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

PART 1 - GENERAL

1.1 SCOPE

A. This specification covers the electrical and mechanical characteristics for Three-Phase Primary and Secondary Unit Substation Transformers.

B. All characteristics, definitions and terminology, except as specifically covered in this specification, shall be in accordance with the latest revision of the following ANSI/IEEE standards.

1.2 RELATED DOCUMENTS

A. ***Related Sections included the following:***
   1. ***[Section 26 01 26 – Maintenance and Testing of Electrical Systems]***
   2. ***[Section 26 13 13 – Medium Voltage Circuit Breaker Switchgear]***
   3. ***[Section 26 13 16 – Medium Voltage Fusible Interrupter Switchgear]***
   4. ***[Section 26 23 00 – Low Voltage Switchgear]***
   5. ***[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.
   2. Conduit entry location, cable termination sizes, mounting.

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

C. The following checked data shall be submitted with the proposal:
   1. Core Losses at 85 deg C or at 20 deg C
   2. Winding Losses
   3. Exciting Current at 100% and 110% rated Voltage.
   4. Percent Impedance
   5. Efficiencies must be provided at loading levels of 100%, 75%, 50% and 25%.
   6. Percent regulation must be provided at 0.8 PF and 1.0 PF.

1.4 RELATED STANDARDS

A. The following codes and standards shall be met as they apply at the time of the purchase order.
   1. C57.12.00 - IEEE Standard General Requirements for Liquid-Immersed Distribution, Power and Regulating Transformers.
   2. C57.12.10 - Safety Requirements 230 kV and Below 833/958 through 8333/10417 kVA, Single-Phase and 750/862 through 60000/80000/100000kVA, Three-Phase without Load Tap Changing; and 3750/4687 Through 60000/80000/100000 kVA with Load Tap Changing.
   3. C57.12.28 - Pad-Mounted Equipment - Enclosure Integrity.
   4. C57.12.70- American National Standard Terminal Markings and Connections for Distribution and Power Transformers.
   5. C57.12.80 - IEEE Standard Terminology for Power and Distribution Transformers.
   6. C57.12.90 - IEEE Standard Test Code for Liquid-Immersed Distribution, Power and Regulating Transformers and IEEE Guide for Short-Circuit Testing of Distribution and Power Transformers.

7. C57.92 - Guide for Loading Mineral-Oil-Immersed Power Transformers Up to and including 100 MVA with 65 deg C or 55 deg C Average Winding Rise.
8. FM 3990 - Less or Nonflammable Liquid-Insulated Transformers
9. UL XPLH - Guide for Transformers, Distribution, Liquid-Filled Type, over 600V
10. ***[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 padmounted tamper-resistant transformers for a minimum of 10 years.

B. The manufacturer shall have a documented quality assurance program.

C. The transformers shall be manufactured by a company which is certified to ISO 9001:2000. A copy of the certificate of Compliance to this requirement is available upon request.

D. All units shall be tested for the following:
1. No-Load (85 deg C) losses at 100% and 110% rated voltage.
2. Total (85 deg C) Losses at rated current.
3. Percent Impedance (85 deg C) at rated current and tap extremes.
4. Excitation Current (100% and 110% voltage) test.
5. Winding Resistance measurement tests and tap extremes.
6. Ratio Tests using all tap settings.
7. Polarity and Phase relation tests.
8. Applied and Induced potential tests.
9. Full wave and Reduced wave impulse test.

E. In addition, the manufacturer shall provide certification upon request for all design and other tests listed in Table 17 of ANSI C57.12.00 including verification that the design has passed Short Circuit Criteria per ANSI C57.12.00 - 1993 and C57.12.90.

F. The manufacturer shall provide the guaranteed average no-load and load losses for the unit at 85 deg C. These losses will be subject to the tolerance specified in Table 19 of ANSI C57.12.00. No-Load Losses: 10% tolerance, Total Losses: 6% tolerance.

