

SPECIFICATIONS FOR DRY TYPE TRANSFORMERS AND PANELBOARDS

SECTION 26 05 00 - ELECTRICAL - BASIC REQUIREMENTS

SECTION 26 08 13 - MEDIUM VOLTAGE EQUIPMENT ACCEPTANCE TESTING

SECTION 26 11 16 - UNIT SUBSTATION (DRY-TYPE)

SECTION 26 24 16 - PANELBOARDS

SECTION 26 05 00
ELECTRICAL - BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Basic requirements for electrical systems.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Section 26 05 19 - Wire and Cable - 600 Volt and Below.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Aluminum Association (AA):
 - a. ADM, Aluminum Design Manual.
 - 2. American Institute of Steel Construction (AISC):
 - a. Steel Construction Manual.
 - 3. American National Standards Institute (ANSI).
 - 4. ASTM International (ASTM):
 - a. A36/A36M, Standard Specification for Carbon Structural Steel.
 - b. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - c. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 5. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. C2, National Electrical Safety Code (NESC).
 - 6. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - 7. National Electrical Manufacturers Association (NEMA):
 - 8. Underwriters Laboratories, Inc. (UL).
- B. Products to be listed by a Nationally Recognized Testing Laboratory (NRTL) in accordance with applicable product standards.
 - 1. Applicable product standards including, but not limited to, ANSI, FM, IEEE, NEMA and UL.
 - 2. NRTL includes, but is not limited to, CSA Group Testing and Certification (CS), FM Approvals LLC (FM), Intertek Testing Services NA, Inc. (ETL), and Underwriters Laboratories, Inc. (UL).

1.3 DEFINITIONS

- A. For the purposes of providing materials and installing electrical work the following definitions shall be used.
 - 1. Outdoor area: Exterior locations where the equipment is normally exposed to the weather and including below grade structures, such as vaults, manholes, handholes and in-ground pump stations.
 - 2. Architecturally finished interior area: Offices, laboratories, conference rooms, restrooms, corridors and other similar occupied spaces.
 - 3. Non-architecturally finished interior area: Pump, chemical, mechanical, electrical rooms and other similar process type rooms.

4. Highly corrosive and corrosive area: Areas identified on the Drawings where there is a varying degree of spillage or splashing of corrosive materials such as water, wastewater or chemical solutions; or chronic exposure to corrosive, caustic or acidic agents, chemicals, chemical fumes or chemical mixtures.
5. Hazardous areas: Class I, II or III areas as defined in NFPA 70.
6. Shop fabricated: Manufactured or assembled equipment for which a UL test procedure has not been established.

1.4 SUBMITTALS

- A. Shop Drawings:
 1. See individual specification sections for submittal requirements for products defined as equipment.
 2. General requirements:
 - a. Provide manufacturer's technical information on products to be used, including product descriptive bulletin.
 - b. Include data sheets that include manufacturer's name and product model number.
 - 1) Clearly identify all optional accessories.
 - c. Acknowledgement that products are NRTL listed or are constructed utilizing NRTL recognized components.
 - d. Manufacturer's delivery, storage, handling and installation instructions.
 - e. Product installation details.
 - f. Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70, include any required calculations.
 - g. See individual specification sections for any additional requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect nameplates on electrical equipment to prevent defacing.

1.6 AREA DESIGNATIONS

- A. Designation of an area will determine the NEMA rating of the electrical equipment enclosures, types of conduits and installation methods to be used in that area.
 1. Outdoor areas:
 - a. Wet.
 - b. Also, corrosive and/or hazardous when specifically designated on the Drawings or in the Specifications.
 2. Indoor areas:
 - a. Dry.
 - b. Also, wet, corrosive and/or hazardous when specifically designated on the Drawings or in the Specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, refer to specific Electrical Specification Sections and specific material paragraphs below for acceptable manufacturers.
- B. Provide all components of a similar type by one (1) manufacturer.

