SECTION 26 12 13
MEDIUM-VOLTAGE TRANSFORMERS, LIQUID-FILLED – DOE 2016

PART 1 - GENERAL

1.1 SCOPE

A. This specification provides the technical requirements for the design, manufacture and test of liquid-type secondary unit substation transformers. Provide all accessories and equipment as described herein and shown on Project Drawings as necessary for a complete installation.

1.2 RELATED DOCUMENTS

A. ***[Related Sections include the following:***
   1. Section 26 24 13 - Switchboards]

1.3 SUBMITTALS

A. The manufacturer shall provide the following information for review and evaluation by the Engineer:
   1. Shop Drawings showing layout, dimensions, voltage, phasing and continuous current capacity.

B. Manufacturer shall provide final, as- built drawings. Installation, Operation and Maintenance manuals shall also be supplied.

1.4 RELATED STANDARDS

A. The liquid-filled type transformer and protection devices in this specification are designed and manufactured according to latest revision of the following standards.
   1. American National Standards Institute, Inc. (ANSI)
   2. Institute of Electrical and Electronic Engineers (IEEE)
   3. National Electrical Manufacturers Association (NEMA)
   4. American Society of Testing and Materials (ASTM)
   5. National Electrical Code (NEC)
   6. Underwriter's Laboratories (UL)
   7. ***[U.S. Department of Energy 10 CFR Part 431 Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule, dated April 18, 2013. These efficiency standards shall take effect January 1, 2016. All transformers covered in the scope of this document and this specification, manufactured after December 31, 2015, shall be compliant with the new standard.]*** **[Editor's note: This standard, known as DOE 2016, applies to transformers rated 2500 kVa or less. For transformers 2501 kVa and larger, this RELATED STANDARD does not apply.]**

1.5 QUALITY ASSURANCE

A. The manufacturer shall have specialized in the design, manufacture and assembly of liquid filled secondary substation transformers for a minimum of 10 years.

B. The manufacturer shall have a well documented quality assurance program, which includes procedures for all activities in order entry, design, material procurement, manufacturing processes, testing, shipping and post shipment product follow.

C. The manufacturer's test floor shall have a documented calibration program. All equipment shall receive regular calibrations. Calibration standards shall be traceable to National Bureau of Standards. Records of all equipment calibration shall be made available to the Buyer upon request.

D. The transformers shall be manufactured by a company, which is certified to ISO 9001, or ISO 9002 as a minimum, for design and manufacture of Power Liquid Filled Type Transformers.

1.6 DELIVERY, STORAGE AND HANDLING

A. Handle and store equipment in accordance with manufacturer's Installation and Maintenance Manuals. One (1) copy of this document to be provided with the equipment at time of shipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. [The medium voltage, liquid filled substation transformer shall be provided by Siemens or pre-approved equal. Approved manufacturers are as follows:
   1. SIEMENS
   2. ***[ ]***

2.2 TECHNICAL REQUIREMENTS

A. Winding Characteristics
   1. ***All windings and internal connections shall be [copper] [aluminum].***
   2. The windings shall be tightly wound utilizing tension devices to place the conductor into the coils.
   3. Sheet conductor shall be used in secondary winding to minimize vertical short circuit forces.
   4. Insulation between layers of the windings shall be Insuldur paper or equal.
   5. The transformer shall be designed and constructed to be completely self protected by its ability to withstand the external short-circuits, as defined by ANSI C57. 12.00.
   6. Evidence of compliance to these short-circuit requirements as required in C57.12.00 and C57.12.90 shall be submitted to the Buyer at the time of quotation.
   7. The transformer design shall be capable of operating above rated voltage or below rated frequency in accordance with ANSI C57.12.00.
   8. ***The impedance shall be as specified on Project Drawings. [ANSI tolerance shall apply.] [The impedance specified will be a maximum value.] [The impedance specified shall be a minimum value.]***

B. Sound Level
   1. The secondary unit substation transformer and auxiliary cooling equipment shall be designed and constructed to minimize the audible noise generated with the transformer energized at rated voltage and with all auxiliary cooling equipment in operation. The acceptable noise level shall be in accordance with NEMA standard TR 1. The measurement procedure shall be as specified in ANSI C57.12.90.

C. Bushings
   1. High voltage and low voltage bushings shall be furnished with the ratings shown on the Transformer Data Sheet.
   2. The bushings shall be sidewall mounted and suitable for high and low voltage terminations as indicated on the Transformer Data Sheet.

