Addendum No. 1
June 11, 2021

Puyallup Electrical Distribution
Washington State University
Puyallup, WA

Project No.5446-2015
Washington State University
Facilities Services, Capital
Addendum No. 1
June 11, 2021

Puyallup Electrical Distribution
Washington State University
Puyallup, WA

Bid Date: June 23, 2021

1. This Addendum forms a part of the Contract Documents and modifies the original Bidding Documents dated June 7, 2021, and any prior addenda, as noted below.

2. Please acknowledge receipt of this addendum on the Form of Proposal.

This Addendum consists of forty-four total pages including the following Attachments:

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<td>00 01 10 - Table of Contents</td>
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<tr>
<td>Division 26 – Electrical (All Sections)</td>
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Changes to prior Addenda:
N/A

Changes to Bidding Requirements:
None

Changes to Specifications:

SP 1-1. SECTION 00 01 10 – Table of Contents

Item 1. Delete section in its entirety, replace with new section dated June 10, 2021.

SP 1-2. DIVISION 26 – ELECTRICAL

Item 1. Add: All sections dated June 10, 2021 and added to the Table of Contents.

Approved Substitution Requests:
N/A

Changes to Drawings:
N/A

END OF ADDENDUM No. 1
CONDITIONS OF THE CONTRACT

00 11 13 Advertisement for Bids
00 21 13 Instructions to Bidders
00 42 13 Form of Proposal
00 50 00 Agreement between Owner and Contractor
00 72 00 General Conditions for Washington State Facilities Construction with Washington State University Amendments

DIVISION 01 GENERAL REQUIREMENTS

01 11 00 Summary of Work
01 26 00 Change Order Procedures
01 29 00 Applications for Payment
  Current Prevailing Wage Rates
01 29 73 Schedule of Values
01 31 19 Project Meetings
01 31 23 Coordination
01 32 13 Progress Schedule
01 32 33 Construction Photographs
01 33 00 Submittals
01 35 16 Alteration Procedures
01 41 00 Regulatory Requirements
01 41 19 Special Provisions
01 45 00 Quality Control
01 45 23 Testing Laboratory Services
01 45 34 Contract Performance Evaluation Program
01 50 00 Construction Facilities & Temporary Controls
01 60 00 Material and Equipment
01 70 00 Project Close-Out
01 74 19 Construction Waste Management
01 78 23 Operation & Maintenance Manuals
01 78 39 Project Record

DIVISION 26 ELECTRICAL

26 00 00 General Electrical Requirements
26 05 13.13 Medium-Voltage Overhead Distribution
26 05 19 Low-Voltage Electrical Power Conductors and Cables
26 05 26 Grounding and Bonding for Electrical Systems
26 05 33 Raceway and Boxes for Electrical Systems
26 12 14 Medium-Voltage Overhead Transformers

END OF SECTION 00 01 10
The Architect or Engineer Stamp on this page applies to all portions of the Specifications below.

ELECTRICAL ENGINEERS:

Affiliated Engineers NW Inc.
1601 Fifth Avenue, Suite 1400
Seattle, WA 98101
Phone: 206.256.0800

Specification Division 26

Specification Sections 26 0000 – 26 1214

END OF ARCHITECTURAL / ENGINEERING STAMPS
PART 1 - GENERAL

1.1 REFERENCE
A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.2 DESCRIPTION
A. Intent of drawings and Specifications is to obtain complete systems tested, adjusted, and ready for operation.
B. Except as otherwise defined in greater detail, the terms "provide", "furnish" and "install" as used in Division 26 Contract Documents shall have the following meanings:
   1. "Provide" or "provided" shall mean "furnish and install".
   2. "Furnish" or "furnished" does not include installation.
   3. "Install" or "installed" does not include furnishing.
C. Include incidental details not usually shown or specified, but necessary for proper installation and operation.
D. Check, verify and coordinate work with drawings and specifications prepared for other trades. Include modifications, relocations or adjustments necessary to complete work or to avoid interference with other trades.
E. Included in this Contract are electrical connections to equipment provided by others. Refer to Architectural, Mechanical, Plumbing, and final shop drawings for equipment being furnished under other sections for exact locations of electrical outlets and various connections required.
F. Information given herein and on drawings is as exact as could be secured but is not guaranteed. Do not scale drawings for dimensions.
G. Where architectural features govern location of work, refer to Architectural Drawings.
H. Perform work in "neat and workmanlike" manner as defined in ANSI/NECA 1, Standard Practices for Good Workmanship in Electrical Contracting.

1.3 RELATED WORK
A. Utility Services:
   1. Determine utility connection requirements and include in Base Bid all costs to Owner for coordination of work with serving utility.
      a. Serving utility: Puget Sound Energy
         Jeremy Tuntland; jeremy.tuntland@pse.com
         253.263.6826
   2. Include costs for temporary service, temporary routing of service or other requirements of a temporary nature associated with utility service.
B. Temporary Services:
   1. Division 01 - Construction Facilities Temporary Controls.
C. Continuity of Service:
1. No service shall be interrupted or changed without permission from Architect and Owner. Obtain written permission before work is started.

2. When interruption of services is required, Engineer, Owner and other concerned parties shall be notified and shall determine a time.

D. Demolition:
1. Perform required demolition to accomplish new work.
   a. Remove abandoned wiring to source of supply.
   b. Remove exposed abandoned conduit. Cut conduit flush with walls and floors, and patch surfaces.
   c. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
   d. Disconnect and remove abandoned luminaries. Remove brackets, stems, hangers, and other accessories.
   e. Disconnect electrical systems scheduled for removal.

2. Accomplish work in neat workmanlike manner to minimize interference; annoyance or inconvenience such work might impose on Owner or other Contractors.

3. Unless otherwise noted, remove from premises materials and equipment removed in demolition work.

4. Equipment noted to be removed and turned over to Owner, shall be delivered to Owner at place and time Owner designates.

5. Where materials are to be turned over to Owner or reused and installed by Contractor, it shall be Contractor’s responsibility to maintain condition of materials and equipment equal to that existing before work began. Repair or replace damaged materials or equipment at no additional cost to Owner.

6. Where demolition work interferes with Owner’s use of premises, schedule work through Architect, Owner and with other Contractors to minimize inconvenience to Owner. Architect must approve schedule before Contractor begins such work.

E. Cleaning and Repair
1. Clean and repair existing materials and equipment that remain or are to be reused.

F. Painting:
1. Furnish equipment with factory-applied finish coats unless specified otherwise.
2. Furnish equipment with factory applied prime finish unless otherwise specified.
3. If factory finish on equipment furnished by Contractor is damaged in shipment or during construction, refinish equipment to satisfaction of Engineer.
4. Furnish one can of touch up paint for each final factory-applied finish coat of product.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

A. Rules and regulations of Federal, State and local authorities and utility companies, in force at time of execution of Contract shall become part of this specification.

1.5 REFERENCE STANDARDS

A. Agencies or publications referenced herein refer to the following:
   1. AEIC Association of Edison Illuminating Companies
   2. ANSI American National Standards Institute
   3. ASME American Society of Mechanical Engineers
4. ASTM American Society for Testing and Materials
5. BICSI Building Industry Consulting Services International
6. EIA Electronic Industries Association
7. FIPS Federal Information Processing Standards
8. FCC Federal Communications Commission
9. ICEA Insulated Cable Engineers Association
10. IEEE Institute of Electrical & Electronics Engineers
11. IESNA Illuminating Engineering Society of North America
12. NEC National Electrical Code
13. NECA National Electrical Contractors Association
14. NEMA National Electrical Manufacturers Association
15. NESC National Electrical Safety Code
16. NETA National Electrical Testing Association
17. NFPA National Fire Protection Association
18. NIST National Institute of Standards & Technology
19. OSHA Occupational Safety and Health Administration
20. TIA Telecommunications Industries Association
21. UL Underwriters Laboratories, Inc.

B. Work shall be in accordance with latest edition of codes, standards or specifications unless noted otherwise.

1.6 LISTING

A. Install materials bearing UL label or UL listing, unless UL label or listing is not available for that type of material.

B. Other nationally recognized testing agencies, acceptable to AHJ, are approved.

1.7 ENCLOSURES

A. Typical NEMA Enclosures and Usage
1. NEMA 3R - Outdoors. Rain, snow, sleet.
2. NEMA 3RX - Same as NEMA 3R plus corrosion resistant.
3. NEMA 4 - Indoors. Falling dirt. Falling and light splashing liquids. Flying dust, lint and fibers. Hose down.
4. NEMA 4X - Same as NEMA 4 - Indoors plus corrosion resistant.
5. NEMA 4 - Outdoors. Rain, sleet, snow. Wind blown dust. Hose down.
6. NEMA 4X - Same as NEMA 4 - Outdoors plus corrosion resistant.
7. NEMA 5 - Indoors. Falling Dirt. Falling Liquids. Settling dust, lint and fibers.
9. NEMA 6P - Same as NEMA 6 - Indoors plus corrosion resistant. Prolonged submersion.
11. NEMA 6P - Same as NEMA 6 - Outdoors plus corrosion resistant. Prolonged Submersion.
12. NEMA 7 - Indoors. Class I, Division 1 or 2, Groups A, B, C or D. (Flammable gas).
13. NEMA 9 - Indoors. Class II, Division 1 or 2. Groups E, R, or G. (Combustible dust).
14. NEMA 12 - Indoors. Falling Dirt. Falling liquids. Flying dust, lint and fibers. Oil or coolant seepage.
15. NEMA 13 - Same as NEMA 12 plus oil or coolant spraying or splashing.

