

SECTION 16320

POWER TRANSFORMER

PART 1 GENERAL

1.1 DESCRIPTION

- A. Design, manufacture, test and deliver to the job site 1 outdoor, self cooled, sealed type, 7500 KVA, three phase, 60 hertz, mineral oil-immersed power transformer similar to existing, including transformer mounted neutral current transformer.
- B. Outdoor transformer shall be complete from incoming terminals to outgoing terminals.
- C. Transformer for operation on a 13,800 volt, 3 phase, 3 wire, CG Heating low resistance grounded system to 4-160 Volt, 3 phase, 3 wire, 60 Hertz resistance grounded system.

1.2 SUBMITTALS

A. General

- 1. Furnish submittals for items that are identified in this SECTION by a different typeface and a bracketed code (e.g., *Item [L]*). Refer to SECTION 01340 for definition of codes for types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this SECTION are specified herein under this Article.

B. Bid Data

- 1. Submit, at the time of bidding, the following information:
 - a. Guaranteed no-load losses at 100 percent voltage.
 - b. Guaranteed losses at 100 percent voltage for both the self-cooled and supplemental load ratings of 1/4, 1/2, 3/4, and 1.
 - c. Exciting current at 100 percent of rated voltage in percent of full load current.
 - d. Impedance at neutral setting of transformer taps.
 - e. Description of production line impulse tests.
 - f. Maximum calculated sound level in decibels of the transformer.
 - g. Description of insulation system and maximum recommended average winding and hot-spot temperatures for operation without diminishing the normal life expectancy of the transformer.
 - h. Hottest spot temperatures for operation of each contact on winding temperature relay and operating tolerance.
 - i. Description of future cooling equipment for supplementary rating.
 - j. KW input to cooling equipment at each stage of cooling.
 - k. List manufacturer, type, rating and physical and electrical characteristics of terminal bushings.
 - l. Oil preservation system, ie. Sealed tank or conservator.
 - m. Short circuit current the transformer will be designed to withstand.
 - n. Description of accessory equipment, including arrestor ratings and description.

- o. Description of transformer construction and material shell or core form, helical disk or layer windings.
 - p. Outline dimensions of assembled transformer.
 - q. Total assembled weight of transformer and parts.
 - r. Weight of transformer core and coils.
 - s. Weight of case.
 - t. Weight and number of gallons of oil.
 - u. Load tap changer type.
- C. Manufacturer's Drawings, Reports, And Guarantee
- 1. *Shop Drawings [B,D,P]*: Submit manufacturer's certified prints showing assembly of units, outline dimensions and weights, shipping lengths, location of conduits, wiring diagrams, installation drawings and a complete bill of material.
 - 2. *Test reports [T]*: Submit on all factory tests. Submit certified test reports of previous tests on essentially identical equipment under actual conditions, not simulated, for transformer temperature test.
 - 3. *Guarantee [G]* the unit to meet the operating conditions, capacity and performance conditions as specified and to remain serviceable for two years after project acceptance. If either the unit or accessories fail to meet operating requirements or if failure of any part occurs during the guarantee period, rework or replace the affected items promptly to meet the CONTRACT requirements at no cost to the OWNER.
- D. Characteristics
- 1. *RATINGS [P,R]*
 - a. Transformer. Transformer shall have one copper high voltage winding and one copper low voltage winding. The high voltage winding shall be rated at 13.8 KV delta, 7.5/8.4 MVA, self cooled, forced air cooled (future), at 65 degC rise with a BIL of 110 KV. The low voltage winding shall be rated at 4.16 KV.Y/2.4 KV, 7.5/8.4 MVA, self cooled, forced air cooled at 65 degC rise with a BIL of 60 KV. The high voltage winding shall have four 2-1/2 percent taps at rated current two above and two below 13.8 KV. The impedance from the 13.8 KV winding to the 4.16 KV winding shall be 7.0 percent on 7.5 MVA base as per ANSI Standard C57.12 within a manufacturing tolerance as per ANSI Standard C57.12.10, Table 10. The high voltage winding shall be connected DELTA and the low voltage winding shall be connected WYE.
 - b. Each transformer shall be designed for a future increased continuous rating of 133 percent of the self cooled rating at 65 degC temperature rise and shall include future auxiliary cooling equipment as described.
 - c. The transformers shall have a rating based on an average copper temperature rise of 65 degC above an ambient air temperature of 30 degC average in a 24-hour period with a maximum of 40 degC for full load continuous operation, and hotspot temperature rise of 80 degC.
 - 2. *PHASE AND NEUTRAL TERMINALS [P]*
 - a. Terminals. shall be standard bushings and shall have the current carrying capacity for the increased rating of 133 percent. Primary and secondary bushings shall be top cover mounted.
 - b. The 13.8 KV bushings shall be 15 KV class, 110 BIL.
 - c. The 4.16 KV bushings shall be 5 KV class, 60 BIL.

