

## SECTION 26 12 13

### MEDIUM VOLTAGE DRY-TYPE TRANSFORMERS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. The scope of this section includes providing and assembling materials and equipment for the unit substation dry type transformer.
- B. Reference to Manufacturer in this section is to be considered the transformer manufacturer.
- C. Related Work: Consult below listed Sections, determine the extent and character of related scope and coordinate work specified herein.

SECTION 26 05 00 – COMMON WORK RESULTS FOR ELECTRICAL

SECTION 26 05 48 – VIBRATION CONTROLS FOR ELECTRICAL SYSTEMS

SECTION 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

SECTION 26 24 13 – LOW VOLTAGE SWITCHBOARDS

SECTION 26 13 16 – MEDIUM VOLTAGE FUSIBLE INTERRUPTER SWITCHGEAR

##### 1.2 REFERENCES

- A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
  - 1. IEEE C57.12.01™ - Standard General Requirements for Dry-Type Distribution and Power Transformers Including Those with Solid Cast and/or Resin-Encapsulated Windings.
  - 2. ANSI C57.12.55 - Conformance Standard for Transformers - Dry-Type Transformers Used in Unit Installations, Including Unit Substations.
  - 3. IEEE C57.12.58™ - Guide for Conducting a Transient Voltage Analysis of a Dry-Type Transformer Coil.
  - 4. NEMA PB 2 -Dead Front Distribution Transformers.
  - 5. ANSI C57.12.51 - Requirements for Ventilated Dry-Type Power Transformers, 501 kVA and Larger Three-Phase, with High Voltage 601-34,500 Volts, Low Voltage 208Y/120-4160 Volts.
  - 6. IEEE C57.12.70™ - Terminal Markings and Connections for Distribution and Power Transformers.
  - 7. IEEE C57.12.80™ - Standard Terminology for Power and Distribution Transformers.
  - 8. IEEE C57.12.91™ - Test Code for Dry-Type Distribution and Power Transformers.
  - 9. IEEE C57.94™ - Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type General Purpose Distribution and Power Transformers.
  - 10. IEEE C57.96™ - Guide for Loading Dry-Type Distribution and Power Transformers (ANSI).

11. IEEE C57.105™ - Guide for Application of Transformer Connections in Three-Phase Distribution Systems.
12. IEEE C57.124™ - Recommended Practice for the Detection of Partial Discharges and the Measurement of Apparent Charge in Dry-Type Transformers.
13. CSA-C88 - Power Transformers and Reactors.
14. NFPA 70 – National Electrical Code (NEC).
15. UL 486A - Wire Connectors and Soldering Lugs for use with Copper Conductors.
16. UL 891 - Dead-Front Electrical Transformers.

### 1.3 SUBMITTALS

- A. Submit the following items with bid proposal response:
  - a. Shop drawings to include: outline dimensions, connection and support points, weight, specified ratings and materials.
  - b. Single line & schematic diagrams.
  - c. Electrical characteristics including voltage, temperature rating, and efficiency.
- B. Submit the following items within two business days of request by Owner's Representative:
  1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
  2. Shop drawings which shall include:
    - a. Front, plan and side view elevations with overall dimensions.
    - b. Connection and support points.
    - c. Anchorage Details.
    - d. Nameplate legends.
    - e. Single line & schematic diagrams.
    - f. Electrical characteristics including voltage, temperature rating, and efficiency.
    - g. Submit manufacturer's installation instructions.
    - h. Preferred alignment (front or rear) with MV switchgear and LV switchboard.
- C. Submit the following items one week prior to delivery of the transformer:
  1. Complete Bill of Material listing all components.
  2. Submit Field Test reports.
  3. Anchorage details including details of vibration insulators installation. (provided by others).
  4. Submit seismic anchorage calculations prepared by a professional structural engineer registered in the State of Texas.
  5. Operations and maintenance manuals.
  6. Warranty
- D. Dimensions and configurations of transformers shall conform to the space allocated on the Drawings. The Manufacturer shall submit a revised layout if equipment furnished varies in size from that shown on drawings for the Owner's Representative approval.