1.8 SUBMITTALS

A. Refer to Division 01 - Submittal Procedures:
1. Submit shop drawings and product data for equipment and systems as requested in respective specification sections. Submittals which are not requested may not be reviewed.
2. Specifically mark general catalog sheets and drawings to indicate specific items submitted and its correlation to specific designation for product in drawings.
3. Specifically indicate proper identification of equipment by name and/or number, as indicated in specification and shown on drawings.
4. When manufacturer's reference numbers are different from those specified, provide correct cross-reference number for each item. Clearly mark and note submittal accordingly.
5. Submit complete record of required components when luminaires, equipment and items specified include accessories, parts and additional items under one designation.
6. Include wiring diagrams for electrically powered or controlled equipment.
7. Submit shop drawings or product data as soon as practicable after signing contracts. Submittals must be approved before installation of materials and equipment.
8. Submittals that are not complete, not permanent, or not properly checked by Contractor, will be returned without review.
9. Bidders shall provide a full compliance review of specifications. Compliance review shall accompany submittals. Compliance review shall include paragraph-by-paragraph review of specifications with the following information “C”, “D”, “E” marked in the margin of the specification section. Unless a deviation or exception is specifically noted in the compliance review, it is assumed that Bidder is in complete compliance with plans and specifications. Lack of these requirements in the submittal shall result in rejection of submittal. Text shall be provided accompanying compliance review as follows:
   a. “C” – Comply with no exceptions
   b. “D” – Comply with deviations. For each of the deviations, provide numbered footnote with reasons for proposed deviation
   c. “E” – Exceptions; do not comply

B. Bookmarks:
1. Submitted documents greater than 50 pages in length shall include electronic bookmarks setup to quickly navigate and easily locate submitted information. Each major series of equipment shall have a bookmark.
2. Hyperlinks can be used to enhance bookmark tools but are not an acceptable substitute for electronic bookmarks. If hyperlinks are used, they should be clearly identifiable as a hyperlink by using a different color text similar to how MS Office identifies hyperlinks.

C. Certificates and Inspections:
1. Obtain and pay for inspections required by authorities having jurisdiction and deliver certificates approving installations to Owner unless otherwise directed.

D. Operation and Maintenance Manuals:
1. Refer to Division 01 - Operation and Maintenance Manuals.
2. Upon completion of work but before final acceptance of system, submit maintenance manuals in electronic pdf format. Organize manuals by specification section number and furnish table of contents and tabs for each piece of equipment or system.

3. Manuals shall include the following:
   a. Copies of shop drawings
   b. Manufacturer's operating and maintenance instructions. Include parts lists of items or equipment, with component exploded views and part numbers. Where manufacturer's data includes several types or models, designate applicable type or model.
   c. CD ROM's of O&M data with exploded parts lists where available
   d. Phone numbers and addresses of local parts suppliers and service companies
   e. Internet/WEB page addresses where applicable
   f. Wiring diagrams
   g. Start up and shut down procedure
   h. Factory and field test records
   i. Additional information, diagrams or explanations as designated under respective equipment or systems specification section

4. Instruct Owner's representative in operation and maintenance of equipment. Instruction shall include complete operating cycle on all apparatus.

5. Furnish O&M manuals and instructions to Owner prior to request for final payment.

6. Include bookmarks as indicated above.

E. Record Documents:
   1. Refer to General Conditions of Contract and Division 01 - Project Record. Prepare complete set of record drawings in accordance with Division 01.
   2. Use designated set of prints of Contract Documents as prepared by Architect to mark-up for record drawing purposes.

1.9 JOB CONDITIONS

A. Coordination:
   1. Equipment and wiring shall be selected and installed for conditions in which it will be required to perform. (i.e., general purpose, weatherproof, rain tight, explosion proof, dust tight, or any other special type as required.)

B. Cutting and Patching:
   1. Refer to General Conditions of the Contract and Division 01 - Alteration Procedures.
   2. Perform cutting and patching required for complete installation of systems, unless otherwise noted. Patch and restore work cut or damaged to original condition. This includes openings remaining from removal or relocation of existing system components.
   3. Provide materials required for patching unless otherwise noted.
   4. Where alterations disturb lawns, paving, walks, etc., replace, repair or refinish surfaces to condition existing prior to commencement of work. This may include areas beyond construction limits.

C. Housekeeping and Cleanup:
   1. Refer to Division 01 - Project Closeout.
   2. As work progresses or as directed by Engineer, periodically remove waste materials from building and leave area of work broom clean. Upon completion of work, remove tools, scaffolding, broken and waste materials, etc. from site.
1.10 WARRANTY

A. Refer to Division 01 for general warranty requirements.

B. Refer to technical sections for warranty requirement for each system.
   1. Where no warranty requirements are called out, warrant for 1 year after acceptance by Owner equipment, materials, and workmanship to be free from defect.

C. Repair, replace, or alter systems or parts of systems found defective at no extra cost to Owner.

D. In any case, wherein fulfilling requirements of any guarantee, if this contractor disturbs any work guaranteed under another contract, this contractor shall restore such disturbed work to condition satisfactory to Architect and guarantee such restored work to same extent as it was guaranteed under such other contract.

E. Warranty shall include labor, material, and travel time.

PART 2 - PRODUCTS

2.1 PRODUCT SUBSTITUTIONS

A. Refer to Division 01 - Product Requirements.

PART 3 - EXECUTION

3.1 GENERAL

A. Verify elevations and dimensions prior to installation of materials.

3.2 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the site under provisions of Division 01.

B. Store and protect products under provisions of Division 01.

C. Store in clean, dry space.

D. Maintain factory wrapping or provide cover to protect units from dirt, water, construction debris, and traffic.

E. Handle in accordance with manufacturer’s written instructions.

F. Handle carefully to avoid damage to components, enclosure, and finish. Lift only with lugs provided for the purpose.

G. Provide supplemental heat if required to prevent moisture contamination.

3.3 EQUIPMENT ACCESS

A. Install raceways, junction and pull boxes, and accessories to permit access to equipment for maintenance. Relocate raceways or accessories to provide maintenance access at no additional cost to Owner.

B. Install equipment with sufficient maintenance space for removal, repair or changes to equipment. Provide ready accessibility to equipment and wiring without moving other future or installed equipment.
3.4 EQUIPMENT SUPPORTS
   A. Provide supporting steel not indicated on drawings as required for installation of equipment and materials including angles, channels, beams, hangers, etc.

3.5 ELECTRICAL SYSTEMS IDENTIFICATION
   A. Refer to Section 26 0553 – Electrical Systems Identification.

3.6 ACCEPTANCE TESTING
   A. Contractor shall perform acceptance testing. Equipment to be tested is noted as “Testing by Electrical Contractor” in technical specification sections. Perform in accordance with Section 26 0812 – Power Distribution Acceptance Tests and Section 26 0813 – Power Distribution Acceptance Test Tables or as outlined in technical specification sections.
   B. When testing is to be witnessed by Architect/Engineer or Inspector, notify them at least 10 days prior to testing date.
   C. When equipment or systems fail to meet minimum test requirements, replace or repair defective work or materials as necessary and repeat inspection and test until equipment or systems meet test requirements. Make repairs with new materials.
   D. Contractor is responsible for certifying in writing equipment and system test results. Certification shall include identification of portion of system tested, date, time, test criteria and name and title of person signing test certification documents.
   E. Maintain copies of certified test results, including those for any failed tests, at project site. At completion of project, include copies of test records and certifications in O&M Manuals.

3.7 CLEANING
   A. Clean systems after installation is complete.
   B. Clean luminaire lenses and lamps at time of installation and clean lens exteriors just prior to final inspection.
   C. Thoroughly clean equipment of stains, paint spots, dirt and dust. Remove temporary labels not used for instruction or operation.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED WORK
A. Section 26 05 26 – Grounding and Bonding for Electrical Systems
B. Section 26 12 14 – Medium-Voltage Overhead Transformers

1.2 REFERENCE
A. Work under this section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION
A. Provide complete overhead electrical primary service, including components necessary to make installation complete and operational.
B. ANSI C2-for Grade B construction installation requirements.
C. Coordinate installation with Owner and with local utility providing primary feed to site.