2.2 MATERIALS

- A. Electrical Equipment Support Pedestals and/or Racks:
 1. Manufacturers:
 - a. Modular strut:

- 1) Unistrut Building Systems.
 - 2) B-Line by Eaton.
 - 3) Globe Strut.
 - 4) Superstrut by Thomas & Betts.
 - 5) Or Approved Equal
2. Material requirements:
- a. Modular strut:
 - 1) Galvanized steel: ASTM A123/123M or ASTM A153/A153M.
 - 2) Stainless steel: AISI Type 316.
 - 3) PVC coated galvanized steel: ASTM A123/A123M or ASTM A153/A153M and 20 mil PVC coating.
 - 4) Aluminum: AA Type 6063-T6.
 - b. Structural members (e.g., I beams, L and C channels):
 - 1) Galvanized steel: ASTM A36/A36M steel with galvanizing per ASTM A123/A123M.
 - 2) Aluminum: AA Type 6061-T6 or 6063-T6.
 - c. Mounting plates:
 - 1) Galvanized steel: ASTM A36/A36M steel with galvanizing per ASTM A123/A123M.
 - 2) Aluminum: AA Type 6063-T6.
 - d. Mounting hardware:
 - 1) Galvanized steel.
 - 2) Stainless steel.
 - e. Anchorage per industry standards.
- B. Field touch-up of galvanized surfaces.
1. Zinc-rich primer.
 - a. One coat, 3.0 mils, ZRC by ZRC Products.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and wire all equipment, including prepurchased equipment, and perform all tests necessary to assure conformance to the Drawings and Specification Sections and ensure that equipment is ready and safe for energization.
- B. Install equipment in accordance with the requirements of:
 1. NFPA 70.
 2. IEEE C2.
 3. The manufacturer's instructions.
- C. In general, conduit routing is not shown on the Drawings.
 1. The Contractor is responsible for routing all conduits including those shown on one-line and control block diagrams and home runs shown on floor plans.
 2. Conduit routings and stub-up locations that are shown are approximate; exact routing to be as required for equipment furnished and field conditions.
- D. When complete branch circuiting is not shown on the Drawings:
 1. A homerun indicating panelboard name and circuit number will be shown and the circuit number will be shown adjacent to the additional devices (e.g., light fixture and receptacles) on the same circuit.
 2. The Contractor is to furnish and install all conduit and conductors required for proper operation of the circuit.

3. The indicated home run conduit and conductor size shall be used for the entire branch circuit.
- E. Do not use equipment that exceed dimensions or reduce clearances indicated on the Drawings or as required by the NFPA 70.
- F. Install equipment plumb, square and true with construction features and securely fastened.
- G. Install electrical equipment, including pull and junction boxes, minimum of 6 inches from process, gas, air and water piping and equipment.
- H. Install equipment so it is readily accessible for operation and maintenance, is not blocked or concealed and does not interfere with normal operation and maintenance requirements of other equipment.
- I. Device Mounting Schedule:
 1. Unless indicated otherwise on the Drawings, mounting heights are as indicated below:
 - a. Light switch (to center): 46 inches.
 - b. Receptacle in architecturally finished areas (to center): 18 inches.
 - c. Receptacle on exterior wall of building (to center): 18 inches.
 - d. Receptacle in non-architecturally finished areas (to center): 46 inches.
 - e. Telephone outlet in architecturally finished areas (to center): 18 inches.
 - f. Telephone outlet for wall-mounted phone (to center): 46 inches.
 - g. Safety switch (to center of operating handle): 54 inches.
 - h. Separately mounted motor starter (to center of operating handle): 54 inches.
 - i. Pushbutton or selector switch control station (to center): 46 inches.
 - j. Panelboard (to top): 72 inches.
- J. Avoid interference of electrical equipment operation and maintenance with structural members, building features and equipment of other trades.
 1. When it is necessary to adjust the intended location of electrical equipment, unless specifically dimensioned or detailed, the Contractor may make adjustments of up to 6 inches in equipment location with the Engineer's approval.
- K. Provide electrical equipment support system per the following area designations:
 1. Dry areas:
 - a. Galvanized system consisting of galvanized steel channels and fittings, nuts and hardware.
 - b. Field touch-up cut ends and scratches of galvanized components with the specified primer during the installation, before rust appears.
 2. Wet areas:
 - a. Galvanized system consisting of galvanized steel channels and fittings, nuts and hardware.
 - b. Field touch-up cut ends and scratches of galvanized components with the specified primer during the installation, before rust appears.
 3. Corrosive areas:
 - a. Aluminum system consisting of aluminum channels and fittings with stainless steel nuts and hardware.
 4. Highly corrosive areas:
 - a. PVC coated steel system consisting of PVC coated steel channels and fittings with stainless steel nuts and hardware.
- L. Provide all necessary anchoring devices and supports rated for the equipment load based on dimensions and weights verified from approved submittals, or as recommended by the manufacturer.