- E. Operation and Maintenance manuals submittals shall include the following:
  - 1. A detailed explanation of the operation of the system
  - 2. Instructions for routine maintenance
  - 3. Pictorial parts list and part numbers
  - 4. Telephone numbers for the authorized parts and service distributors.
  - 5. Final testing reports
  - 6. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

#### 1.4 QUALIFICATIONS

- A. The manufacturer of the transformer shall be an OEM product of the manufacturer producing the LV switchboard and the MV switchgear provided in Section 26 13 16 and Section 26 24 13.
- B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- C. The equipment shall be seismic tested or qualified per local building code.
  - 1. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the International Building Code (IBC) for the applicable Site Classification.
  - 2. Guidelines for the installation consistent with the IBC requirements shall be provided by the equipment manufacturer and based upon testing of representative equipment. Equipment certification acceptance criteria shall be based upon the ability for the equipment to be returned to service immediately after a seismic event within the above requirements without the need for repairs.

#### 1.5 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new.
- B. Manufacturer shall pay for the services of a qualified testing agency Manufacturer's technician to perform the specified factory tests of paragraphs 3.3 TESTING and 3.4 FIELD QUALITY CONTROL of this section. The Manufacturer shall notify the Owner's Representative at least five (5) working days in advance of performance of work requiring testing. The Manufacturer shall provide all material required for testing.
- C. Qualifications: The testing agency(ies) shall be a member of International Electrical Testing Association and specializing in testing products specified in this section with minimum five years of documented experience.

#### 1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery: Transformer components shall not be delivered to the site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipment shall be replaced and returned to manufacturer at no additional cost to the Owner's Representative. Components shall be properly packaged in factory-fabricated containers and mounted on shipping skids.

- B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic. Provide heat where required to prevent condensation.
- C. Handling: Handle in accordance with NEMA PB2.1 and manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to manufacturer.

#### 1.7 WARRANTY

- A. Equipment and components offered under this Section shall be covered by a two (2) year parts and labor warranty for malfunctions resulting from defects in materials and workmanship.
- B. Manufacturer warranty for transformer shall be for two years commencing of the date of successful energizing of equipment following completion of all required testing.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, the following:
  - 1. Square D.
  - 2. Eaton (Cutler-Hammer).
  - 3. General Electric Company.
  - 4. Siemens.

#### 2.2 TRANSFORMER

- A. The transformer(s) shall be the unit substation type with front accessible primary and side-mounted secondary terminations.
- B. Primary terminations shall be designed for close coupling to a metal enclosed MV fusible switchgear section. Secondary terminations shall be designed for close coupling to a LV switchgear section.
- C. Orientation shall be primary on the right for USSB-A for left for USSB-B when facing the transformer front. Verify orientation on the drawings.
- D. The transformer(s) shall be rated 4.16 kVA, delta primary voltage; 208/120 V wye secondary with two 2-1/2% full capacity above normal and two 2-1/2% full capacity below normal primary taps. Impedance shall be 5.75  $\pm$ 7-1/2%. All transformers shall have an average temperature rise of 150° C above a 40° C maximum, 30° C average ambient.
- E. The basic impulse levels (BIL) shall be a minimum of 60 kV.
- F. The coils shall be wound with aluminum conductors.
- G. The transformer shall be either cast coil or VPI type.
- H. Transformer sound levels shall be warranted by the manufacturer not to exceed the values specified in IEEE Std. C57.12.01™.

- I. Construction and installation shall meet local seismic code requirements.