1.4 REFERENCE STANDARDS
A. ANSI 55-3 Porcelain Pin Insulator
C. ASTM B232 Standard Specification for Concentric-Lay-Stranded Aluminum Conductors, Coated-Steel Reinforced
D. ASTM B498 Standard Specification for Zinc-Coated (Galvanized) Steel Core Wire for Use In Overhead Electrical Conductors
E. ANSI O5.1 2017 Wood Poles – Specifications and Dimensions and supplements
F. ANSI O5.3 Solid-Sawn Wood Crossarms and Braces
G. AWPA T1 Specification for Treated Wood
H. AWPA P20 All Barrier Protection System
N. IEEE C37.42 Standard Specification for High-Voltage Fuses and Accessories
O. NEMA WC 70/ICEA S-95-658 Nonshielded Power Cables Rated 2000 V or Less for the Distribution of Electrical Energy

1.5 SUBMITTALS
A. Submit shop drawings for equipment provided under this Section.

PART 2 - PRODUCTS

2.1 POWER POLES:
A. Description: Solid wood pole
B. Manufacturers:
   1. Pacific Wood Preserving of Oregon
   2. Stella-Jones Corporation
C. Wood Species: Coastal Douglas Fir
   1. Wood pole quality and dimensions shall meet the requirements of ANSI O5.1 with the following clarifications:
      a. Poles shall be shaved full length and free from “barber pole” and “wheel gouging” depressions
      b. Wood shall be cut from live trees
      c. Use of anti-splitting iron shall not be permitted
      d. Mechanical damage shall not be evident
D. Preservative treatment
   1. Full length with Copper Naphthenate meeting requirements of AWPA 36. Carrier and co-solvent shall be 100 percent pure diesel product.
   2. Penetration meeting requirements of meeting of AWPA T1
   3. Retention .095 pounds per cubic foot in accordance with AWPA U1. Use category UC4B.
   4. Incised full-length. Min depth ½”
   5. Increment borings, measuring depth of penetration and sapwood thickness shall all be in accordance with AWPA Standard M2. All holes made by borings shall be filled with tight fitting cylindrical plugs which have been thoroughly treated with preservative.
E. Pole classification
   1. Class shall be Type 2 minimum unless otherwise noted. Ground line circumference for height and class shall match or exceed ANSI O5.1.
   2. Label poles with height, class, manufacturer's name, and date of manufacture.
      a. Information shall be stamped into a 2 inch round aluminum tag recessed 1/4 inch into the pole and securely nailed. Place the center of the brand or tag on the face of the pole 12ft 0in from pole butt.
b. Pole length and circumference class shall be stamped with 1/4 inch numerals into an aluminum tag

3. Pole heights to match existing and as indicated on drawings. Existing pole height to be verified. Where conflict exists between height indicated on drawings and existing pole height, the existing pole height shall be used.

F. Pole Liners
   1. Manufacturers: Copper Care Wood Preservatives Inc.
   2. Barrier protection systems shall meet application requirements of AWPA Book of Standards.
   3. Barrier protection system shall meet ASTM D4801 for weather resistance.
   4. System shall be compatible with wood pole preservative using three layer construction: Polyethylene, copper foil, polyethylene terephthalate.
      a. Sealing tape shall be silicon, self-fusing, 4" nominal width.

G. Pole Top
   1. Manufacturers: Osmose Utilities Services Inc.,
   2. Butyl mastic material: non-drying, non-hardening, adhesion properties -60°F to 220°F
   3. Ultraviolet protection: polyethylene protective film
   4. Size: Diameter selection matching pole class. Shape fitting to pole irregularities.

2.2 CROSSARM

A. Description: Dimensionally sawn solid wood

B. Manufacturers:
   2. DIS-TRAN Wood Products
   3. Stella-Jones Corporation

C. Wood Species: Coastal Douglas Fir

D. Preservative treatment meeting requirements of AWPA T1
   1. Copper chromated arsenate (CCA) poles pressure treated to 12 lb test.
   2. Incised full-length. Min depth 3/8"
   3. Chamfer to edges of crossarms.
      a. 6 pin crossarms – 8'-0"
      b. 8 pin crossarms – 10'-0" (not used)

E. Dimensionally compliant with NESC Grade B construction: 3 ¼" x 4 ¼"

2.3 INSULATORS:

A. Description: Wet process, pin type insulators, dead end insulators and spool.

B. Manufacturers:
   1. Victor Insulators, Inc.
   2. Powerline hardware
   3. PPC Insulators

C. Pin type: ANSI class 55-1
1. Leakage distance: 7” min
2. Cantilever strength: 2500lb min
3. Flashover voltage: 55kV dry, 30kV wet

D. Dead End
1. Leakage distance: 16” min
2. Mechanical failing load: 15,000lb min
3. Flashover voltage: 90kV dry, 60kV wet

E. Spool type: ANSI class 53-5
1. Transverse Strength: 6000lb min
2. Flashover voltage: 35kV dry, 18kV wet

F. Guy Strain Insulators
1. Tensile Strength: 12000lb min
2. Flashover voltage: 30kV dry, 15kV wet

2.4 LOADBREAK CUTOUT

A. Description: Overhead pole-top, fuse holder physically and electrical interchangeable with manufactures listed for this device.

B. Manufacturers:
2. Eaton
3. S&C Electric Company

C. Electrical Ratings: 15kV, 110kV BIL, 100A continuous, 300A load break, 10kA sym. interrupting
1. Fuse link current range: 1A to 100A
2. Arc chute where replacing existing cutout with arc chute
3. Polymer insulated. EPDM, EPR or other carbon based materials not approved

D. Mounting: NEMA type B crossarm bracket

E. Fuse: Expulsion, Type K
1. Design compatible with cutout device
2. Amperage: as determined by equipment protected.

<table>
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<th>Transformer Fusing 2.4/4.16kV</th>
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<td>kVA (1 Phase)</td>
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2.5 HARDWARE

A. Description: Steel pins, brackets, clevises, racks, cluster brackets, crossarm braces and miscellaneous hardware required for pole supported overhead distribution.

B. Braces: Steel, 1/4in x 1 1/4in x 28in min length, Hot dipped galvanized steel after fabrication

C. Cluster Mounts: Double band, sized for pole, aluminum alloy

D. Hot dipped galvanized steel after fabrication

2.6 CONDUCTOR

A. Aluminum Conductor Steel Reinforced for use as overhead distribution conductor
   1. Manufacturers:
      a. Southwire.
      b. General Cable
      c. Houston Wire & Cable
   2. Bare, 4AWG, 6/1 Stranding.
      a. Steel core class A galvanized
      b. Aluminum alloy: 1350-H19
   3. Weight: 57lbs/100ft - 67% Aluminum 32% Steel
   4. Rated breaking strength 1860lbs
   5. Ampacity: 140A

B. Ground Wire: Medium hard drawn or medium soft drawn, bare solid copper unless otherwise noted on drawings.
   1. Conductor guard: UV stabilized PVC, impact resistant, 8 ft lengths.

2.7 GUY

A. Tensioned cable installations.
   1. Size 3/8” diameter, 7 strand
   2. Extra High Strength (EHS) grade with minimum breaking strength 15,400lbs
3. Type "C" galvanized coating: 2.55 oz/sqft.

B. Guy anchors: Cross plate, Manta Ray or Screw type. Holding strength Class 5 soil type – sand, gravel & clay, compacted course sand: 18,000 lb min.

C. Guards:
   1. Guy strand guards: ozone and sunlight resistant, full round, polyethylene, yellow finish, 8ft.
      a. Provide for each guy altered or set

2.8 PRIMARY TAP:

   A. Hot Line Clamp.
      1. Designed for standard “hot stick” application - positive pressure type
      2. Pressure type jumper wire connector
      3. Permanently lubricated eyebolt threads
      4. Conductor range #8 – 2/0
      5. Verify Main Conductor: material, solid or stranded
      6. Verify Tap Conductor: material, solid or stranded

2.9 GROUNDING

   A. Ground rod: Reference 26 05 26 Grounding and Bonding for Electrical Systems

   B. Ground conductor: Reference 26 05 26 Grounding and Bonding for Electrical Systems

PART 3 - EXECUTION

3.1 INSTALLATION

   A. Provide

   B. Provide excavation required by work including pole base excavation, guy anchor placement and riser modification. Include incidental including utility locates, clearing, pavement removal, shoring and transportation. On completion of work, restore grade to original elevation and replace surfaces to existing conditions.

   C. Verify existing utilities prior to excavation.

   D. Set power pole depth at 10% of pole length plus 3ft. Install true to vertical where no strain requires counter set. Set not more than 4 inches for each 10ft of pole length above grade.

   E. Set poles aligned existing run except at corners, terminals or points of strain where set racked against strain.

   F. Holes used to set poles shall be dug large enough to permit use of tampers to full depth of hole. Backfill to be free of debris larger than 2in. Backfill in layers and compact mechanically.

