PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY
A. This Section includes the following types of transformers with medium-voltage primaries:

1. Pad-mounted, liquid-filled transformers.

1.3 DEFINITIONS

1.4 SUBMITTALS
A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, utility or manufacturer’s anchorage and base recommendations, installed devices and features, location of each field connection, and performance for each type and size of transformer indicated.

B. Source quality-control test reports.

C. Follow-up service reports.

D. Operation and Maintenance Data: For transformer and accessories to include in emergency, operation, and maintenance manuals.
1.5 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of transformers and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with IEEE C2.


E. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store transformers protected from weather and so condensation will not form on or in units. Provide temporary heating according to manufacturer’s written instructions.

1.7 PROJECT CONDITIONS

A. Service Conditions: IEEE C37.121, usual service conditions except for the following:

1. Altitudes above 1000 feet.

1.8 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork shall meet load requirements. Requirements for concrete bases for electrical equipment are specified in Division 26 “Hangers and Supports for Electrical Systems.”

B. Coordinate installation of louvers, doors, spill retention areas, and sumps. Coordinate installation so no piping or conduits are installed in space allocated for medium-voltage transformers except those directly associated with transformers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CooperIndustries;CooperPowerSystemsDivision.

2.2 PAD-MOUNTED, LIQUID-FILLED TRANSFORMERS


B. Insulating Liquid: Less flammable, edible-seed-oil based, and UL listed as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D 92. Liquid shall be biodegradable and nontoxic.
C. Insulation Temperature Rise: 55 deg C when operated at rated kVA output in a 40 deg C ambient temperature. Transformer shall be rated to operate at rated kilovolt ampere in an average ambient temperature of 30 deg C over 24 hours with a maximum ambient temperature of 40 deg C without loss of service life expectancy.

D. Cooling System: Class OA/FA, self-cooled, and with forced-air-cooled rating. Cooling systems shall include auxiliary cooling equipment, automatic controls, and status indicating lights.

E. Impedance: 5.75 percent, ± 7.5%.

F. Accessories: Grounding pads, lifting lugs, and provisions for jacking under base. Transformers shall have a steel base and frame allowing use of pipe rollers in any direction, and an insulated, low-voltage, neutral bushing with removable ground strap. Include the following additional accessories:
   1. Liquid-level gage.
   2. Pressure-vacuum gage.
   3. Liquid temperature indicator.
   4. Drain and filter valves.
   5. Pressure relief device.

G. Basic Impulse Level: Comply with U.L. 1062.

H. Full-Capacity Voltage Taps: Four 2.5 percent taps, 2 above and 2 below rated high voltage; with externally operable tap changer for de-energized use and with position indicator and padlock hasp.

I. High-Voltage Terminations and Equipment: Dead front with universal-type bushing wells for dead-front bushing-well inserts, complying with IEEE 386 and including the following:
   1. Bushing-Well Inserts: One for each high-voltage bushing well.

J. Station class lightning arrestors provide at medium voltage side of transformer.

K. Winding material shall be copper.

2.3 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Electrical Identification."

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Perform design and routine tests according to standards specified for components. Conduct transformer tests according to IEEE C57.12.90.

B. Factory Tests: Perform the following factory-certified tests on each transformer:
   1. Resistance measurements of all windings on rated-voltage connection and on tap extreme connections.
2. Ratios on rated-voltage connection and on tap extreme connections.


4. No-load loss at rated voltage on rated-voltage connection.

5. Excitation current at rated voltage on rated-voltage connection.

6. Impedance and load loss at rated current on rated-voltage connection and on tap extreme connections.


8. Induced potential.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for medium-voltage transformers.

B. Examine roughing-in of conduits and grounding systems to verify the following:
   1. Wiring entries comply with layout requirements.
   2. Entries are within conduit-entry tolerances specified by manufacturer and no feeders will have to cross section barriers to reach load or line lugs.

C. Examine walls, floors, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and that requirements in Division 26 Section "Grounding and Bonding" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install transformers and anchor to concrete bases according to utility or manufacturer's written instructions, seismic codes at Project, and requirements in Division 26 Section "Hangers and Supports for Electrical Systems."

B. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

3.3 IDENTIFICATION

A. Identify field-installed wiring and components.

3.4 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding."

B. Connect wiring according to Division 26 Section "Conductors and Cables."
3.5 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality control tests in accordance with Division 26 section “Electrical Testing”

B. Visual and Mechanical Inspection
   1. Compare equipment nameplate information with single line diagram.
   2. Inspect for physical damage, cracked insulators, leaks, tightness of connections, and general mechanical and electrical conditions.
   3. Verify proper auxiliary device operation.
   4. Verify proper liquid level in all tanks and bushings.
   5. Perform specific inspections and mechanical tests as recommended by manufacturer.
   6. Verify proper equipment grounding.

C. Electrical Tests
   1. Perform insulation resistance tests, winding-to-winding and windings-to-ground, utilizing a meg-ohmmeter with test voltage output as shown in accordance with N.E.T.A. Acceptance Testing Specifications, Table 10.5. Test duration shall be for 10 minutes with resistance values tabulated at 30 seconds, 1 minute, and 10 minutes. Calculate Polarization index.
   2. Perform a turns ratio test between windings at all tap positions. The final tap setting is to be set at the secondary system rated voltage at full load or as directed by the Architect/Engineer.
   3. Insulating liquid shall be sampled in accordance with ASTM D-923. Sample shall be laboratory tested for:
      a. Dielectric breakdown voltage: ASTM D-877 or ASTM D-1816
      b. Acid neutralization number: ASTM D-974
      c. Interfacial tension: ASTM D-971 or ASTM D-2285
      d. Color: ASTM D-1500
      e. Visual Condition: ASTM D-1524
      f. Perform dissolved gas analysis (DGA) in accordance with ANSI/IEEE C57.104 or ASTM D-3612 for transformers 500 kVA and larger.
   4. Perform insulation power factor tests or dissipation factor tests on all windings and bushings. Overall dielectric-loss and power factor ($C_H$, $C_L$, $C_{HL}$) shall be determined. Test voltages should be limited to the line to ground voltage rating of the transformer winding.
   5. Perform tests and adjustments on tap-changer, fan and pump controls, and alarm function.
   6. Verify proper core grounding if accessible.
7. Perform percent oxygen test on the nitrogen gas blanket for 3000 kVA or larger.

D. Test Values

1. Perform insulation resistance tests in accordance with N.E.T.A. Acceptance Testing Specifications, Table 10.5. Results to be temperature corrected in accordance with Table 10.14.

2. The polarization index should be used for future reference.

3. Turns ratio test results shall not deviate more than one half percent (0.5%) from either the adjacent coils or the calculated ratio.

4. Maximum power factor of liquid filled transformers corrected to 20°C shall be in accordance with N.E.T.A. Acceptance Testing Specifications, Table 10.3.

5. Bushing power factors and capacitances that vary from nameplate values by more than ten percent (10%) should be investigated.

6. Dielectric fluid should comply with N.E.T.A. Acceptance Testing Specifications, Table 10.4.

E. Remove and replace malfunctioning units and retest as specified above.

F. Test Reports: Prepare written reports to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective actions taken to achieve compliance with requirements.

3.6 FOLLOW-UP SERVICE

A. Voltage Monitoring and Adjusting: Perform the following voltage monitoring after Substantial Completion but not more than six months after Final Acceptance:

1. During a period of normal load cycles as evaluated by Owner, perform seven days of three-phase voltage recording at secondary terminals of each transformer. Use voltmeters with calibration traceable to National Institute of Science and Technology standards and with a chart speed of not less than 1 inch per hour. Voltage unbalance greater than 1 percent between phases, or deviation of any phase voltage from nominal value by more than plus or minus 5 percent during test period, is unacceptable.

2. Corrective Actions: If test results are unacceptable, perform the following corrective actions, as appropriate:
   a. Adjust transformer taps.
   b. Prepare written request for voltage adjustment by electric utility.
3. Retests: After corrective actions have been performed, repeat monitoring until satisfactory results are obtained.


**END OF SECTION**