## 2.3 CONSTRUCTION

- A. The entire transformer shall be of unit construction with all parts designed, manufactured, and assembled by a single manufacturer to assure coordination between all items.
- B. Transformer section shall be of front access only and a single enclosure bolted together to form a rigid assembly. The sides and rear shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide adequate ventilation within the enclosure.
- C. Transformer enclosure(s) shall be ventilated indoor and fabricated of heavy gauge, sheet steel construction. Enclosures are to be provided with lifting provisions on the base structure and shall have jacking pads designed to be flush with the enclosure. The base is to be constructed of steel members to permit skidding or rolling in any direction. Vibration isolators to be selected by the Owner's representative and provided by others shall be installed by the manufacturer between the core and coil and the enclosure.
- D. The design of all current carrying devices or parts of transformers shall conform to the standard specified in the related sections of UL No. 891 and National Electrical Manufacturer's Association (NEMA) Standard PB-2, except as these characteristics may be modified herein.
- E. The transformers shall be floor mounted, self-supporting, dead-front and rear, front accessible, front connected, distribution type, manufactured complete with all parts, fittings and equipment, including buses, circuit breakers, barriers, terminals, wiring and connections. The enclosure shall be 90" high, made of cold rolled steel on a structural shape, or formed, steel frame and shall be mounted on two 3 inch-5lb. continuous channel iron sills, which shall be closed at the ends between the two channels.
- F. All serviceable components and connections shall be front accessible.
- G. Overall transformer dimensions shall fit within the areas allotted on the drawings.
- H. Alignment with other sections (front or rear) will be selected by the Owner's representative. Manufacturer will submit preferred alignment in initial shop drawings.
- I. All transformer sections shall be constructed of National Electrical Code (NEC) gage steel. All holes, supports, studs and openings shall be standardized to enable interchange of interior and front cover units. All sections shall be fabricated with right angle corners, plumb edges and surfaces. All transformer sections shall line up evenly, front and rear.

## 2.4 BUS

- A. Connections to the MV switchgear shall be copper braid or bus bars of silver-plated copper. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on NEMA standard temperature rise criteria of 65°C over a 40°C ambient (outside the enclosure).
- B. Provide a full capacity neutral bus where a neutral bus required.
- C. Bus bars, connection bars and wiring on the back of the transformer shall be arranged so that all accessibility is provided for cable connections from the front.

- D. Electrical clearance between parts of opposite polarity, and between live parts and ground, shall conform to the National Electrical Code (NEC).
- E. All connections between bus bars shall be of a bolted-type. Clamps will not be accepted. All bus bars shall be accurately formed, and all holes shall be made in a manner that will permit bus bars and connections to be fitted into place without being forced.
- F. Bolts, nuts and washers used to maintain contact on bus and connection bars shall be non-ferrous material, zinc-electroplated steel, or of other corrosion resistant processed steel.
- G. Current carrying nuts shall be made of copper alloy having adequate conductivity and shall be of size to carry the circuit current without exceeding the temperature rise normally specified for copper. Current carrying nuts shall be silver-plated when they are used with connections that are silver-plated.
- H. All connections between bus bars shall be made by drilling and tapping the bus bars and attaching the breakers or jumper bars with cap screws
- I. All nuts and connections shall be fitted with locking devices to prevent loosening.
- J. All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with conical spring-type washers.

### PART 3 - EXECUTION

#### 3.1 DELIVERY AND ASSEMBLY

- A. Manufacturer shall deliver all transformer components to site or other location within 20 miles of the site as directed by the Owner's Representative.
- B. Transformer components will be placed at the final placement location on the site by others under observation of the Manufacturer's technician.
- C. Transformer shall be assembled at the final placement location by the Manufacturer's technician.

#### 3.2 PREPARATION

- A. Insure all incoming conduits for bottom entry into transformer are in place and located as required per shop drawings.
- B. Provide anchorage details, coordinated with the transformer mounting provision, prepared and stamped by a licensed engineer as stated in Part 1.
- C. Coordinate all requirements for termination of bus and conductors of the equipment provided in Section 26 13 16 and Section 26 24 13.