1. Do not cut, or weld to, building structural members.
 2. Do not mount safety switches or other equipment to equipment enclosures, unless enclosure mounting surface is properly braced to accept mounting of external equipment.
- M. Provide non-metallic corrosion resistant spacers to maintain 1/4 inches separation between metallic equipment and/or metallic equipment supports and mounting surface in wet areas, on below grade walls and on walls of liquid containment or processing areas such as Basins, Clarifiers, Digesters, Reservoirs, etc.
- N. Do not place equipment fabricated from aluminum in direct contact with earth or concrete.
- O. Screen or seal all openings into equipment mounted outdoors to prevent the entrance of rodents and insects.
- P. Do not use materials that may cause the walls or roof of a building to discolor or rust.
- Q. Identify electrical equipment and components in accordance with industry standards.
- R. Provide field markings and/or documentation of available short-circuit current (available fault current) and related information for equipment as required by the NFPA 70 and other applicable codes.
- S. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
1. Determine the SCCR rating by one of the following methods:
 - a. Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
 - b. Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
 - c. Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
 2. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the equipment or control panel circuit originates.
 3. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.

3.2 FIELD QUALITY CONTROL

- A. Verify exact rough-in location and dimensions for connection to electrified equipment, provided by others.
- B. Replace equipment and systems found inoperative or defective and re-test.
- C. The protective coating integrity of support structures and equipment enclosures shall be maintained.
1. Repair galvanized components utilizing a zinc rich paint.
 2. Repair painted components utilizing touch up paint provided by or approved by the manufacturer.
 3. Repair PVC coated components utilizing a patching compound, of the same material as the coating, provided by the manufacturer of the component.
 4. Repair surfaces which will be inaccessible after installation prior to installation.
- D. Replace nameplates damaged during installation.

END OF SECTION

SECTION 26 08 13
MEDIUM VOLTAGE EQUIPMENT ACCEPTANCE TESTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Basic requirements for acceptance testing.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. 400, Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems.
 - b. 400.2, Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF) (less than 1 Hz).
 2. InterNational Electrical Testing Association (NETA):
 - a. ATS, Standard for Acceptance Testing Specifications for Electric Power Equipment and Systems.
 3. Nationally Recognized Testing Laboratory (NRTL).
 4. Telecommunications Industry Association/Electronic Industries Alliance/American National Standards Institute (TIA/EIA/ANSI):
 - a. 455-78-B, Optical Fibres - PART 1-40: Measurement Methods and Test Procedures - Attenuation.
 - b. NEMA WC 74/ICEA S-93-639, 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.
- B. Qualifications:
1. Testing firm:
 - a. An independent firm performing, as the sole or principal part of its business for a minimum of 10 years, the inspection, testing, calibration, and adjusting of systems.
 - b. Must have an established monitoring and testing equipment calibration program with accuracy traceable in an unbroken chain, according to NIST.
 2. Field personnel:
 - a. Minimum of one year field experience covering all phases of electrical equipment inspection, testing, and calibration.
 - b. Relay test technician having previous experience with testing and calibration of relays of the same manufacturer and type used on project and proficient in setting and testing the types of protection elements used.
 - c. Supervisor certified by NETA or NICET.
 - 1) As an alternative, supervising technician may be certified by the equipment manufacturer
 3. Analysis personnel:
 - a. Minimum three years combined field testing and data analysis experience.
 - b. Supervisor certified by NETA or NICET.
 - 1) As an alternative, supervising technician may be certified by the equipment manufacturer.

1.3 SUBMITTALS

- A. Shop Drawings:

1. Equipment Monitoring and Testing Plan.
- B. Informational Submittals:
 1. Cable test reports from the manufacturer in accordance with ANSI/NEMA WC 74/ICEA S-93-639 and NETA ATS:
 - a. Voltage Withstand Tests
 - b. Partial Discharge Tests
 - c. Insulation/Conductor Resistance Tests
 2. Prior to energizing equipment:
 - a. Coordinated phasing diagram.
 - b. Photocopies of continuity tests.
 - c. VLF Medium Voltage Test Report.
 3. Within two weeks after successful completion of Demonstration Period (Commissioning Period):
 - a. Single report containing information including:
 - 1) Summary of Project.
 - 2) Information from pre-energization testing.
 - 3) Testing and monitoring reports.