G. When a total owning cost evaluation is used, the economic factors for no-load and load losses used in the analysis shall be provided on the inquiry.

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 padmounted distribution transformer shall be provided by Siemens or pre-approved equal. Approved manufacturers are as follows:
1. SIEMENS
2. ***[ ]***

2.2 RATINGS

A. The transformer shall be designed in accordance with this specification and shall have the following ratings:
   1. ***[300] [500] [750] [1000] [1500] [2000] [2500] [3000] [3750] [5000] [7500] [10000]*** kVa.
   2. ***[60HZ] [50HZ]***
   3. ***[Indoor] [Outdoor, near building]***
   4. ***[65 deg C] [75 deg C] [55/65 deg C] [55/75 deg C]*** Temperature Rise
   5. ***[Special Altitude: _____ft (m)]***
   6. Impedance: ***[_____%Z] [ANSI Standard] [Minimum] [Maximum]*** +/-7.5% Tolerance

B. Primary voltage and the basic impulse insulation level (BIL) shall be:
   1. ***[2400 Delta, [Distribution Transformer - 60 kv] [Power Transformer - 60 kv] BIL]***
   2. ***[4160 Delta, [Distribution Transformer - 60 kv] [Power Transformer - 75 kv] BIL]***
   3. ***[4800 Delta, [Distribution Transformer - 60 kv] [Power Transformer - 75 kv] BIL]***
   4. ***[7200 Delta, [Distribution Transformer - 75 kv] [Power Transformer - 95 kv] BIL]***
   5. ***[12000 Delta, [Distribution Transformer - 95 kv] [Power Transformer - 110 kv] BIL]***
   6. ***[12470 Delta, [Distribution Transformer - 95 kv] [Power Transformer - 110 kv] BIL]***
   7. ***[13200 Delta, [Distribution Transformer - 95 kv] [Power Transformer - 110 kv] BIL]***
   8. ***[13800 Delta, [Distribution Transformer - 95 kv] [Power Transformer - 110 kv] BIL]***
   9. ***[14400 Delta, [Distribution Transformer - 95 kv] [Power Transformer - 110 kv] BIL]***
   10. ***[16340 Delta, [Distribution Transformer - 95 kv] [Power Transformer - 110 kv] BIL]***
   11. ***[34500 Delta, [Distribution Transformer - 150 kv] [Power Transformer - 200 kv] BIL]***
   12. ***[43800 Delta, [Power Transformer - 250 kv] BIL]***
   13. ***[4160GrdY/2400, [Distribution Transformer - 60 kv] [Power Transformer - 75 kv] BIL]***
   14. ***[8320GrdY/4800, [Distribution Transformer - 75 kv] [Power Transformer - 95 kv] BIL]***
   15. ***[12470GrdY/7200, [Distribution Transformer - 95 kv] [Power Transformer - 110 kv] BIL]***
   16. ***[13200GrdY/7620, [Distribution Transformer - 95 kv] [Power Transformer - 110 kv] BIL]***
   17. ***[13800GrdY/7970, [Distribution Transformer - 95 kv] [Power Transformer - 110 kv] BIL]***
   18. ***[22860GrdY/13200, [Distribution Transformer - 125 kv] [Power Transformer - 150 kv] BIL]***
   19. ***[23900GrdY/13800, [Distribution Transformer - 125 kv] [Power Transformer - 150 kv] BIL]***
   20. ***[24940GrdY/14400, [Distribution Transformer - 125 kv] [Power Transformer - 150 kv] BIL]***
   21. ***[34500GrdY/19920, [Distribution Transformer - 150 kv] [Power Transformer - 200 kv] BIL]***
   22. ***[43800GrdY/25300, [Power Transformer - 250 kv] BIL]***

C. Secondary voltage and the basic impulse insulation level (BIL) shall be:
   1. ***[208Y/120, [Distribution Transformer - 30 kv] [Power Transformer - 45 kv] BIL]***