D. Core
   1. The core shall be clamped and braced to resist distortion caused by short-circuit stresses within rating or transportation handling and to prevent the shifting of core laminations.
   2. The core shall be constructed of high-grade, grain oriented, silicon steel laminations, with high magnetic permeability. Core construction shall include step-lap mitered joints to keep core losses, excitation current and noise level at a minimum.

E. De-Energized Tap Changer

1. A manually operated de-energized tap changer shall be provided for changing the primary winding taps.
2. Full capacity taps shall be located in the high voltage windings and shall be in accordance with the Transformer Data Sheet.
3. The tap changer shall be capable of carrying the full transformer short-circuit current without damage or contact separation.
4. The sidewall mounted tap changer shall be gang operated from a single operating point and shall have a position indicator.
5. The tap changer operating mechanism shall include provisions for pad locking in each tap position.

F. Insulating Fluid And Preservation System
1. The fluid preservation system shall be a sealed tank type.
2. ***The insulating fluid shall be [mineral oil] [HTH] [Silicone fluid] [Natural Ester Fluid].***
3. The transformer insulating fluid shall be certified to contain no detectable PCB's at the time of shipment and the tank shall be so labeled. Certification shall also be provided that the transformer and components have not been contaminated with PCB's prior to shipment.
4. The transformer insulating fluid shall meet or exceed the requirements of the appropriate ANSI and ASTM fluid Standards. The transformer fluid shall be tested for dielectric breakdown and moisture content just prior at the time of shipment.

G. Tank Design
1. The transformer tank, cooling equipment and compartments subject to pressures shall be designed to withstand, without permanent deformation, pressures of at least twenty-five percent greater than maximum operating pressures. The maximum design withstand pressure shall be indicated on the nameplate.
2. Tank design shall include sufficient expansion volume to allow operation under specified load conditions.
3. The main cover shall be of welded onto the tank.
4. One or more handholds shall be provided in the tank cover for access to bushing connections and current transformers, when required. The opening shall be of sufficient size to allow removal of any CT.
5. The transformer base shall be suitable for rolling or skidding in the direction of either tank base centerline.
6. The base shall be designed so the center of gravity of the transformer as assembled for transport does not fall outside the base for a tilt of fifteen degrees.
7. Lifting lugs shall be provided at each corner of the tank. The lifting lugs shall be designed to provide a minimum safety factor of 5.
8. Jacking area, pads or bosses shall be provided.
9. Pulling provisions, for towing the transformer parallel to either centerline, shall be provided.

H. Gaskets
1. The gaskets shall be compatible for the insulating fluid in the transformer tank.
2. Gaskets in contact with Silicone fluid or vapors shall be Viton material.
3. Metal surfaces to which gaskets are applied shall be smooth, and shall have sufficient rigidity to assure proper compression of the gaskets.

I. Cooling System
1. ***The transformer shall be [self-cooled] [self-cooled /fan cooled]. [Fan cooling shall provide 12% additional kva through base ratings of 2000 kva, and 25% additional kva for base ratings of 2500 kva. The fan-cooled rating is for temporary overload conditions.]***
2. Cooling tubes or radiators shall be rigidly supported to the tank wall, either through pipes or brackets.

J. Grounding Provisions
   1. All non-energized metallic components of the transformer shall be grounded.
   2. Tank grounding provisions shall consist of two ground pads, welded to the base or to the tank wall near the base on diagonal corners.
   3. A copper-faced or stainless steel ground pad with two holes spaced horizontally at 1.75-inch centers and tapped for 0.5 inch 13-UNC tread shall be provided.

K. Wiring
   1. All devices mounted on the transformer, including current transformer secondary circuits, shall be wired to the control cabinet.
   2. All control wiring shall be a minimum of #14 AWG type SIS and #12 AWG for current transformers.
   3. Wiring shall be terminated with a ring-type insulated compression lug.
   4. Each wire shall be identified with a wire marker.
   5. All symbols and wiring identification systems shall be in accordance with the applicable ANSI standard.

L. Nameplates
   1. Transformer shall be furnished with a non-corrosive diagrammatic nameplate, permanently attached with non-corrosive hardware. The diagrammatic nameplate shall include the name of the manufacturer of the equipment as well as the location where the transformer was manufactured and tested. In addition, the transformer manufacturer and location of manufacture is to be supplied at the time of quotation.
   2. The nameplate shall contain all connection and rating information in accordance with ANSI C57.12.00 nameplate C, plus the approximate weight of parts to be lifted for un-tanking, type and quantity of oil, and the date of manufacture.
   3. A non-corrosive nameplate located next to the operating handle of the de-energized tap changer shall be provided which states the following: “Warning - Do not operate this tap changer unless the transformer is de-energized.”