PART 2 - PRODUCTS

2.1 FACTORY QUALITY CONTROL

- A. Provide Electrical equipment with all factory tests required by the applicable industry standards or NRTL.

PART 3 - EXECUTION

3.1 SPECIFIC EQUIPMENT TESTING REQUIREMENTS

- A. Switchgear and Switchboards:
 1. Perform inspections and tests per NETA ATS 7.1.
 2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
- B. Transformers - Small Dry Type:
 1. Perform inspections and tests per NETA ATS 7.2.1.1.
 2. Perform the following additional tests:
 - a. Record phase-to-phase, phase-to-neutral, and neutral-to-ground voltages at no load after energizing, and at operating load after startup.
 3. Adjust tap connections as required to provide secondary voltage within 2-1/2% of nominal under normal load after approval of Engineer.
 4. Record as-left tap connections.
- C. Transformers - Large Dry Type:
 1. Perform inspections and tests per NETA ATS 7.2.1.2.
 2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
 3. Perform the following additional tests:
 - a. Record phase-to-phase, phase-to-neutral, and neutral-to-ground voltages at no load after energizing, and at operating load after start-up.
 4. Adjust tap connections as required to provide secondary voltage within 2-1/2% of nominal under normal load.

5. Record as-left tap connections.
- D. Cable - Low Voltage:
1. Perform inspections and tests per NETA ATS 7.3.2.
- E. Cable – 15 kV Medium Voltage:
1. Perform inspections and tests per manufacturer’s recommendations.
 2. Prior to energization, perform a Very low frequency (VLF) test following IEEE 400.2 Guide for Field Testing of Shielded Power Cable systems for baseline data for future VLF maintenance testing:
 - a. VLF testing shall include:
 - 1) Withstand test to evaluate whether the cable can handle the test voltage (See IEEE 400.2 Table 3).
 - a) Cable System Testing Voltage: 15kV (Phase to Phase).
 - b) Installation Test Voltage: 19kV RMS (Phase to Ground).
 - c) Withstand Test Duration: 30 minutes.
 - 2) Tangent delta test, including differential tangent delta and tangent delta stability, for baseline comparison:
 - a) Line to Ground Voltage: 7.2kV.
 - b) Applies Test Voltages: 3.6kV, 7.2kV, 10.8kV, 14.4kV.
 - c) Test Duration: 3 Minutes at each voltage.
 - b. VLF testing shall be completed by technicians trained to use testing equipment with at least three years of experience in performing VLF testing on medium voltage cables.
 3. Results for new cable shall be compared to Table G.2 in IEEE 400.2.
 - a. Acceptable Condition:
 - 1) Tangent Delta Stability at 7.2kV: <0.1
 - 2) Tip Up: <5
 - 3) Tangent Delta at 7.2kV: <10
 - b. Discrepancies between field test results and Table G.2 shall be notated and discussed with testing equipment manufacturer to determine validity of results.
 4. Grounding:
 - a. Perform inspections and tests per manufacturer’s recommendations.
 - b. Components: Test all components per applicable paragraphs of this Specification Section and manufacturer’s recommendations.
- F. Grounding:
1. Perform inspections and tests per NETA ATS 7.13.
 2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.

END OF SECTION

SECTION 26 11 16
UNIT SUBSTATION (DRY-TYPE)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Unit substation.
- B. Related Sections include but are not necessarily limited to:
 - 1. Section 26 05 00 - Electrical - Basic Requirements.
 - 2. Section 26 08 13 – Medium Voltage Equipment Acceptance Testing.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. Shop drawings shall be issued to Owner for review and approval prior to a release for manufacturing.
 - 2. Product technical data including:
 - a. Technical data including assembly and component ratings.
 - b. Nameplate drawings for all equipment.
 - c. Mounting and loading information.
 - d. Installation instructions and procedures.
 - e. See Section 26 05 00 for additional requirements.
 - 3. Fabrication and/or layout drawings:
 - a. General arrangement.
 - b. Elevation.
 - c. Equipment splits with dimensions.
 - d. Single-line and three-line.
 - e. Wiring diagrams for all accessories.
 - 4. Test reports:
 - a. Factory tests
 - b. No product shall be delivered to site prior to factory witness testing by Owner's engineer and/or approval of issued Certified Test Report.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Special Site Constraints: Delivery to the Ross Substation location has the following dimensional and weight limitations due to the elevator shaft cage. Cage dimensions are 123" high x 144" wide x 55" deep with a maximum weight of 13,500 lbs. Equipment shall be ordered in shipping splits that can be safely delivered to the installation location. Protect, disassemble, reassemble equipment as required to be delivered. Transformers will likely have to be delivered with their cast coil assemblies removed and reassembled on location.
- B. Protect nameplates on electrical equipment to prevent defacing.
- C. Protect materials during delivery and storage and maintain within manufacturer's written storage requirements. At minimum, store indoors in clean, dry space with uniform temperature to

prevent condensation and protect electronics from potential damage from electrical and magnetic energy.