2. ***[480Y/277, [Distribution Transformer - 30 kv] [Power Transformer - 45 kv] BIL]]***
3. ***[575Y/332, [Distribution Transformer - 30 kv] [Power Transformer - 45 kv] BIL]]***
4. ***[600Y/347, [Distribution Transformer - 30 kv] [Power Transformer - 45 kv] BIL]]***
5. ***[690Y/398, [Distribution Transformer - 30 kv] [Power Transformer - 45 kv] BIL]]***
6. ***[240 Delta, [Distribution Transformer - 30 kv] [Power Transformer - 45 kv] BIL]]***
7. ***[480 Delta, [Distribution Transformer - 30 kv] [Power Transformer - 45 kv] BIL]]***
8. ***[240 Delta with 120 Mid-Tap, [Distribution Transformer - 30 kv] [Power Transformer - 45 kv] BIL]]***
9. ***[480 Delta with 240 Mid-Tap, [Distribution Transformer - 30 kv] [Power Transformer - 45 kv] BIL]]***
10. ***[2400 Delta, [Distribution Transformer - 60 kv] [Power Transformer - 60 kv] BIL]***
11. ***[4160 Delta, [Distribution Transformer - 60 kv] [Power Transformer - 75 kv] BIL]***
12. ***[4800 Delta, [Distribution Transformer - 60 kv] [Power Transformer - 75 kv] BIL]***
13. ***[7200 Delta, [Distribution Transformer - 75 kv] [Power Transformer - 95 kv] BIL]***
14. ***[12000 Delta, [Distribution Transformer - 95 kv] [Power Transformer - 110 kv] BIL]***
15. ***[12470 Delta, [Distribution Transformer - 95 kv] [Power Transformer - 110 kv] BIL]***
16. ***[13200 Delta, [Distribution Transformer - 95 kv] [Power Transformer - 110 kv] BIL]***
17. ***[13800 Delta, [Distribution Transformer - 95 kv] [Power Transformer - 110 kv] BIL]***
18. ***[14400 Delta, [Distribution Transformer - 95 kv] [Power Transformer - 110 kv] BIL]***
19. ***[16340 Delta, [Distribution Transformer - 95 kv] [Power Transformer - 110 kv] BIL]***
20. ***[4160GrdY/2400, [Distribution Transformer - 60 kv] [Power Transformer - 75 kv] BIL]***
21. ***[8320GrdY/4800, [Distribution Transformer - 75 kv] [Power Transformer - 95 kv] BIL]***
22. ***[12470GrdY/7200, [Distribution Transformer - 95 kv] [Power Transformer - 110 kv] BIL]***
23. ***[13200GrdY/7620, [Distribution Transformer - 95 kv] [Power Transformer - 110 kv] BIL]***
24. ***[13800GrdY/7970, [Distribution Transformer - 95 kv] [Power Transformer - 110 kv] BIL]***
25. ***[22860GrdY/13200, [Distribution Transformer - 125 kv] [Power Transformer - 150 kv] BIL]***
26. ***[23900GrdY/13800, [Distribution Transformer - 125 kv] [Power Transformer - 150 kv] BIL]***
27. ***[24940GrdY/14400, [Distribution Transformer - 125 kv] [Power Transformer - 150 kv] BIL]*** ***[Note to specifier – Other voltage are available upon request,]***

D. Cooling Class:
   1. ***[ONAN] [ONAF 15% or 25% Capacity] [ONAF 33% Capacity] [ONAF (Future)]***

E. Liquid Type:

1. ***[EnviroTemp FR3™ Fluid][BIOTEMP®]***

2.3 TAPS

A. The transformer shall be furnished with full capacity high-voltage taps. The tap changer shall be clearly labeled to reflect that the transformer must be de-energized before operating the tap changer as required in Section 5.1.1 of ANSI C57.12.10. Taps shall be provided on the higher voltage of dual voltage primary units. The tap changer switch shall be an externally operated, snap action switch with a lever handle. Padlocking provisions are standard. The unit shall have one of the following tap configurations:
   1. ***[No taps]***
   2. ***[Two - 2½% taps above and below rated voltage (Cooper Standard)]***
   3. ***[Four - 2½% taps below rated voltage]***
   4. ***[Four - 2½% taps above rated voltage]***
   5. ***[NEMA taps (14400, 13800, 13200, 12470, 12540)]***
   6. ***[Others as needed _____]***