M. Exterior Finish
   1. The transformer painting system shall be the Seller’s standard. The transformer shall be thoroughly cleaned and phosphortized, paint with at least one corrosion inhibiting primer and one finish coat to provide a minimum total dry-film thickness of not less than 3 mils.
   2. The finish shall be ANSI 61.
   3. Supply one quart of touch up paint.

2.3 ACCESSORIES

A. The transformer shall be equipped with a complete set of standard ***accessories [plus optional alarm contacts].***
   1. Magnetic liquid level gauge ***[with alarm contacts].***
   2. Dial type thermometer ***[with alarm contacts].***
   3. Pressure-vacuum ***[with alarm contacts].***
   4. A 1-inch upper filter press connection with pipe cap.
   5. A 1-inch drain valve and bottom filter press connection with drain valve plug

B. ***[Optional accessories to be included are as follows:***
   1. Winding hot-spot temperature indicator with alarm contacts.
   2. Mechanical relief device [with alarm contacts].
   3. A rapid pressure rise relay with seal-in relay contacts and controls mounted in a control wiring cabinet. The operating voltage shall be [115 ac] [230 ac] [24 dc] [48 dc] [125 dc] [240 dc]. A space heater [with thermostat] shall be provided in the control cabinet.
   4. A NEMA Type 4 control cabinet shall be provided. The cabinet door shall have provisions for padlocking. Current transformer terminal blocks shall be the shorting type.]

2.4 ENGINEERING DATA REQUIREMENTS

A. Outline Drawings
   1. The outline drawings shall be completely dimensioned and, as a minimum, show the following:
      a. Plan, and all elevations, including clearance for bushing and core and coil removal.
      b. High voltage and low voltage bushing details.
      c. Location of all hand-holes.
      d. Location and identification of all accessories.
      e. Size and location of all conduit entrances for Buyers connections.
      f. Anchoring details.
      g. Ground pad locations.
      h. Weight of core and coil, transformer tank and fittings, weight and gallons of fluid, and total shipping weight.

B. Wiring Diagrams
   1. Interconnecting wiring of all components of the forced cooling equipment.
   2. Wiring of all devices with switches and relays, or electrical connections, including current transformers.
   3. Identification of all terminal blocks and all connections to be made by Buyer.

C. Nameplate Drawing
   1. A nameplate drawing showing required ANSI information shall be provided

D. Installation, Operating, And Maintenance Instructions
   1. The seller shall provide an instruction, operating and maintenance manual covering all equipment furnished.

E. Parts
   1. The Seller shall provide a renewal parts list to the Buyer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install transformer as shown on Project Drawings and in accordance with manufacturer's Instruction/Installation Manual.

B. Provide concrete pad with sufficient structural support and in accordance with local codes and standards. Concrete pad requirements should be coordinated with transformer manufacturer.

C. Grounding should be per Project Drawings and in accordance with local codes and standards and in compliance with the NEC.

3.2 ADJUSTMENTS AND CLEANING

A. Remove debris from jobsite and wipe dust and dirt from all components.

B. Repaint marred and scratched surfaces with touch up paint to match original finish.

3.3 TESTING

A. Field-testing will be conducted at the expense of the Owner, if required for final acceptance.

B. Each transformer shall receive all standard routine tests as required by ANSI C57.12.00 and performed as specified by ANSI C57.12.90.

C. Short Circuit withstand capability shall be verified by full short circuit tests on similar or larger units in accordance with the latest revision of ANSI C57.12.00 and ANSI C57.12.90. Short Circuit withstand verification shall be submitted to the purchaser, upon request, prior to shipment of the transformers.

D. ***[Optional tests, as indicated on the Transformer Data Sheet, will also be required.]***

E. Device functionality test shall be performed.

F. The test facility used to perform loss tests shall utilize test equipment with calibration traceable to NIST or an approved equal 3rd party laboratory.

G. A certified test report shall be submitted and shall contain the test data for each transformer serial number manufactured. The certified test report shall as a minimum contain the data as specified in ANSI C57.12.90.

3.4 WARRANTY

A. Equipment manufacturer warrants that all goods supplied are free of non-conformities in workmanship and materials for one year from date of initial operation, but not more than eighteen months from date of shipment.

END OF SECTION