- d. The 7.62 neutral KV bushing shall be 15 KV class, 110 KV BIL.
- 3. **LIGHTNING ARRESTORS [U]**
 - a. Lightning arrestors on the primary shall be station type 10 KV mounted adjacent to each high voltage terminal and suited for transformer protection on a 13200Y/7620 volt grounded neutral incoming service.
 - b. Lightning arrestors on the secondary shall be distribution class 3 KV mounted adjacent to each low voltage terminal and suited for transformer protection on a 4160/2900 volt resistance grounded neutral outgoing service.
 - c. A permanently connected 1/4 inch x 1 inch copper ground strap shall be provided from the base of each lightning arrestor to the grounding pad at the base of the transformer.
- 4. **GROUND PADS**
 - a. Two 4 bolt type ground pads shall be furnished. The two pads shall be welded at an accessible location near the base of the transformer. Ground pad shall be tied to substation grounding system with 250 Kcmil bare copper ground wire.
- 5. **SHORT CIRCUIT CAPABILITY**
 - a. Each transformer shall be capable of withstanding, without injury, the mechanical and thermal stresses caused by a maximum short circuit current possible in accordance with ANSI Standard C57.12.90.

1.3 QUALITY CONTROL

A. Specifications And Standards

- 1. All equipment shall conform to the latest applicable standards of ANSI, IEEE, and NEMA.

B. Quality Assurance Provisions

- 1. Manufacturer's Quality Assurance Program. Stipulate, with the bid, the provisions currently practiced in the plant to assure quality control.
- 2. Inspection. Thoroughly inspect all the work of this specification before shipment to the site. Reject and replace any deficient work and ensure that quantities comply with requirements.
- 3. All material and workmanship shall be subject to inspection and test after its delivery to the job site. In case any items of equipment are found to be defective in material or workmanship or otherwise not in conformity with the specifications, the OWNER shall have the right to reject such items or require their correction at no expense to the OWNER.
- 4. The OWNER reserves the right to witness any or all standard factory tests.
- 5. *Testing [T]:*
 - a. Resistance measurement, ratio, polarity and phase relation excitation loss, excitation current, impulse, corona, impedance voltage and load loss, applied potential, induced potential, and temperature tests per latest ANSI C57.12.00.
 - b. Do not perform transformer temperature tests where such tests have been performed on essentially identical transformer under actual conditions, not simulated, and test data is available.

1.4 MAINTENANCE DATA AND OPERATING INSTRUCTIONS

- A. Furnish, per SECTION 01730, operating and maintenance manuals for instructions for operation and maintenance of equipment and list of recommended spare parts.

1.5 FIELD SERVICES

- A. Furnish specialized field services to insure the correct installation and operation of the transformers. Specifically it shall be required that a field service engineer be made available to check out the transformer and its accessories during erection prior to energization, and after placing the transformer in service. Field services shall be included as part of transformer quotation price.

PART 2 PRODUCTS

2.1 MANUFACTURE

- A. General Electric
- B. Cooper Power Systems
- C. ABB Power T&D Co.
- D. Interstate Transformer
- E. Sunbelt Transformer

2.2 FABRICATION

- A. Configuration And Materials
 - 1. *RELAYS AND SAFETY DEVICES [U,T]*
 - a. A pressure-vacuum bleeder relief device set to operate at maximum safe operating pressure (positive or negative) shall be furnished and mounted approximately 60 inches above foundation including support beams. An alarm contact is required.
 - b. Mechanical resealing type of pressure relief device with a semaphore indicating target and alarm contact shall be furnished and mounted on the main tank cover so that the indicating target is visible from the ground.
 - c. A fault sudden pressure alarm relay shall be furnished and mounted on the main tank with the "a" and "b" contact leads wired to a terminal block in the control cabinet.
 - d. A top oil thermometer shall be furnished and mounted approximately 60 inches above transformer supporting surface including support beams. The thermometer will shall be located one inch below the low-oil level position and the well shall be mounted to the tank using 1/2 inch - 14 NPT coupling. The alarm contacts shall be wired to a terminal block in the control cabinet.
 - e. A hotspot thermometer thermal imaging type with four independently adjustable "a" contacts, 6 inch dial with scale range of 0 to 160 degC and resettable maximum