2.4 WINDING TEMPERATURE RISE RATING

A. ***[The transformer shall have a 65 deg C average winding temperature rise rating. The above winding temperature rise shall not exceed 65 deg C when loaded at base kVA rating.] [The transformer shall have a 55 deg /65 deg C average winding temperature rise rating. The above winding temperature rise shall not exceed 55 deg C when loaded at base kVA rating. The transformer shall provide an additional 12% capacity at the 65 deg C rating.] [The transformer, filled with EnviroTemp FR3, shall have a 75 deg C average winding temperature rise rating. The above winding temperature rise shall not exceed 75 deg C when loaded at base kVA rating.] [The transformer, filled with EnviroTemp FR3, shall have a 55/75 deg C average winding temperature rise rating. The above winding temperature rise shall not exceed 55 deg C when loaded at base kVA rating. The transformer shall provide an additional 22% capacity at the 75 deg C rating.]***

2.5 IMPEDANCE

A. The percent impedance voltage, as measured on the rated voltage connection, shall be per ANSI C57.12.10 – latest revision.

2.6 COOLING

A. ***[The transformer shall be cooled by the natural circulation of air over the tanks surfaces and any corrugate or radiators if required, allowing only the base kVA rating shall be provided with Class ONAN.] [The transformer shall be cooled by the natural circulation of air over the tank surface, with an additional rating obtained by forced air circulated over the radiator or corrugate, shall be provided with ONAN/ONAF rated cooling including all control equipment, 15% for 750 kVA – 2000 kVA and 25% for 2500 kVA – 10MVA.] [The transformer shall be cooled by the natural circulation of air over the tank surface, with an additional rating obtained by forced air circulated over the radiator or corrugate, shall be provided with ONAN/ONAF rated cooling including all control equipment, 33% for 750 kVA – 10MVA.] [The transformer shall be cooled by the natural circulation of air over the tank surface, with future kVA capacity built into the cooling surfaces and conductors shall be provided with ONAN/Future ONAF rated cooling. (750 kVA & above).]***

2.7 HIGH VOLTAGE BUSHINGS AND TERMINALS

A. ***[The transformer shall be provided with three (3) sidewall mounted high voltage bushings plus an HO neutral bushing for WYE connected transformers rated for full three-phase duty with either a two-hole spade or an eyebolt connector. The high voltage bushings shall be mounted in Segment 2 or in Segment 4 of the transformer.] [The transformer shall be provided with [three (3)] [six (6)] sidewall***

mounted high voltage bushings, either 200 amp wells or 600amp dead-break for deadfront application and arranged for [radial] [loop] feed configuration. The high voltage bushings shall be mounted in Segment 2 or in Segment 4 of the transformer.] [The transformer shall be provided with three (3) cover mounted electrical grade wet process porcelain high voltage bushings plus an HO neutral bushing for WYE connected transformers rated for full three-phase duty with [a two-hole spade] [an eyebolt connector]. The high voltage bushings shall be mounted in Segment 2, Segment 3, or Segment 4 of the transformer.]

1. ***[Wells and Inserts (200 A)]***
2. ***[Deadbreak One-Piece Bushings (600 A)]***

2.8 LOW VOLTAGE BUSHINGS AND TERMINALS

A. The low-voltage line and neutral bushings shall be sidewall mounted molded epoxy for secondaries less than 1000V and with a 6-Hole NEMA spade. Low-voltage bushings above 1000 V shall be electrical grade wet process porcelain The low-voltage bushings shall be located in Segment 2 or Segment 4 opposite of the specified high-voltage configuration.