   G. Crossarms.
      1. Brace: Use 1/2in bolt at crossarm, secure to pole using 5/8in through-bolts.
      2. Single crossarm: Bolt crossarms to poles with 5/8in through-bolts using square washers at each end. Extend bolts 1/4in min. 2in max. beyond nuts. Install bolt head on crossarm side of pole.
3. Double crossarm: Bolt crossarms to poles with 5/8in double-arming bolts using square washers at each end. Extend bolts 1/4in min. 2in max. beyond nuts.

4. Bolt crossarms at right angles to line supported.

H. Install overhead conductor in accordance with National Electrical Safety Code for sag and tension requirements using appropriate design loading requirements for site. Do not exceed 25% of rated strength.
   1. Handling of conductor shall use methods and practices that prevent deformation or weakening.
   2. Splices: non-bolted compression type as recommended by manufacturer. Not permitted within 10ft of support. Tensile strength of splice greater than breaking strength of conductor.
   3. Attached conductors to insulators by means of clamps, shoes or tie-wires in accordance with type of insulator and manufacturers recommendations. Install ties on pin insulators tight against conductor and insulator with ends turned down flat against conductor.
   4. Adjust sag and tension to higher clearance of: match existing or 18ft clearance min.


J. Install guys in line with strain with lead angle matching existing. Set anchors to insure maximum withdrawal resistance. Provide additional anchor shafts where depth is required. Set anchor rod aligned with guy attachment on pole. Set anchor rod eye 12” min above ground.
   1. Install guy strain insulators
   2. Ground guy cable

K. Provide vertical grounding conductor over length of pole rise. Ground conductor installed in one continuous length from driven ground rod connection to pole top. Attach in straight run aligned with longitudinal axis of pole. Staple ground conductor every 6 inches for first 8ft above grade and last 2ft at pole top, the 2ft interval otherwise. Provide conductor guard from ground line through rise to transformer space.
   1. Bond non-current carrying metallic parts, frames of equipment, surge arrestors

L. Drive ground rods to depth of full length of rod plus required depth below grade. Set rod 3ft from base maximum. Reference 26 05 26 Grounding and Bonding for Electrical Systems

M. Install wires as indicated and make up connections using proper clamps, anti-oxidant compounds, and tinned lugs, to prevent corrosion due to dissimilar metals.

N. Install brackets and accessories to connect riser.

O. Provide jumpers and taps fully rated with main line.

P. Provide cable supports and sealing system for protective conduit system.

Q. Secure conduit to pole every 4 ft.

3.2 QUALITY CONTROL

A. Preservative concentration in wood pole shall comply with requirements of AWPA A9.

B. Preservative penetration in wood poles shall comply with requirements of AWPA A76.
3.3 FIELD QUALITY CONTROL

A. Medium-Voltage Surge Arresters:
   a. Visual and Mechanical Inspection:
      1) Compare equipment nameplate data with drawings and specifications.
      2) Inspect physical and mechanical condition.
      3) Inspect anchorage, alignment and grounding.
      4) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer’s published data.
      5) Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.
   b. Electrical Tests:
      1) Perform resistance measurements through bolted connections.
      2) Test grounding connection with a point-to-point resistance test.
   c. Test Values:
      1) Compare microhm or millivolt drop values to manufacturer’s published data. In the absence of manufacturer’s data, compare similar units. Investigate deviations of more than 50% from lowest value.
      2) Insulation resistance should be in accordance with manufacturer’s published data.
      3) Resistance between the arrester ground terminal and ground shall be less than 0.5 ohm.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED WORK
   A. Section 26 0529 - Hangers and Supports for Electrical Systems
   B. Section 26 0533 - Raceway and Boxes for Electrical Systems
   C. Section 26 0553 - Electrical Systems Identification
   D. Section 26 0812 - Power Distribution Acceptance Tests
   E. Section 26 0813 - Power Distribution Acceptance Test Tables

1.2 REFERENCE
   A. Work under this section is subject to requirements of Contract Documents including General
      Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION
   A. Section includes conductors and cables rated 600 V and less, connectors, splices, and
      terminations rated 600 V and less, sleeves and sleeve seals for cables.
   B. Conductor and conduit sizes in these contract documents are based on copper wire.

1.4 REFERENCE STANDARDS
   B. ASTM B 8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard,
      Medium-Hard, or Soft.
   C. NEMA WC 70 – Non-Shielded Power Cable 2000 V or less for the Distribution of Electrical Energy
      (ICEA S-95-658).
   D. NFPA 70 – National Electrical Code.
   E. UL 44 – Thermoset-Insulated Wires and Cables.
   F. UL 83 – Thermoplastic-Insulated Wires and Cables.
   G. UL 486A-486B – Wire Connectors.
   H. UL 486C – Splicing Wire Connectors.
   I. UL 486D – Standard for Insulated Wire Connector Systems for Underground Use or in Damp or
      Wet Locations.
   J. UL 486E – Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper
      Conductors.
   K. UL 1569 – Standard for Metal-Clad Cables.
1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Manufacturer’s Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation.

C. Test Reports: Indicate field test and inspection procedures and interpret test results and corrective action taken for compliance with specification requirements.

D. Closeout Submittals:
   1. Project Record Documents:
      a. Record actual locations of components and circuits.
   2. Operation and Maintenance Data:
      a. Include manufacturer’s recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with NFPA 70 for components and installation.
   2. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

B. Wire and cable boxes and reels shall bear the date of manufacture.
   1. Date of manufacture shall not precede contract date by more than one year.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Protect from dirt, fumes, water, corrosive substances, and construction debris.

1.8 WARRANTY

A. Refer to Division 01 and Section 26 0000 – General Electrical Requirements for general warranty requirements.

B. Manufacturer shall provide standard 1 yr warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Southwire Company

B. General Cable Corporation

C. Cerrowire
2.2 DESCRIPTION
A. NEMA WC 70; single copper conductor insulated wire; 600V rated insulation; 90°C maximum operating temperature for dry and wet or damp locations.
   1. Thermoplastic-insulated wires and cables: NEMA WC 70, UL 83; Type, THWN-2.
   2. Thermoset-insulated wires and cables: NEMA WC 70, UL 44; TypeXHHW-2.

2.3 TERMINATIONS
A. Bolted or screw type lug, or direct to bolted.

2.4 SERVICE DROP CABLE
A. Neutral supported, preassembled triplex conductor
B. Copper conductor; 600v rated insulation; 90°C maximum operating temperature for dry and wet conditions
   1. 200A service aerial:
      a. Aluminum conductor
      b. Messenger size: 1/0 AWG, 7 strand, ACSR-rated strength 4380min.
      c. Conductor 3/0 AWG, 9 strand
      d. Phase Conductor Insulation: crosslinked polyethylene (XLPE)
      e. Bare Neutral/Messenger

PART 3 - EXECUTION
3.1 INSTALLATION OF CONDUCTORS AND CABLES
A. Install conductors in a raceway system, unless otherwise specified or indicated.
B. Install conductors only after:
   1. Mechanical work likely to damage conductors has been completed
   2. Raceway installation is complete and supported
C. Pull conductors into raceway at same time.
D. Neatly train and lace conductors inside boxes, and equipment.
E. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer’s recommended maximum pulling tensions and sidewall pressure values.
F. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
3.2 CONDUCTOR INSULATIONS AND WIRING METHODS

A. Service Entrance: THHN/THWN-2, XHHW-2, rated 90°C for wet locations, single conductors in racewayType SE or USE multi-conductor cable.

3.3 CONNECTORS, SPLICES, AND TERMINALS

A. Connectors:
   1. Except where equipment is furnished with bolted or screw type lug, use compression set pressure connectors with insulating covers. Use compression tools and die compatible with connectors being installed.
   2. Use bolt or compression-set type with application of insulating tape, pre-stretched or heat-shrinkable insulating tubing for splices and taps of #8 AWG conductors and larger. Install with hydraulic compression tool.
   3. Tighten electrical connectors and terminals according to manufacturer’s published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Splices:
   1. Splice wires and cable only in accessible locations such as within junction boxes.
   2. Make splices to carry full capacity of conductors with no perceptible temperature rise.
   3. Use electrical tape to build up insulation level equivalent to cable insulation and cover with not less than two half-lapped layers of plastic electrical tape, for joints, taps, and splices of #1 AWG conductors and larger.
   4. Plastic snap-on splice insulators are not allowed.
   5. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
   6. Use oxide inhibitor in each splice and tap conductor.

C. Terminals:
   1. Insulate ends of spare conductors with electrical tape and identify spare circuit number where appropriate.
   2. Train wires to eliminate fanning of stands, crimp with proper tool and die.
   3. Torque screw termination per manufacturer’s recommended values.