1.5 REGULATORY REQUIREMENTS

- A. Domestic Preference
 - 1. The medium voltage metal-enclosed switchgear shall meet the requirements of the Build America, Buy America Act (BABA).
 - 2. Manufacturer's dedicated domestic preference resources shall provide all supporting documentation to the soliciting entity to certify compliance with the above domestic preference requirement.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. ABB.
 - 2. Eaton.
 - 3. Siemens.
 - 4. Schneider Electric.
 - 5. Approved Equal.

2.2 PRIMARY EQUIPMENT

- A. The equipment shall have the following accessories/features:
 - 1. NEMA 12 construction.
 - 2. Cable connection to transformer. Include transition section as required.

2.3 TRANSFORMER

- A. **Transformer 1** shall have the following accessories/features:
 - 1. Dry-Type, Unit Substation with Transformer and Secondary-Side Fused Disconnect Switch.
 - 2. Construction: NEMA 12 enclosure.
 - a. Enclosure Alternate: Where approved by Owner, NEMA 1, gasketed with filtered openings.
 - 3. Coil material:
 - a. Copper.
 - b. Vacuum Pressure Impregnation (VPI)
 - c. Cast Coil
 - 4. kVA and Voltage Ratings:
 - a. 1500 kVA
 - b. 12.47 kV (Delta) – 4.16Y/2.4 kV (Wye)
 - 5. Configurations:
 - a. Number of phases: Three.
 - b. Frequency: 60 Hz.
 - c. Polarity: ANSI standard.
 - d. Percent impedance: ANSI standard.
 - e. Basic impulse level (BIL):
 - 1) Primary: 95 kV
 - 2) Secondary: 60 kV
 - 6. Temperature rise: 185 °C Rated, 115 °C Rise above 40 °C Ambient
 - 7. Efficiency: Meet all current Department of Energy rules.

8. Dry type construction.
 9. Connections:
 - a. Primary:
 - 1) Cable Entry: From Top or side
 - 2) One set of three (3) single conductor, 15 kV Class cables
 - 3) Bolted Lug Terminations
 10. Tap-changer: De-energized type on H-winding, five total with:
 - a. Two 2.5% above and two 2.5% below nominal tap.
 11. Finish color: Gray (ANSI 61 or equivalent)
- B. Transformer 2 shall have the following accessories/features:**
1. Dry-Type Transformer.
 2. Construction: NEMA 12 enclosure.
 - a. Enclosure Alternate: Where approved by Owner, NEMA 1, gasketed with filtered openings.
 3. Coil material:
 - a. Copper.
 - b. Vacuum Pressure Impregnation (VPI)
 - c. Cast Coil
 4. kVA and Voltage Ratings:
 - a. 500 kVA
 - b. 12.47 kV (Delta) – 480/277 V (Wye)
 5. Configurations:
 - a. Number of phases: Three.
 - b. Frequency: 60 Hz.
 - c. Polarity: ANSI standard.
 - d. Percent impedance: ANSI standard.
 - e. Basic impulse level (BIL):
 - 1) Primary: 95 kV
 - 2) Secondary: 35 kV
 6. Temperature rise: 185 °C Rated, 115 °C Rise above 40 °C Ambient
 7. Efficiency: Meet all current Department of Energy rules.
 8. Dry type construction.
 9. Connections:
 - a. Primary:
 - 1) Cable Entry: From Top
 - 2) 1) set of three (3) single conductor, 15 kV Class cables
 - 3) Bolted Lug Bus Bar Terminations
 10. Tap-changer: De-energized type on H-winding, five total with:
 - a. Two 2.5% above and two 2.5% below nominal tap.
 11. Finish color: Gray (ANSI 61 or equivalent)

2.4 SECONDARY EQUIPMENT

- A. Transformer 1 shall have the following accessories/features:**
1. Secondary-Side Fused Disconnect Switch:
 - a. 5 kV, 600 A, 25 kA rms, metal enclosed load interrupter switch.
 - b. Narrow design.

