

SECTION 26 12 16
DRY-TYPE MEDIUM VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the design, manufacturing, furnishing, installation, connection, and testing of indoor ventilated dry-type medium voltage transformers for existing secondary unit substations.

1.2 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.3 FACTORY TESTS

- A. Transformers shall be thoroughly tested at the factory to assure that there are no electrical or mechanical defects. Tests shall be conducted per UL, IEEE, NEMA and ANSI Standards and reports shall be provided in standard ANSI format. Factory tests shall be certified and signed by a registered professional engineer. The following tests shall be performed:

1. Dry-Type Medium Voltage Transformers:

- a. Perform insulation-resistance tests winding-to-winding and each winding-to-ground.
- b. Resistance measurements of all windings on the rated voltage connection of each unit and the tap extremes of one unit for each size transformer specified.
- b. Perform turns-ratio tests on the rated voltage connection and on all tap positions.
- c. Polarity and phase-relation tests on the rated voltage connections.
- d. No-load loss at rated voltage on the rated voltage connection.
- e. Exciting current at rated voltage on the rated voltage connection.
- f. Applied potential test.
- g. Induced potential tests.
- h. Impedance and load loss at rated current on the rated voltage connection of each unit and on the tap extremes of one unit for each size transformer specified.

- i. Impulse test on the high voltage windings.
- j. Temperature test at self-cooled rating and fan-cooled rating.
- B. Factory test shall comply with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, paragraph 1.6, sub-paragraph E.
- C. Factory Test Instrument Calibration:
 - 1. The manufacturer shall have a calibration program which assures that All applicable test instruments are maintained within rated accuracy.
 - 2. The accuracy shall be directly traceable to the National Institute of Standards and Technology.
 - 3. Instrument calibration frequency schedule shall not exceed 12 months for both test floor instruments and leased specialty equipment.
 - 4. Dated calibration labels shall be visible on all test equipment.
- D. The Wilkes-Barre VA Medical Center reserves the right to witness factory tests. Provide equipment test schedules for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the COR 30 calendar days before scheduled test date.

1.4 SUBMITTALS

- A. Submit two hardcopies and one electronic copy in pdf format of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with the SOW and specifications.
 - b. Prior to fabrication of transformers, submit the following data for approval:
 - 1) Complete electrical ratings including KVA, primary and secondary voltage and current, taps, basic impulse level, decibel rating, insulation class and temperature rise, nominal impedance, sound levels and no load and full load losses.
 - 2) ANSI nameplate rating data/diagram.
 - 3) Product data sheets.
 - 4) Elementary and interconnection wiring diagrams and installation information and details.
 - 5) Technical data for each component.
 - 6) Dimensioned exterior views of the transformers.
 - 7) Dimensioned section views of the transformers.

- 8) Floor plan of the transformers.
- 9) Provisions and required locations for external conduit, bus and wiring entrance/exits.
- 10) Approximate design weights.
- 11) Provisions for lifting.
- 12) Primary and secondary close-coupled connection details.
- 13) Specified factory tests.
- 14) Specified UL listing
- 15) Renewal parts list where applicable.

2. Manuals:

- a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals. Manuals shall be assembled in durable, hard covered, water resistant binders. The manuals shall be assembled and indexed in the order noted in the table of contents. The contents of the manuals shall be as follows:
 - 1) Information required in paragraph 1.4.A.1.b.
 - 2) Information for testing, repair, troubleshooting, assembly, and disassembly.
- b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the scheduled installation date.

3. Test Reports:

- a. Submit certified factory design and production test reports for approval.
- b. Submit certified field test reports immediately following equipment energization.

4. Certifications: Submit the following:

- a. Certification by the manufacturer that transformers conform to the requirements of the SOW and the specifications.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata), form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. American National Standards Institute (ANSI)
C57.12.55Dry-Type Transformers in Unit Installations,