3.4 FIELD QUALITY CONTROL

A. Test 600 volt conductors and cables.
   1. Inspection and test procedures comply with NETA:
      a. Visual and Mechanical Inspection:
         1) Compare cable data with drawing and specifications.
         2) Inspect exposed sections of cables for physical damage.
         3) Verify tightness of accessible bolted electrical connections by calibrated torque wrench in accordance with manufacturer’s published data.
         4) Inspect compression-applied connectors for correct cable match and indentation.
         5) Verify visible cable bends meet or exceed ICEA and manufacturer’s minimum allowable bending radius.
6) Inspect for correct identification and arrangements.
7) Inspect jacket and insulation condition.

b. Electrical Tests:
   1) Perform insulation-resistance test using megohm meter. Applied potential to be 1000 VDC. Individually test each conductor with other conductors grounded. Test duration shall be one minute.
   2) Perform continuity tests to ensure correct cable connection.

c. Test Values:
   1) Insulation-resistance values should not be less than 50 megohms.

B. Interpret test results in writing and submit to Engineer.

C. Replace conductors and cables that are found defective, at no expense to Owner.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED WORK
   A. Section 26 0513.13 - Medium-Voltage Open Conductors

1.2 REFERENCE
   A. Work under this Section is subject to requirements of Contract Documents including General
      Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION
   A. Section includes methods and materials for grounding systems and equipment, as required by
      State Codes, NFPA 70, applicable portions of other NFPA codes, as indicated herein, and plus
      the following special applications:
      1. Overhead-lines grounding.
      2. Underground distribution grounding.
   B. Maximum resistance to ground shall be less than 5 ohms.

1.4 REFERENCE STANDARDS
   A. ASTM B 3 – Specification for Soft or Annealed Copper Wire
   B. ASTM B 8 – Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-
      Hard or Soft
   C. ASTM B 33 – Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes
   D. IEEE C2 – National Electrical Safety Code (ANSI)
   E. NETA MTS – Maintenance Testing Specifications
   F. NFPA 70 – National Electrical Code
   G. NFPA 70B – Recommended Practice for Electrical Equipment Maintenance
   H. UL 467 – Grounding and Bonding Equipment

1.5 SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Field Quality-Control Test Reports:
      1. Indicate field test and inspection procedures and interpret test results and corrective action
         taken for compliance with specification requirements.
1.6 QUALITY ASSURANCE
   A. Regulatory Requirements:
      1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70.
      2. Comply with UL 467 for grounding and bonding materials and equipment.

1.7 DELIVERY, STORAGE, AND HANDLING
   A. Store products in clean, dry space. Protect from dirt, fumes, water, corrosive substances, and construction debris.

1.8 WARRANTY
   A. Refer to Division 01 and Section 26 0000 – General Electrical Requirements for general warranty requirements.
   B. Manufacturer shall provide standard 1 yr written warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of substantial completion.

PART 2 - PRODUCTS

2.1 CONDUCTORS
   A. Bare Copper Conductors:
      2. Bonding Conductor: #4 AWG, stranded conductor.

2.2 CONNECTORS
   A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
   B. Bolted Connectors for Conductors and Pipes: Electro-tin plated copper or copper alloy, bolted pressure-type, with at least two bolts.
      1. Pipe Connectors: Clamp type, sized for pipe.
   C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
   D. Compression Connectors: Irreversible type.

2.3 GROUNDING ELECTRODES
   A. Ground Rods: Copper-clad steel; 5/8 in diameter by 8ft length.
PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install stranded conductor #4 AWG.

B. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors
   3. Connections to Ground Rods: Bolted connectors
   4. Connections to Structural Steel: Welded connectors

3.2 GROUNDING OVERHEAD LINES

A. Comply with IEEE C2 grounding requirements.

B. Install two parallel ground rods if resistance to ground by a single, ground-rod electrode exceeds 25 ohms.

C. Drive ground rods until tops are 300 mm (12") below finished grade in undisturbed earth.

D. Ground-Rod Connections: Install welded connections to rods

E. Secondary Neutral and Transformer Enclosure: Interconnect and connect to grounding conductor.

F. Protect grounding conductors running on surface of wood poles with molding extended from grade level up to and through communication service and transformer spaces.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 100 mm (4") will extend above finished floor. If necessary, install ground rod before manhole is placed and provide #1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof PVC sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 50 mm above to 150 mm (2" above to 6") below concrete. Seal floor opening with waterproof, nonshrink grout.

3.4 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
   1. Feeders and branch circuits
   2. Lighting circuits
   3. Flexible raceway runs
C. Install equipment grounding conductor from secondary side of each transformer to grounding electrode system as required for separately derived system.

D. Install grounding conductor to luminaires.

3.5 SEQUENCING, SCHEDULING

A. Permanently attach service grounds before permanent building service is energized where existing building has been altered.

B. Permanently attach equipment grounds prior to energizing equipment.

3.6 INSTALLATION

A. Connections: Exposed and visible for inspection at all times. Do not install ground connections under surface improvements.

B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

C. Ground Rods: Drive rods until tops are 12in below final grade.
   1. Interconnect ground rods with grounding electrode conductor below grade. Make connections without exposing steel or damaging coating, if any.
   2. For grounding electrode system, install rods spaced at least one rod length from each other and located at least the same distance from other grounding electrodes if more than two are installed.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

E. Make grounding connections on surface that has been cleaned of paint, dirt, oil, etc., so that connections are bare metal to bare metal contact.

F. Make grounding connections tight with UL listed grounding devices, fittings, bushings, etc.

G. Flexible Metallic Conduit: Install green wire grounding conductor with phase conductors in conduit.

3.7 FIELD QUALITY CONTROL

A. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
   1. Test completed grounding system at each location where a maximum ground-resistance level is specified. Make tests at ground rods before any conductors are connected.

B. Interpret test results in writing and submit to Engineer.

C. Inspect completed system by commissioning authority, prior to backfilling.
END OF SECTION
SECTION 26 0533

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED WORK
   A. Section 26 0519 – Low-Voltage Electrical Power Conductors and Cables
   B. Section 26 0526 – Grounding and Bonding for Electrical Systems

1.2 REFERENCE
   A. Work under this section is subject to requirements of Contract Documents including General
      Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION
   A. Section includes raceways, fittings, pull and junction boxes, tap boxes and raceway seals.

1.4 REFERENCE STANDARDS
   A. ANSI/NECA 1 – Standard Practices for Good Workmanship in Electrical Contracting
   B. ANSI C80-1 – Rigid Steel Conduit-Zinc Coated (GRS)
   C. ANSI C80-3 – Electrical Metallic Tubing-Zinc Coated (EMT)
   D. ANSI C80-5 – Aluminum Rigid Conduit-Zinc Coated (ARC)
   E. ASTM A 53/A 53M – Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded
      and Seamless
   G. NEMA 250 – Enclosures for Electrical Equipment (1000 V Maximum)
   H. NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic
      Tubing and Cable
   I. NEMA OS 1 – Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
   J. NEMA RN 1 – Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and
      Intermediate Metal Conduit
   K. NEMA TC 2 – Electrical Polyvinyl Chloride (PVC) Conduit
   L. NEMA TC 3 – PVC Fittings for Use with Rigid PVC Conduit and Tubing
   M. NFPA 70 – National Electrical Code
   N. UL 1 – Flexible Metal Conduit
   O. UL 6 – Electrical Rigid Metallic Conduit-Steel
P. UL 360 – Liquid-Tight Flexible Steel Conduit
Q. UL 514A – Metallic Outlet Boxes
R. UL 514B – Conduit, Tubing, and Cable Fittings
S. UL 651 – Schedule 40 and 80 Rigid PVC Conduit and Fittings
T. UL 797 – Electrical Metallic Tubing-Steel
U. UL 870 – Wireways, Auxiliary Gutters, and Associated Fittings
V. UL 1660 – Liquid-Tight Flexible Nonmetallic Conduit
W. UL 2024 – Optical Fiber and Communication Cable Raceway

1.5 SUBMITTALS

A. Product Data:
   1. Raceways
   2. Fittings
   3. Wireways
   4. Pull and junction boxes
   5. Tap boxes
   6. Raceway seals

B. Manufacturer’s Installation Instructions:
   1. Indicate application conditions and limitations of use stipulated by product testing agency.
      Include instructions for storage, handling, protection, examination, preparation and installation of product.

C. Closeout Submittals:
   1. Project Record Documents:
      a. Record actual specifications of equipment installed. wall ducts, indoor service poles, floor boxes, tap boxes, outlet, pull and junction boxes.
   2. Operation and Maintenance Data:
      a. Include manufacturer’s recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.
      b. Include spare parts data listing, source, and current prices of replacement parts and supplies.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with NFPA 70.
   2. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect from dirt, water, construction debris, and traffic.
B. Protect PVC conduit from sunlight.
C. Comply with manufacturer’s written instructions.

1.8 WARRANTY
A. Refer to Division 01 and Section 26 0000 – General Electrical Requirements for general warranty requirements.
B. Manufacturer shall provide standard 1 yr written warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of substantial completion.