- indicating hand shall be furnished and mounted adjacent to the top-oil thermometer with the alarm contacts wired to a terminal block in the control cabinet.
- f. A pressure-vacuum gauge with a scale range of 15 psi positive and 30" vacuum and mounted adjacent to the top-oil thermometer shall be furnished on sealed tank system only.
 - g. A 6 inch magnetic oil level gauge shall be furnished. The 25 degC oil level mark shall be at the left hand edge of the horizontal centerline of the dial face. The gauge shall have low-oil alarm contacts accessible for testing and shall be wired to a terminal block in the control cabinet.
2. BUSHINGS
 - a. Where applicable, bushings shall be the interchangeable type and current rating shall be greater than the maximum 65 degC transformer nameplate current rating and shall permit transformer emergency loading.
 3. CORE AND COILS
 - a. Ground conductors (straps) from each core shall be clearly identified and brought to an accessible terminal on the underside of the cover near a manhole that is appropriately marked.
 - b. The core to ground resistance shall be not less than 25 megohms in air as measured with a 500 volt megger.
 4. OIL PRESERVATION [D]
 - a. Equipment shall be provided to maintain a dry nitrogen atmosphere in the space above the oil. Automatic controls shall feed the gas into the transformer through a reducing valve from a steel cylinder whenever the internal pressure falls below a preset value.
 - b. A means shall be provided to sample the transformer internal gas for oxygen content determination. All equipment shall be housed in a weatherproof, padlockable cabinet for mounting adjacent to the transformer.
 - c. The transformers shall be shipped with core and coil under oil.
 5. TANK
 - a. The completely assembled transformer shall have welded on non-detachable cooling radiators and be designed to withstand without permanent deformation both 10 psig positive pressure and essentially full vacuum.
 - b. Designed operating pressures shall not exceed 8 psig positive or 8 psig negative.
 - c. The tank cover shall be welded.
 - d. Base shall be fabricated of heavy structural steel integral with tank, with four pulling eyes, suitable for direct mounting on a concrete pad.
 - e. Provide handholes and/or manholes, as required, for access to all internal connections.
 - f. Provide spare handhole/manhole gaskets.
 - g. Provide vent valve or plug, drain valve or plug, liquid sampling valve and filter press connection.
 - h. Tank finish shall be Gray (match existing transformers). Provide one quart of touch-up paint for each transformer.
 6. CONFIGURATION [D]
 7. HANDLING FACILITIES
 - a. Lifting eyes or lugs shall be provided for lifting of the cover, the core and the coil assembly from the tank, and the complete transformer.

- b. Jacking pad shall be accessible for insertion of jacks when the transformer is completely assembled.
 - c. The base members of the transformer shall permit rolling in the directions of the center lines of both the length and width segments.
8. *LOAD TAP CHANGER [D,P]*
- a. Provide Automatic Load Tap Changing equipment with plus or minus approximately 10% regulation of the low voltage winding in sixteen approximately 5/8% steps above and below the rated low voltage.
 - 1) The Load Tap Changing device shall be reactance-arcing or vacuum interrupting type.
 - 2) The LTC switch shall be located in an oil filled compartment mounted on the transformer with removable bolted covers for access without lowering the oil in or opening the main tank. The compartment shall be furnished with a liquid level gauge, a drain/sampling valve, and a pressure relief device.
 - 3) The LTC motor drive mechanism shall be suitable for 120 volt single phase operation. Power source provided by installer. Provide a hand crank for manual operation in a storage place. An electrical interlock shall be furnished to prevent operation by the motor while utilizing the hand crank. Furnish electrical and mechanical stops to prevent over travel of the drive mechanism.
 - 4) Furnish a weather-proof, padlockable cabinet for control devices. Cabinet shall contain LTC motor control panel, automatic control panel, hand crank panel, LTC position indicator, LTC operation counter, 120 volt screw-base lamp socket with switch, 120 volt convenience outlet, and 120 volt heater with manual switch. Power source provided by installer.
 - 5) The transformer installation contractor will furnish a source of potential for the voltage sensing device. PT to be connected line to line (X1-X2) and shall be 0.3Y accuracy classification.
 - 6) Furnish current transformer(s) for supply of the line-drop compensator and for paralleling equipment.
9. *NEUTRAL GROUNDING RESISTOR [D,P]*
- a. Provide a cover mounted low-voltage neutral grounding resistor rated for 10 seconds, 400 amperes and 750 degC rise.
10. *RADIATORS, HEAT EXCHANGERS, FANS AND CONTROLS [D,P,R,T]*
- a. Provide all devices and wiring for future automatic fan cooling to increase the self cooled rating to 133%. The fans shall be suitable for operation on a single phase, 60 Hertz, 120 volt, service supplied by the OWNER. Manufacturer shall supply fuse block with fuses, or circuit breakers for overcurrent protection. Provide a contact for future remote monitoring of fan operation.

PART 3 EXECUTION

3.1 WORKMANSHIP

- A. All work shall be done by craftsmen experienced in the trade and shall be performed in accordance with the best practices of the trade.

3.2 PREPARATION FOR SHIPMENT

- A. The enclosure and all components shall be thoroughly cleaned before shipment. All units shall be appropriately marked.
- B. All parts shall be wrapped, crated and thoroughly protected against damage and weather in transit. All frames shall have a channel spacer at the base to ensure stability of the frame. Provide covers, cushioning material, and other protection as required to protect material from damage by weather or other causes until delivery at the site.
- C. Load, secure, and brace the equipment for shipment.
- D. Shipping identification shall include the OWNER'S Purchase Order Number, Item Number, and Contract Number. For each Purchase Order, where more than one shipping container is used, the container number and the total number of containers shall appear in the identification.
- E. Shipping:
 - 1. All work shall be shipped by conveyance as to best assure timely delivery.
 - 2. Any work damaged during delivery shall be rejected and repaired or replaced by the transformer manufacturer, at the OWNER'S discretion, at no cost to the OWNER.

END OF SECTION

Revision History	
Date	Rev. No.
A	0
B	0
C	0
02-19-09	0

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