Including Unit Substations - Conformance
Standard

- C57.98Guide for Transformer Impulse Tests
- C. International Code Council (ICC):
 - IBC-15.....International Building Code
- D. Institute of Electrical and Electronic Engineers (IEEE):
 - C57.12.01-15.....General Requirements for Dry-Type Distribution
and Power Transformers
 - C57.12.51Requirements for Ventilated Dry-Type Power
Transformers, 501 KVA and Larger, Three-Phase
With High-Voltage 601 to 34,500 Volts, Low
Voltage 208Y/120 to 4160 Volts
 - C57.12.91Test Code for Dry-Type Distribution and Power
Transformers
 - C57.94Recommended Practice for Installation,
Application, Operation and Maintenance of Dry-
Type General Purpose Distribution and Power
Transformers
 - C57.96Guide for Loading Dry-Type Distribution and
Power Transformers
- E. National Electrical Manufacturers Association (NEMA):
 - ST 20-97R.....Standard for Dry-Type Transformers for General
Applications
 - TR 1-13.....Transformers, Step Voltage Regulators and
Reactors
 - LA 1-09.....Surge Arresters
- F. National Fire Protection Association (NFPA):
 - 70-14.....National Electrical Code (NEC)
- G. Underwriters Laboratories (UL):
 - 1562.....Standards for Transformers, Distribution, Dry-
Type - Over 600 Volts
 - 467-07.....Grounding and Bonding Equipment
- H. United States Department of Energy
 - 10 CFR Part 431.....Energy Efficiency Program for Certain
Commercial and Industrial Equipment

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products in accordance with

manufacturer's instruction. A copy of the instructions shall be included with the equipment at time of shipment.

- B. Deliver each transformer on individual shipping skids for ease of handling. Each transformer shall be wrapped for protection.
- C. Inspect for concealed shipping damage.
- D. Store in a clean, dry and environmentally controlled space. Maintain factory protection or provide equivalent temporary protection.

1.7 REGULATORY REQUIREMENT

- A. Provide UL listed label on each transformer.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Unless otherwise specified, transformers shall be in accordance with ANSI, ASTM, IEEE, NFPA and UL 10 CFR Part 431 as referenced and described in these specifications and the SOW.
- B. Transformers shall be designed, manufactured, and rated for indoor installation and service, with ventilation openings
- C. Transformers are retrofits for existing oil and R-temp filled units and their size shall conform to the available space between existing primary and secondary substation components already in place. The depth of the new replacement transformer shall not exceed the depth of the existing concrete housekeeping pads which are +/- 6'-0".
- D. Existing primary voltage surge arrestors are mounted to the wall of the existing transformer housings which are close-coupled to the primary switches. Provide new primary voltage surge arrestors as part of this work. Physical location and mounting of the new surge arrestors shall be as per the transformer manufacturer's recommendations. The existing conditions will be available for inspection and measurement during a scheduled pre-bid electrical shutdown. The rear covers of the primary switch and secondary switchgear cubicles for each transformer will be removed for inspection and measurement during this shutdown.

2.4 DRY-TYPE TRANSFORMERS

- A. Shall comply with IEEE C57.12.51 for dry-type transformers rated 501 kVA and larger.

- B. Provide vacuum pressure impregnated (VPI) type transformers with a Class H insulation system rated 220 degrees C, and with an 80 degree C average winding temperature rise above a 40 degrees C maximum ambient.
- C. Transformer cores at minimum shall be constructed of high permeability, cold-rolled, grain oriented, silicon steel (grade M6 or better) and step-lap mitered core joints.
- D. Two transformers, A & B, shall be each rated 1500kVA and one transformer, C, shall be rated 750kVA. Fan cooling is not required - Natural air convection AA rating only. All three shall be rated 95 kV BIL primary and 10 kV BIL secondary and shall be a 60 hertz design.
- E. Transformer voltage ratings for A & B: 12,470 Volts - 208/120 Volts, Transformer voltage rating for C: 12,470 Volts - 480/277 Volts.
- F. Primary and secondary windings:
 - 1. Windings shall be copper.
 - 2. Primary windings shall be delta-connected.
 - 3. Secondary windings shall be wye-connected.
 - 4. Secondary windings shall have neutral bushings for transformers with wye-connected secondary windings.
- G. Provide four 2-1/2 percent full capacity taps, two above and two below rated primary voltage. Locate tap adjustments on the face of the medium voltage coil. Adjustments shall be accessible by removing the front panel and shall be made when the transformer is de-energized.
- H. Minimum final tested impedance for each transformer shall not be less than: A-6.31%, B-6.39% and C-6.01% at 80 degrees C.
- I. Diagrammatic stainless steel or laser-etched anodized aluminum nameplates.
- J. Transformer shall include ground pads, lifting lugs and provisions for jacking under the base. Transformer base construction shall be suitable for using rollers or skidding in any direction. The transformers shall have an insulated low-voltage neutral bushing with lugs for ground cable, and with removable ground strap.
- K. Vibration isolation pads shall be provided to isolate the core and coil assembly from the casing to prevent transmission of structural borne vibration.
- L. Transformer structures and enclosures shall be thoroughly cleaned, phosphate treated and painted at the factory. The enclosure shall be of the knock down case design constructed of heavy gauge sheet steel and equipped with removable panels for access to the core and coils. Finish

