes an Ohmmeter, an Insulation Resistance Tester (Megger), Low-Resistance Meter, and thermographic imaging equipment capable of detecting a minimum temperature difference of 1°C at 30°C. Other needed equipment includes a tape measure, ambient thermometer, and ambient humidity indicator.
        15. Medium-voltage cables will be considered defective if they do not pass tests and inspections.
            1. Correct deficiencies and retest to demonstrate compliance.
            2. Prepare test and inspection reports. Complete one of the attached data sheets for each cable inspected or use an equivalent data sheet from a recognized testing authority.

Delete subparagraphs below to suit Project.

* + - 1. Where new cable is being connected to existing cable, perform the following tests:
         1. Perform insulation resistance test on new cable on reel.
         2. Perform VLF withstand and tan-delta test on cable after cable is pulled but prior to connection to existing cable.
         3. Perform VLF withstand and tan-delta test and insulation resistance tests on existing and new cable together at a voltage not to exceed the rating of the load break or the cable manufacturer’s suggested voltage, whichever is lower.
         4. Perform final termination of cable to load.
         5. Do not exceed the operating voltage when testing existing cables and terminations.
         6. Perform the withstand test for a minimum of 30 minutes.
         7. Use sinusoidal waveform for testing.
  1. PROTECTION
     1. Provide final protection and maintain conditions, in a manner acceptable to Manufacturer and Installer, to prevent entrance of moisture into the cable and ensure that medium-voltage cable is without damage or deterioration at Substantial Completion.
        1. End Caps: If cables are not to be immediately terminated, inspect protective waterproof caps on cable ends, and replace if damaged. Water infiltration of cable will result in reject of cable. Nitrogen purging of cable to remove water is not acceptable. Cable end caps shall be installed by a qualified cable splicer/terminator.

1. MEASUREMENT AND PAYMENT
   1. GENERAL
      1. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the [Schedule of Unit Prices] [Lump Sum price bid for the Project].

End of Section

Revision History:

05/01/2014 Conversion to 2004 CSI Numbering System

10/15/2014 Added Sole Source and Salient Characteristics Note to Part 2 and revisions

01/29/2015 Revised Sole Source

09/27/2019 Revised per F&I Standards

04/30/2024 Updated Operations and Maintenance Data