#### D. TESTING

- E. Test transformer to IEEE C57.12.91™ and in accordance with the latest version of ANSI and NEMA standards. Testing shall include, but not be limited to, the following:
  - 1. Ratio.
  - 2. Polarity.
  - 3. Phase Rotation.

4. No-Load Loss.
5. Excitation Current.
6. Impedance Voltage.
7. Load Loss.
8. Applied Potential.
9. QC Impulse Test.
10. Temperature Test (typical data from previous unit is acceptable).
11. Sound Test (typical data from previous unit is acceptable).

F. The transformer shall be completely assembled, wired, adjusted, and tested at the factory.

G. The manufacturer shall provide three (3) certified copies of factory test reports.

### 3.3 ASSEMBLY

- A. Install transformers in accordance with manufacturer's written instructions, as shown on the drawings and as specified herein.
- B. Handling, storage, installation and energize of transformers operations performed by the Manufacturer shall be carried out in accordance with latest edition of NEMA Publications PB 2.1.
- C. Freestanding transformers shall be accurately aligned, leveled and bolted in place on full-length channels.
- D. Provide and install mounting hardware brackets, bus bar drilling and filler pieces for all unused spaces.
- E. Replace any panel pieces, doors or trims having dents, bends, warps or poor fit that may impede ready access, security or integrity.
- F. Check and tighten all bolts and connections with a torque wrench using manufacturer's recommended values.
- G. Include nameplates and warning signs as specified in Section 26 05 53.
- H. Provide permanent identification for each feeder and piece of equipment by means of plastic laminated nameplates. All nameplates shall conform to requirements of Section 26 05 53.
- I. Transformers shall be anchored and braced to withstand seismic forces as calculated per Section 26 05 00.

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Technician shall perform all quality control electrical testing, calibration and inspection required herein. Testing agencies objectives shall be to:
  1. Assure transformer installation conforms to specified requirements and operates within specified tolerances.
  2. Field test and inspect to insure operation in accordance with manufacturer's recommendations and specifications.
  3. Prepare final test report including results, observations, failures, adjustments and remedies.

4. Apply label on transformer upon satisfactory completion of tests and results.
  5. Verify ratings and settings and make final adjustments.
- B. Field adjustments:
1. The Manufacturer shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study and protective device coordination study.
  2. Necessary field settings of devices, adjustments and minor modifications to equipment to accomplish conformance with an approved short circuit and protective device coordination study, shall be carried out by the Manufacturer at no additional cost to the owner.
- C. Field adjustments:
1. The Manufacturer shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study and protective device coordination study.
  2. Necessary field settings of devices, adjustments and minor modifications to equipment to accomplish conformance with an approved short circuit and protective device coordination study, shall be carried out by the Manufacturer at no additional cost to the owner.
- D. Owner Witnessed Testing: Allow a period of 2 hours per transformer for the Owner's Representative to review and final check. This review shall be done when the transformer is de-energized, therefore plan accordingly.
- E. In the event that the system fails to function properly during the testing, as a result of inadequate pretesting or preparation, the Manufacturer shall bear all costs incurred by the necessity for retesting including test equipment, transportation, subsistence and the Owner's Representative's hourly rate.
- F. Replace at no additional cost to the owner all devices that are found defective or do not operate within factory specified tolerances.
- G. Submit the testing agency's final report for review prior to project closeout and final acceptance by the owner. Test report shall indicate test dates, devices tested, results, observation, deficiencies and remedies. Test report shall be included in the operation and maintenance manuals.

### 3.5 CLEANING

- A. Prior to energizing of transformers the Manufacturer shall thoroughly clean the interior of enclosure of all construction debris, scrap wire, etc. using manufacturer's recommended materials and methods.
- B. Touch-up paint any marks, blemishes, or other finish damage suffered during assembly.

END OF SECTION