PART 2 - PRODUCTS

2.1 RIGID METAL CONDUIT (RMC)
A. Rigid Steel Conduit (RSC): ANSI C80.1, UL 6; heavy wall galvanized steel
B. Fittings (couplings, conduit bodies, connectors and bushings): NEMA FB 1, UL 514B; aluminum alloy threaded; connectors with double locknuts and steel insulating bushings, thermoplastic insulating bushings for conduits 53 mm (2”) and smaller; conduit bodies cover: cast, with stainless steel screws and neoprene gaskets; PVC coated to match conduit.
C. Fittings Manufacturers: Cooper Crouse-Hinds; Carlon Electric Products/Prime Conduit Inc.; O-Z/Gedney; Appleton; Hubbell

2.2 ELECTRICAL METALLIC TUBING (EMT)
A. ANSI C80.3, UL 797; galvanized steel tubing
B. Fittings (couplings, conduit bodies, and connectors): NEMA FB I, UL 514B; steel, conduit bodies cover: stamped, with stainless steel screws and neoprene gaskets. Indent or, drive-on, die-cast or pressure cast fittings not permitted.
C. Fittings Manufacturers: Same as manufacturers listed in 2.1.F.

2.3 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)
A. UL 360; interlocked steel , with PVC jacket
B. Fittings: NEMA FB 1, UL 514B; steel

2.4 METAL WIREWAYS
A. NEMA 250, UL 870; sheet metal troughs with hinged or removable cover, Type: rating suitable for environmental extremes possible where applied.
B. Size: length as indicated on drawings. Where size is not indicated, provide minimum dimensions required for compliance with numbers and size of pathway connected to the enclosure.
C. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mated with wireways as required for complete system.
D. Wireways Covers: Flanged-and-gasketed type
E. Knockouts: none  
F. Finish: Manufacturer’s standard enamel finish  
G. Manufacturers: Hoffman; Square D Co.

2.5 PULL AND JUNCTION BOXES
A. Cast-Metal, Pull, and Junction Boxes: NEMA FB 1; cast aluminum galvanized, cast iron with ground flange, gasketed cover and stainless steel cover screws  
B. Field-fabricated boxes not allowed without prior approval of local authority having jurisdiction.  
C. Manufacturers: O-Z/Gedney; Raco; Cooper Crouse-Hinds

2.6 TAP BOXES
A. Multi-tap connectors as indicated on drawings.  
B. Manufacturers: Ilsco

2.7 EXPANSION FITTINGS
A. Malleable iron, hot dip galvanized allowing 100 mm(4") (±50 mm(2")) raceway movement.  
B. Manufacturers: OZ/Gedney AX Series

2.8 RACEWAY PENETRATION SEALS
A. Thruwall Seals.  
B. Manufacturers: New construction – OZ/Gedney FSK Series; existing construction – OZ/Gedney CSM Series  
C. For one through four conductors: Manufacturers: OZ/Gedney CSB Series  
D. For greater than four conductors: Manufacturers: OZ/Gedney EYA Series with sealing compound  
E. Low-temperature: Manufacturers: OZ/Gedney EYA Series with sealing compound

2.9 CABLE SUPPORTS
A. Manufacturers: OZ/Gedney Type S; or equivalent by manufacturer listed in 2.1.F.

2.10 SLEEVE SEALS
A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.  
   1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.  
   2. Pressure Plates: Stainless steel. Include two for each sealing element.  
   3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.
PART 3 - EXECUTION

3.1 COORDINATION

A. Verify that exterior wet location boxes are gasketed type cast boxes with matching cover.

B. Verify with manufacturer that “touch-up” paint kit and are available for use.

3.2 EXAMINATION

A. Examine surfaces to receive raceways and boxes for compliance with installation tolerances and other conditions affecting performance of raceway’s installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Raceways:
   1. Comply with ANSI/NECA 1 and NFPA 70 for installation requirements applicable to products specified in Part 2 except where requirements on drawings or in this Section are stricter.
   2. Arrange raceways to maintain headroom and present neat appearance.
   3. Raceway routing is shown in approximate locations, unless dimensioned. Route to complete raceway installation before starting conductor installation.
   4. Keep raceways at least 300 mm(12") away from parallel runs of flues, steam, hot-water pipes or ductwork. Do not block access to junction boxes, mechanical equipment or prevent removal of equipment, etc.
   5. Cut raceways square using saw or pipe cutter.
   6. Use hydraulic one-shot raceway bender or factory elbows for bends in raceway larger than 53 mm(2"), unless sweep elbows required. Bend raceways according to manufacturer’s recommendations. Do not use torches or open flame to aid in bend of PVC conduit.
   7. Use raceway fittings compatible with raceways and suitable for use and environment.
   8. Provide bushings on all raceways.
   9. Raceways minimum sizes:
      a. Minimum raceway size [21 mm(3/4”)] except as noted on drawings.
      b. Minimum size for liquidtight flexible metal conduit is 21 mm(3/4”)
   10. Raceways Supports:
      a. Independently support or attach raceway system to structural parts of construction. Do not attach raceways to piping system.
      b. Raceway supports for horizontal or vertical single runs:
         1) Hot dipped galvanized heavy-duty sheet steel straps, mineralac clamps or steel slotted support channel system with appropriate components.
         2) Spring steel type pressure clamps for raceways 21 mm(3/4”) and smaller.
      c. Raceway supports for horizontal and vertical multiple runs:
         1) Supports fabricated with steel slotted channel systems with appropriate components.
         2) Anchor vertical runs to structure.
         3) Spring-steel type pressure clamps for raceways 21 mm(3/4”).
      d. Arrange raceway supports to prevent misalignment during wiring installation.
      e. Do not fasten raceways to corrugated metal roof deck.
   11. Identify raceways per requirements in Section 26 0553 – Electrical Systems Identification.
12. Ground raceways per requirements in Section 26 0526 – Grounding and Bonding for Electrical Systems.

13. Flexible Conduit Connections: Use maximum of 1800 mm (72") of flexible conduit for equipment subject to vibration, noise transmission, or movement.

14. Use tools approved for use with PVC coated conduits and fittings.

15. Install stainless steel raceway clamps, mounting hardware, supports, hangers, etc., when located in "wet" or "wash-down" areas.

B. Expansion Fittings:
1. Install raceway expansion and deflection fittings in all raceway runs embedded in or penetrating concrete where movement perpendicular to axis of the raceway may be encountered.

2. Install raceway expansion fittings complete with bonding jumpers in raceway runs that cross expansion joints in structure and raceway runs mechanically attached to 2 separate structures.

3. Install fitting(s) that provide expansion and contraction for at least 0.01 mm per m (0.0004" per ft) of length of straight run per °C (°F) of temperature change.

4. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer’s written instructions for conditions at specific location at time of installation.

C. Raceway Penetration Seals:
1. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

2. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

3. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 25 mm (1") annual clear space between pipe and sleeve for installing mechanical sleeve seals.

4. Underground, Exterior-Wall Penetrations: Install cast-iron “wall pipes” for sleeves. Size sleeves to allow for 25 mm (1") annual clear space between raceway and sleeve for installing mechanical sleeve seals.

5. Sleeve-Seal Installation: Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

D. Raceway Sealing Fittings:
1. Install listed watertight seals to prevent the passage of moisture and water vapor through raceway, where raceway passes from interior to exterior of the building, where raceway passes between areas of different temperatures .

2. Seal raceways entering or passing through “hazardous (classified) areas” as defined in NFPA 70.

3.4 APPLICATION

A. Provide raceways and boxes in accordance with the following table:

<table>
<thead>
<tr>
<th>Application</th>
<th>Approved Raceways</th>
<th>Approved Boxes</th>
<th>Application Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underground</td>
<td>Rigid steel conduitSchedule 80 PVC</td>
<td>Schedule 40 PVC</td>
<td>Cast Metal Boxes or</td>
</tr>
</tbody>
</table>

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### Application

<table>
<thead>
<tr>
<th>Application</th>
<th>Approved Raceways</th>
<th>Approved Boxes</th>
<th>Application Notes</th>
</tr>
</thead>
<tbody>
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<td>In or Under Slab on Grade</td>
<td>rigid steel conduit</td>
<td>Schedule 80 PVC</td>
<td>Nonmetallic Handholes</td>
</tr>
<tr>
<td>Outdoor Locations, Above Grade</td>
<td>rigid steel conduit</td>
<td></td>
<td>Cast or Nonmetallic boxes</td>
</tr>
<tr>
<td>Wet and Damp Locations</td>
<td>rigid steel conduit</td>
<td></td>
<td>Cast or Nonmetallic boxes</td>
</tr>
<tr>
<td>Exposed Subject to Damage</td>
<td>rigid steel conduit</td>
<td></td>
<td>Cast Metal</td>
</tr>
<tr>
<td>Hazardous Locations</td>
<td>intermediate metal conduit</td>
<td></td>
<td>Cast Metal</td>
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<tr>
<td>Locations requiring Mechanical Protection</td>
<td>Rigid Steel Conduit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vibrating equipment</td>
<td>Liquid Tight Flexible Metal Conduits</td>
<td></td>
<td>Lengths for FMC &amp; LFMC may range between 0.6 m(2 ft) to 1.2 m(4 ft)</td>
</tr>
</tbody>
</table>

### 3.5 FIELD QUALITY CONTROL

A. Inspect raceway, boxes, and wireways for physical damage, proper alignment, and supports.

B. Replace any damaged component of the raceway system or install new raceway system.

C. Inspect components, wiring, connections and grounding.

### 3.6 REPAINTING

A. Repair damage to galvanized finishes with manufacturer-supplied zinc-rich paint kit. Leave remaining paint with Owner.