1. ***[6-Hole Spade] [12-Hole Spade]***

2.9 TANK AND TERMINAL COMPARTMENT

A. The core and coil shall be vacuum processed to ensure maximum penetration of insulating fluid into the coil insulation system. While under vacuum, the windings shall be energized to heat the coils and drive out moisture and the transformer will be filled with preheated filtered degassed insulating fluid. The core shall be manufactured from burr-free, grain-oriented silicon steel and shall be precisely stacked to eliminate gaps. The coil shall be insulated with B-stage, epoxy coated, diamond pattern, insulating paper, which shall be thermally cured under pressure to ensure proper bonding of conductor and paper. The winding shall be of aluminum or copper construction.

B. The dielectric coolant shall be listed less-flammable fluid meeting the requirements of National Electrical Code Section 450-23 and the requirements of the National Electrical Safety Code (IEEE C2-1997), Section 15. The dielectric coolant shall be non-toxic, non-bioaccumulating and be readily and completely biodegradable per EPA OPPTS 835.3100. The base fluid shall be 100% derived from edible seed oils and food grade performance enhancing additives. The fluid shall not require genetically altered seeds for its base oil. The fluid shall result in zero mortality when tested on trout fry per OECD G.L. 203. The fluid shall be certified to comply with the US EPA Environmental Technology Verification (ETV) requirements and tested for compatibility with transformer components. The fluid shall be Factory Mutual Approved, UL Classified Dielectric Medium (UL-EOUV) and UL Classified Transformer Fluid (UL-EOVK), EnviroTemp FR3™ fluid.

C. All transformer oil must be bulk tested for polychlorinated biphenyl's (PCBs) per ASTM D4059 and certified, upon request, as having no detectable level of PCB.

D. Panel type radiators or corrugate type cooling is welded directly to the tank when additional cooling is required. Detachable panel type radiators are available as an option.

E. The tank must be welded using precision cut, cold-rolled steel plate and equipped with extra-heavy duty, welded-in-place lifting lugs and jacking pads. The tank base must be designed to allow skidding or rolling in any direction.

F. The transformer shall be of sealed tank construction of sufficient strength to withstand a pressure of 7 psig without permanent distortion and 15 psig without rupturing.

G. The tank shall include a pressure relief device as a means to relieve tank pressure in excess of pressure resulting from normal operation. The venting and sealing characteristics shall be as specified to meet the requirements of Factory Mutual Standard 3990.

H. The tank shall be cleaned with an alkaline cleaning agent to remove grease and oil. An iron phosphate coating shall then be chemically bonded to the metal to assure coating adhesion and retard corrosion. The tank shall be primed with an electro-deposited epoxy coating to provide a barrier against moisture, salt and corrosives. The top-coat shall be a liquid polyurethane coating to seal and add ultraviolet protection. The tank coating shall meet all performance requirements in ANSI C57.12.28 – latest revision.

2.10 PRIMARY AND SECONDARY TERMINATIONS ***[Pick one of the following 6 choices.]***

A. ***[Throat***
   1. ***A throat is used on a transformer with sidewall mounted bushings for connecting the transformer with bus duct. It extends 8 inches above and below the centerline of the bushings.]***

B. ***[Flange (required with primary air disconnect switch)***
   1. ***A flange is used on a transformer with sidewall mounted bushings for direct connection to metal clad switchgear and is required with the primary air disconnect switch option. The flange extends 8 inches above and 32 inches below the bushing centerline.]***

C. ***[Bottom entry air terminal chamber***
   1. ***The partial height bottom entry air terminal chamber extends approximately 24 inches below the centerline of the bushings and has a bottom removable plate that can accommodate cable glands or conduit hubs. A lift-off front panel or hinged door is included.]***

D. ***[Top entry air terminal chamber***
   1. ***The partial height top entry air terminal chamber has a chimney with a removable cover that extends 24 inches above the bushing centerline and can be equipped with cable glands or conduit hubs. Bus duct can be adapted to match the top of the chimney for bus termination. A lift-off front panel or hinged door is included.]***