- c. With fuses rated to provide secondary-side transformer protection.
 - d. Cabled or bussed line side connections to transformer, include transition section as required.
 - e. Cabled load-side connections.
- B. The equipment shall have the following accessories/features:
- 1. Control power transformer to supply power to auxiliary devices (e.g., cooling fans, heaters, etc.)
 - 2. NEMA 12 construction.
 - 3. Finish color: Gray (ANSI 61 or equivalent)

2.5 CONSTRUCTION

- A. Transformer shall be cooled by natural air convection.
- B. The electrical insulation system shall utilize Class F material in a fully rated 185 degrees C system.
- C. The transformer shall be designed to meet the sound level standards for dry-type transformers as defined in NEMA TR1. The measurement procedure shall be as specified in ANSI C57.12.90
- D. The transformer shall be NRTL listed and labeled.
- E. The transformer shall be of explosion-resistant, fire-resistant, air-insulated, ventilated dry-type construction, and cooled by the natural circulation of air through the windings.
- F. High-voltage and low-voltage windings shall be copper.
- G. The high- and low-voltage coil assembly shall be Vacuum Pressure Impregnated (VPI) polyester.
- H. The high- and low-voltage coil assembly shall be preheated to evaporate any moisture, then placed into a vacuum pressure tank. The air in the tank shall be evacuated; and at extremely low absolute pressure, all air bubbles are to be drawn out of the insulating materials. The resin shall be introduced to a level that submerges all parts while the vacuum is maintained. Then the vacuum shall be released and pressure applied, after which the coil shall be removed and placed in an oven for several hours in order for the resin to catalyze into a composite mass, completely sealing and binding the winding.
- I. The transformer shall be supplied in a knockdown case design, for ease in fitting through limited openings, and shall be of heavy gauge sheet steel construction, equipped with removable panels for access to the core and coils. Front and rear panels shall incorporate louvered ventilating grills.

2.6 ACCESSORIES:

- A. Diagram instruction plate.
- B. Provisions for lifting and jacking.
- C. Core Winding Temperature Monitor
- D. Removable center panel for access to high-voltage strap-type connector taps for de-energized tap changing.
- E. Two ground pads with continuous ground bus.

2.7 MAINTENANCE MATERIALS

- A. Touch-up paint.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

B. Arrange as shown on the Drawings.

3.2 FIELD QUALITY CONTROL

A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

B. Acceptance tests: See Section 26 08 13.

3.3 TRAINING

A. A qualified factory-trained manufacturer's representative shall provide the Owner with 4 hours of on-site training in the operation and maintenance of the unit substation and its components.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Branch circuit panelboards.
 - 2. Distribution panelboards.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Section 26 05 00 - Electrical - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. PB 1, Panelboards.
 - 2. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - 3. Underwriters Laboratories, Inc. (UL):
 - a. 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.
 - b. 67, Standard for Panelboards.

1.3 DEFINITIONS

- A. Branch Circuit Panelboard: Bus rating of 400A and less or where labeled as Branch Circuit Panelboard on the Drawings.
- B. Distribution Panelboard: Bus rating of 600A and greater or where labeled as Distribution Panelboard on the Drawings.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Product technical data.
 - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
 - b. See Specification Section 26 05 00 for additional requirements.
 - 2. Fabrication and/or layout drawings:
 - a. Panelboard layout with alphanumeric designation, branch circuit breakers size and type, as indicated in the panelboard schedules.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data
 - 2. Panelboard schedules with as-built conditions.
- C. Informational Submittals:
 - 1. Service equipment marking and documentation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Eaton.
2. GE by ABB.
3. Square D by Schneider Electric.
4. Siemens Corporation.
5. Or approved equal.