B. Repair damage to PVC or paint finishes with manufacturer-supplied touch-up coating. Leave remaining coating with Owner.

### 3.7 ADJUSTING

A. Install knockout closures in unused openings in boxes.

### 3.8 CLEANING

A. Clean interior and exterior of boxes, wireways. Remove dust, debris and other material.
PART 1 - GENERAL

1.1 RELATED WORK
   A. Section 26 000 – General Electrical Requirements
   B. Section 26 0513.13 – Medium-Voltage Overhead Distribution
   C. Section 26 0526 – Grounding and Bonding for Electrical Systems

1.2 REFERENCE
   A. Work under this section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION
   A. Single-phase Overhead Type Distribution Transformers 5–167 kVA. Provide pole mount transformers, with primary connections to overhead medium-voltage distribution and secondary connections to both overhead and underground cables.

1.4 REFERENCE STANDARDS
   A. IEEE Std C57.12.00™– General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
   B. IEEE Std C57.12.20™– Overhead-Type Distribution Transformers 500kVA and Smaller: High Voltage, 34500V and Below; Low Voltage, 7970/13800Y V and below
   C. IEEE Std C57.12.31™– Pole Mounted Equipment–Enclosure Integrity
   D. IEEE Std C57.12.35™– Bar Coding for Distribution Transformers and Step-Voltage Regulators
   E. IEEE Std C57.12.90™– Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
   F. IEEE Std C57. 91™– Guide for Loading Mineral-Oil-Immersed Transformers and Step-Voltage Regulators
   G. IEEE Std C57.154™ - Design, Testing, and Application of Liquid Immersed Distribution, Power, and Regulating Transformers using High-Temperature Insulation Systems and Operating at Elevated Temperatures
   H. NEMA TR 1 (R2000)–Transformers, Regulators and Reactors, Audible Sound Levels

1.5 SUBMITTALS
   A. Submit shop drawings for equipment provided under this Section.
   B. The following data shall be submitted:
      1. Factory test results
a. No-Load losses at rated current reported at:
   1) 95°C or 20°C for 75°C AWR units
   2) 85°C or 20°C for 65°C and 65/75°C AWR units
   3) 75°C or 20°C for 55°C and 55/65°C AWR units

b. Total losses at rated current reported at:
   1) 95°C for 75°C AWR units
   2) 85°C for 65°C AWR units
   3) 75°C for 55°C AWR units

c. Percent Impedance at rated current

d. Excitation current (100% voltage) test

e. Ratio tests using all tap settings

f. Polarity and phase relation tests

g. Induced potential tests

h. Full wave and reduced wave impulse test

i. No load losses will be

C. Submit connection diagrams. Provide connection diagrams that indicate wiring and connections, general physical layout of device components.

D. Submit manufacturer’s instructions for power transformers including special provisions required to install equipment components and system packages. Provide special notices that detail impedances, hazards and safety precautions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Eaton: Cooper Power Systems Division

B. Central Maloney Incorporated

C. ABB

2.2 RATINGS

A. Winding Rise (AWR): 65°C when measured at the top of the tank.

B. Short-Circuit Withstand: In accordance with IEEE C57.12.00. Capable of withstanding mechanical and thermal stresses causes by short circuits on the external terminals of the low voltage windings

C. Standard kVA ratings, continuous duty: 5, 10, 15, 25, 37.5, 50, 75, 100, 167.

D. Primary voltage: 2400/4160Y

E. Primary BIL: 60kV.

F. Secondary voltage:
   1. 120/240 (5-100kVA-3 Bushings, 167kVA-4 Bushings)
   2. 240/480 (5-100kVA-3 Bushings, 167kVA – 4 Bushings)
   3. 120V (2 Bushings)
4. 277V (2 Bushings)

G. Secondary BIL: 30Kv

H. Taps: Two-2 ½% taps above and below rated voltage (Split Taps). Furnish transformer with full capacity high-voltage taps. The tap-changer shall be clearly labeled to reflect that the transformer must be de-energized before operating the tap-changer as required in IEEE Std C57.12.20. The tap-changer shall be operable on the higher voltage only for transformers with dual voltage primaries. The unit shall have one of the following tap configurations:

I. The transformer shall have a dual voltage primary capable of being reconnected with an externally operable, de-energized switch. The voltage provided and the basic insulation level (BIL) shall be in accordance with Table 1.

### Table 1

<table>
<thead>
<tr>
<th>Transformer High-voltage</th>
<th>Minimum kVA Rating For Low-voltage Rating of:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Transformer High-voltage</td>
</tr>
<tr>
<td></td>
<td>Rating (V)</td>
</tr>
<tr>
<td>2400/4160Y x</td>
<td>2400/4160Y</td>
</tr>
<tr>
<td>7200/12470Y</td>
<td>7200/12470Y</td>
</tr>
<tr>
<td>4160GrdY/2400 x</td>
<td>4160GrdY/2400</td>
</tr>
<tr>
<td>12470GrdY/7200</td>
<td>12470GrdY/7200</td>
</tr>
</tbody>
</table>

1. Low-voltage rating of 120/240 volts or 240/480 volts is suitable for series, multiple, or three-wire service.

2.3 CORE AND COIL

A. The core and coil shall be vacuum processed to ensure maximum penetration of insulating fluid into the coil insulation system. While under vacuum, the transformer will be filled with preheated filtered degassed insulating fluid. The core shall be manufactured from burr-free, grain-oriented silicon steel and shall be precisely stacked to eliminate gaps in the corner joints. The coil shall be insulated with B-stage, epoxy coated, diamond pattern insulating paper, which shall be thermally cured under pressure to ensure proper bonding of conductor and paper.

B. Transformers 75kVA and below shall be manufactured with interlaced windings in order to provide superior surge suppression (Interlaced windings above 75kVA are not required for superior surge suppression due to greater volts/turn at the higher kVA's)

2.4 TANK CONSTRUCTION

A. Include pressure relief device as a means to relieve pressure in excess of pressure resulting from normal operation. The venting and sealing characteristics shall be as follows:

1. Cracking pressure: 10psig ± 2 psig
2. Resealing pressure: 6 psig minimum
3. Zero leakage from reseal pressure to -8 psig
4. Flow at 15 psig: 35 SCFM minimum

B. Recessed tank bottom offering protection from uneven surfaces.
C. Internal marking provided indicating nominal insulating fluid level per - IEEE Std C57.12.20.

D. Mild steel cover ring with stainless steel cover ring loops and a stainless-steel bolt. Bronze nut material for corrosion mitigation.

E. Anodized aluminum laser engraved nameplate. Nameplate shall conform to IEEE Std C57.12.00, nameplate A.

F. Provision for arrester mounting pads, grounding provisions, ANSI® support lugs (hanger brackets) and lift lugs. Hanger brackets based on engineered drawings.

2.5 INSULATING FLUID

A. The dielectric coolant shall be listed less-flammable fluid meeting the requirements of National Electrical Code Section 450-23 and the requirements of the National Electrical Safety Code (IEEE Std C2™), Section 15. The dielectric coolant shall be non-toxic per OECD G.L. 203, non-bioaccumulating and be readily and completely biodegradable per EPA OPPTS 835.3100. The base fluid shall be 100% derived from edible seed oils and food grade performance enhancing additives. The fluid shall not require genetically altered seeds for its base oil. The fluid shall be certified to comply with the US EPA Environmental Technology Verification (ETV) requirements and tested for compatibility with transformer components. The fluid shall be Factory Mutual Approved®, UL® Classified Dielectric Medium (UL-EOUV) and UL® Classified Transformer Fluid (UL-EOVK), Envirotemp™ FR3™ fluid.

B. Transformer components shall be certified to comply with industry standards when tested in Envirotemp™ FR3™ fluid. Certified test reports for each transformer component shall be provided upon request.

2.6 TERMINATIONS

A. High Voltage Bushings and Terminal:

1. Transformers with GrdY medium voltage (example: 12470GrdY/7200) will be manufactured with one (1) high voltage bushings. Transformers with Y medium voltage (example: 7200/12470Y) will be manufactured with two (2) high voltage bushings.

2. high-voltage bushings provided shall be in accordance with Table 3.