shall be ANSI 61 Gray paint applied using an electrostatically deposited dry powder paint system. All ventilating openings shall be in accordance with NEMA and NEC standards and specific transformer design requirements for natural air convection flow.

- M. Additional features, accessories and ancillary equipment shall include the following:
1. Winding temperature indicator shall be provided on all three phases.
 2. Primary and secondary switchgear terminations shall be close-coupled.
 3. Provide copper cable connections between the existing primary switches and new transformers. Provide undrilled flanges for field drilling and flexible bus braid/ribbon type connections between the transformer and existing secondary switchgear.
 4. Provide distribution class 15KV metal-oxide varistor type surge arresters at each new transformer installation as referenced in paragraph 2.1.D. Comply with NEMA LA 1. Provide each ungrounded conductor of each incoming circuit with an appropriate arrester for the application voltage.
 5. The existing 15KV primary switch fuses for all three existing transformers are: 9F60 Series, EJO-1 type current limiting fuses, 15.5KV, 100 Amps. If the characteristics of the new replacement transformers require a different size and type of current limiting fuse provide new replacement fuses for each 15KV primary switch based on the transformer manufacturer's recommendations.
- N. Transformer energy efficiency shall comply with the United States Department of Energy's 10 CFR Part 431.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation, testing, adjustments and placing into service of the transformers shall be accomplished by the transformer manufacturer's factory trained product field service engineering team.
- B. Install transformers in accordance with the NEC and as recommended by the manufacturer.
- C. Coordinate the components of the transformers and their arrangements electrically and mechanically. Coordinate all circuit entrances into the transformers, including methods of entrance and connections.

- D. Anchor transformers in accordance with manufacturer's recommendations and instructions.
- E. Mount transformers on existing concrete slabs and within the confines of the existing available space between the existing primary switches and secondary switchgear.
- F. Remove debris from jobsite and clean all equipment and components installed. Repaint marred or scratched surfaces with touch up paint to match original finish.
- F. Transformer Grounding:
 - 1. Surge arresters and neutral shall be bonded directly to the transformer enclosure, and then to the existing grounding electrode system with bare copper conductors which shall be sized to match existing grounding system conductors. Lead lengths shall be kept as short as practical with no kinks or sharp bends.
 - 2. Perform ground-impedance measurements utilizing the fall of potential method on the existing secondary unit substation prior to replacement of the transformers and record measurements. Perform measurements on the existing secondary unit substations after replacement of the transformers and record measurements. Provide measurement documentation to the COR.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform tests in accordance with the manufacturer's recommendations. Include the following as a minimum:
 - 1. Transformer Inspection and Tests:
 - a. Compare equipment nameplate data with specifications and approved shop drawings.
 - b. Inspect physical and mechanical condition. Check for damaged or cracked insulators.
 - c. Inspect all field-installed bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey after energization under load.
 - d. Perform specific inspections and mechanical tests as recommended by manufacturer.
 - e. Perform insulation resistance tests and turns-ratio tests.

- f. Perform overpotential test on all high and low voltage windings to ground.
- g. Verify that resilient mounts are free and shipping brackets have been removed.
- h. Verify the winding core, frame, and enclosure groundings are correct.
- i. Verify that the tap-changer is set at specified ratio.
- j. Verify proper primary and secondary voltage after energization and prior to loading.

3.3 FOLLOW-UP VERIFICATION

- A. Upon completion of acceptance checks, settings, and tests, the contractor shall demonstrate that the transformers are in good operating condition and properly performing the intended function.
- B. A factory-trained manufacturer's field service representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations and these specifications.

3.6 INSTRUCTION

- A. Furnish the services of a factory-trained manufacturer's field service representative for one 2-hour training period for instructing personnel in the maintenance and operation of the transformers on dates coordinated with the COR.

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