2.2 MANUFACTURED UNITS

- A. Standards: NEMA PB 1, NFPA 70, UL 50, UL 67.
- B. Ratings:
 1. Current, voltage, number of phases, number of wires as indicated on the Drawings.
 2. Short Circuit Current Rating (SCCR) and/or Ampere Interrupting Current (AIC) ratings equal to or greater than the interrupting rating indicated on the Drawings or in the schedule.
 - a. Series rating is not acceptable.
 - b. When fault current or minimum interrupting rating is not indicated, use rating of upstream equipment or infinite bus calculation of transformer secondary.
 3. Service Entrance Equipment rated when indicated on the Drawings or when shown to be fed from a utility source.
- C. Construction:
 1. Interiors factory assembled and designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.
 2. Multi-section panelboards: Feed-through or sub-feed lugs.
 3. Main lugs: Solderless type approved for copper and aluminum wire.
- D. Bus Bars:
 1. Main bus bars:
 - a. Tin plated aluminum or tin-plated copper sized to limit temperature rise to a maximum of 65 degrees C above an ambient of 40 degrees C.
 - b. Drilled and tapped and arranged for sequence phasing of the branch circuit devices.
 2. Ground bus and isolated ground bus, when indicated on the Drawings: Solderless mechanical type connectors.
 3. Neutral bus bars: Insulated 100% rated or 200% rated, when indicated on the Drawings and with solderless mechanical type connectors.
- E. Overcurrent and Short Circuit Protective Devices:
 1. Main overcurrent protective device:
 - a. Molded case circuit breaker.
 2. Branch overcurrent protective devices:
 - a. Molded case circuit breaker.
 3. Factory installed.
- F. Enclosure:
 1. Boxes: Code gage galvanized steel, furnish without knockouts.
 2. Trim assembly: Code gage steel finished with rust inhibited primer and manufacturers standard paint inside and out.
 3. Branch circuit panelboard:
 - a. Trims supplied with hinged door-in-door construction.
 - 1) Outer door:
 - a) Allows access to the interior of the enclosure.
 - b) Hinged to the enclosure.

- c) Opened by removal of screws or by operating a mechanical latch located behind the inner door.
 - 2) Inner door:
 - a) Allows access to breakers (non-live parts).
 - b) Hinged to outer door.
 - c) Opened by operation of a keyed corrosion resistant chrome-plated combination lock and catch. Locks for all branch circuit panelboards keyed alike.
 - b. Trims for surface mounted panelboards, same size as box.
 - c. Trims for flush mounted panelboards, overlap the box by 3/4 inches on all sides.
 - d. Nominal 20 inches wide and 5-3/4 inches deep with gutter space in accordance with NFPA 70.
 - e. Clear plastic cover for directory card mounted on the inside of each door.
 - f. NEMA 12 rating: Door gasketed.
- 4. Distribution panelboard:
 - a. Trims cover all live parts with switching device handles accessible.
 - b. Minimum 8 inches deep and less than or equal to 12 inches deep with gutter space in accordance with NFPA 70.
 - c. Clear plastic cover for directory card mounted front of enclosure.
 - d. NEMA 12 rating is indicated: Doors gasketed and lockable with corrosion resistant chrome-plated combination lock and catch, all locks keyed alike, or provisions for padlocks.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install as indicated on the Drawings, in accordance with the NFPA 70, and in accordance with manufacturer's instructions.
- B. Support panelboard enclosures from wall studs or modular channels support structure, per Specification Section 26 05 00.
- C. Provide NEMA 12 rated enclosure. Where enclosure type is not indicated, provide enclosure rating suitable for the atmosphere where equipment is installed.
- D. Equipment Marking and Documentation:
 - 1. Provide labeling per NFPA 70 and other applicable codes.
 - 2. Service equipment:
 - a. Arc-flash hazard warning label. (Ref. NFPA 70 Article 110.16(A) and (B))
 - b. Available fault current label and documentation of the calculations made for compliance with marking requirements. (Ref. NFPA 70 Article 110.24)
 - 3. Other than service equipment:
 - a. Arc-flash hazard warning label. (Ref. NFPA 70 Article 110.16(A))
 - b. Available fault current label. (Ref. NFPA 70 Article 408.6)
 - 4. Identify (tag) all equipment and equipment components.
 - 5. Provide labels and tags in accordance with NEC.
 - 6. Available fault current and other required label data from Coordinated Power System Study as required by the contract documents.
- E. Provide each panelboard with a typed directory:
 - 1. Identify all circuit locations in each panelboard with the load type and location served.
 - 2. Use Owner-furnished mechanical equipment designation if different than designation indicated on the Drawings.

3. Use final building room names and numbers as identified by the Owner if different than designation indicated on the Drawings.
4. Identify spare overcurrent devices.

END OF SECTION