<table>
<thead>
<tr>
<th>BIL withstand (kV)</th>
<th>Creepage distance (minimum) mm (in)</th>
<th>Minimum 60-Hz dry 1-minute withstand (kV)</th>
<th>Minimum 60-Hz wet 10-second withstand (kV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td></td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>45</td>
<td></td>
<td>15</td>
<td>13</td>
</tr>
<tr>
<td>60</td>
<td></td>
<td>21</td>
<td>20</td>
</tr>
<tr>
<td>75</td>
<td></td>
<td>27</td>
<td>24</td>
</tr>
<tr>
<td>95</td>
<td>255 (10)</td>
<td>35</td>
<td>30</td>
</tr>
<tr>
<td>95a</td>
<td>380 (15)</td>
<td>42</td>
<td>36</td>
</tr>
</tbody>
</table>

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3. The bushing terminals provided shall be tin plated to accommodate both aluminum and copper conductors. The size of these terminals shall be in accordance with Table 4.

Table 4
High-Voltage Terminal Sizes for Single-Phase Transformers

<table>
<thead>
<tr>
<th>Size of Terminal Opening</th>
<th>AWG Size of Conductor Terminal will Accommodate</th>
<th>kVA Range for High Voltage Rating of:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inches (Millimeters)</td>
<td></td>
<td>5 kV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>And</td>
</tr>
<tr>
<td></td>
<td></td>
<td>below</td>
</tr>
<tr>
<td>5/16 (7.9)</td>
<td>No 8 Solid to No 2 Stranded</td>
<td>10-167</td>
</tr>
<tr>
<td>5/8 (15.9)</td>
<td>No 6 Solid to No 4/0-19 Stranded</td>
<td>250-500</td>
</tr>
</tbody>
</table>

4. The color of the bushings shall match Light Gray Number 70, Munsell Notation 5BG7.0/0.4.

B. Low Voltage Bushings and Terminals
1. The internal secondary leads shall be permanently embossed with the letters A, B, C, and D Per IEEE Std C57.12.00™ and IEEE Std C57.12.20™. This marking can be used as a means to locate such leads with respect to one another for internal reconnection.

2. The size of the terminals shall be in accordance with Table 5.

Table 5
Low-Voltage Terminal Sizes for Single-Phase Transformers

<table>
<thead>
<tr>
<th>Size of Terminal Opening</th>
<th>AWG Size of Conductor Terminal will Accommodate</th>
<th>Transformer Low Voltage Rating (volts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inches (Millimeters)</td>
<td></td>
<td>120/240</td>
</tr>
<tr>
<td>5/16 (7.9)</td>
<td>No 8 Solid to No 2 Stranded</td>
<td>-</td>
</tr>
<tr>
<td>5/8 (15.9)</td>
<td>No 6 Solid to No 4/0-19 Stranded</td>
<td>10-15</td>
</tr>
<tr>
<td>13/16 (20.6)</td>
<td>No 2 Solid to 350 kcmil-19 Stranded</td>
<td>25-50</td>
</tr>
<tr>
<td>15/16 (23.8)</td>
<td>No 1/0 Solid to 500 kcmil-37 Stranded</td>
<td>75</td>
</tr>
<tr>
<td>1-1/4 (31.8)</td>
<td>No 2/0 Solid to 1000 kcmil-61 Stranded</td>
<td>100</td>
</tr>
<tr>
<td>Spade H</td>
<td>- - -</td>
<td>167-250</td>
</tr>
</tbody>
</table>
2.7 FINISH

A. Transformer shall be painted Munsell Notation 5BG7.0/0.4, ANSI 70 Gray. The coating system shall meet or exceed IEEE Std C57.12.31™ standard coating system requirements for pole-mount equipment, including the following performance tests:
   1. Salt spray test per ASTM B117 / D1654
   2. Cross hatch adhesion test ASTM D3359
   3. Humidity test per ASTM D4585 / D3363
   4. Impact test per ASTM D2794 / B1117
   5. Ultraviolet accelerated weathering (QUV) test per ASTM G154 / D523
   6. Abrasion resistance Taber abraser test per ASTM D4060 / B1117
   7. Certified test data shall be furnished upon request.

2.8 Overcurrent Protection: Reference 26 05 13.13 Medium-Voltage Overhead Distribution.

2.9 Overvoltage Protection

A. Overvoltage protection shall be provided with transformer.
   1. Primary overvoltage protection
      a. Direct Connected UltraSIL Polymer-Housed Surge Arrester

2.10 Accessories

A. Provide the following 15kV insulated cover, high voltage terminal shall be supplied with a side-mounted handwheel type wildlife guard sized to fit each transformer securely. Provide non-pcb decal, secondary voltage decal, extra creep bushings, vacuum pressure gauge, fluid level gauge, temperature gauge, drain valve with sampling device, tank ground connector, and ground strap.

PART 3 - EXECUTION

3.1 SHIPPING

A. The unit shall be sufficiently banded or blocked to a wood pallet.

3.2 INSPECTION

A. Visually inspect equipment and components at time of delivery. Submit report to Engineer with list of items to be corrected.

3.3 INSTALLATION

A. Provide required work for pole mounted installation including rigging, hardware, connection and testing.

B. Provide liquid filling of transformer at job site where required including supervision, pumping, vacuum and fluid testing.

C. Install equipment per manufacturer’s recommendation. Install level and true to vertical.

D. Protect equipment during installation to prevent twisting or deformations, exposure to potentially damaging environments. Maintain protection until completion of construction,
E. The manufacturer shall provide the guaranteed average no-load and load losses for the unit when specified. These losses will be subject to the tolerances listed in Table 6.

Table 6: Tolerance for Transformer Losses

<table>
<thead>
<tr>
<th>3.4 No-Load Losses (%)</th>
<th>3.5 Total Losses (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.6 10</td>
<td>3.8 6</td>
</tr>
<tr>
<td>3.7</td>
<td></td>
</tr>
</tbody>
</table>

Transformers shall conform to efficiency levels for liquid immersed distribution transformers, as specified in the Department of Energy ruling “10 CFR Part 431 Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule; April 18, 2013.” Manufacturer shall comply with the intent of all regulations set forth in noted ruling.

3.9 FIELD QUALITY CONTROL

1. Perform phase-rotation test of existing service. Provide identical phase-rotation from new service for compatibility with existing load requirements.

2. Liquid Filled Transformers:
   a. Visual and Mechanical Inspection:
      1) Compare equipment nameplate data with drawings and specifications.
      2) Inspect physical and mechanical condition for physical damage, cracked insulators, and tightness of connection.
      3) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer’s published data.
      4) Verify correct liquid level in tanks and bushings.
      5) Perform specific inspections and mechanical tests as recommended by manufacturer.
      6) Verify correct equipment grounding.
   b. Electrical Tests:
      1) Perform insulation-resistance tests, winding-to-winding and each winding-to-grounding with test voltage in accordance with Table 5. Test duration shall be for 10 minutes with resistance tabulated at 30 seconds, 1 minute, and 10 minutes.
      2) Perform insulation power-factor/dissipation-factor tests on windings and correct to 20°C(68°F) in accordance with test equipment manufacturer’s instructions.
      3) Perform power-factor/dissipation-factor tests (or hot collar watts-loss tests) on bushings and correct to 20°C(68°F) in accordance with test equipment manufacturer’s instructions.
      4) Perform excitation-current tests in accordance with test equipment manufacturer’s instructions.
   c. Test Values:
      1) Bolt-torque levels shall be in accordance with manufacturer.
      2) Provide Insulation-resistance test values at one minute. Verify within acceptable tolerance.
3) Polarization index should be compared to manufacturer’s factory test results. If manufacturer’s data is not available, acceptance test results will serve as baseline data.

4) Turns-ratio test results shall not deviate more than 0.5% from either the adjacent coils or the calculated ratio.

5) Maximum power factor of liquid-filled transformers corrected to 20°C(68°F) shall be in accordance with transformer manufacturer’s published data. Compare with test equipment manufacturer’s published data.

6) Investigate bushing power factors and capacitances that vary from nameplate values by more than 10%. Investigate any bushing hot collar watts-loss results that exceed test equipment manufacturer’s published data.

7) Consult manufacturer if winding-resistance measurements vary more than 1% from adjacent windings.

8) Consult manufacturer if core insulation is less than one megohm at 500 VDC.

B. Medium-Voltage Surge Arresters:
   a. Visual and Mechanical Inspection:
      1) Compare equipment nameplate data with drawings and specifications.
      2) Inspect physical and mechanical condition.
      3) Inspect anchorage, alignment and grounding.
      4) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer’s published data.
      5) Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.
   b. Electrical Tests:
      1) Perform resistance measurements through bolted connections.
      2) Test grounding connection with a point-to-point resistance test.
   c. Test Values:
      1) Compare microhm or millivolt drop values to manufacturer’s published data. In the absence of manufacturer’s data, compare similar units. Investigate deviations of more than 50% from lowest value.
      2) Insulation resistance should be in accordance with manufacturer’s published data.
      3) Resistance between the arrester ground terminal and ground shall be less than 0.5 ohm.

END OF SECTION