E. ***[Full length bottom entry cabinet***
   1. ***A full height bottom entry air terminal chamber is a weather-resistant metal enclosure around sidewall mounted bushings that extends downward to the transformer base level and upward approximately 10 inches above the bushing centerline. It is intended for underground feed and is provided with facilities for arresters. A lift-off front panel or hinged door is included.]***

F. ***[Full length top entry cabinet***
   1. ***A full height top entry air terminal chamber is a weather resistant metal enclosure around sidewall mounted bushings that extends downward to the transformer base level and upward approximately 24 inches above the centerline of the bushings. A lift-off front panel or hinged door is included.]***

G. The tank shall be complete with an anodized aluminum laser engraved nameplate. This nameplate shall meet ANSI C57.12.00 - 1993 for Nameplate C.

2.11 PROTECTION

A. The overcurrent protection scheme provided with the transformer shall consist of one of following attributes and meet the requirements of Factory Mutual Standard 3990, which limits the I^2t energy inside the transformer tank. If for any reason a special protection scheme is required it shall be clearly stated on the inquiry or data sheet.
   1. ***[The high-voltage overcurrent protection scheme provided with the transformer shall be a loadbreak Bay-O-Net assembly with a flapper valve to minimize oil spillage. Overcurrent protection shall be provided by a Bay-O-Net expulsion fuse mounted in series with a partial range under-oil ELSP current-limiting fuses with an interrupting rating of 30,000 A.] [The transformer primary shall include a Vacuum Fault Interrupter. The VFI shall***

have a maximum interrupting rating of 12000A RMS symmetrical with resettable fault protection up through 35kV. The VFI shall also include a Tri-Phase electronic breaker control with over 100 minimum trip settings and 5 selectable time current curves.] [Primary Air Disconnect Switch ((5, 15 kV) 600A)) shall be provided that is in accordance with IEEE/ANSI C37.20.3 and NEMA SG-5. The switch shall include an EPR-insulated copper cable transition and provisions for mounting surge arresters. The switch shall be a three-pole, two-position gang operated air interrupter to include a manual stored energy mechanism for ease of operation. The switch shall be enclosed in modular self-supporting, bolted design including an electrostatically applied paint finish exceeding ANSI C37.20.3 and a 500W cabinet heater. A 1200A Primary Air Disconnect Switch is available as an option. Note: The transformer must be specified with the High Voltage Flange in order to provide the primary air disconnect switch. The transformer primary air disconnect switch shall include a current-limiting non-expulsion power fuse.]

2. ***[On/Off Loadbreak Switch] [4-Position Sectionalizing Switch - T-Blade Switch] [4-Position Sectionalizing Switch - V-Blade Switch]***

2.12 PRIMARY OVERVOLTAGE PROTECTION ***[Note to specifier: The overvoltage protection scheme provided with the transformer shall consist of one of the following attributes. If for any reason a special protection scheme is required it shall be clearly stated on the inquiry. Arresters are mounted inside primary air disconnect switch. Full Length cabinet must be specified if primary air disconnect switch is not.]***

A. Primary overvoltage protection shall consist of:
   1. ***[[Provisions for arresters] [Externally mounted], [Heavy-Duty Distribution Class] [Intermediate Class] [Station Class] MOV arresters. Arrester housing shall be [Cooper Power Systems' UltraSIL silicone rubber] [Approved equal] [Porcelain].]***
   2. ***[Elbow type MOVE arresters in conjunction with deadfront bushing wells and inserts.]***
   3. ***[[Vacuum Fault Interrupter with Time Current Curve: [EF] [TF] [KF] [F] [H]] [Bayonet Expulsion Fuse in Series with ELSP Current Limiting fuse] [Primary 600 Amp Air Disconnect Switch that shall be [Unfused] [Non-Disconnect Power Fuse] [Disconnect Power Fuse] [Current-Limiting Fuse]]***

2.13 FEATURES

A. The following standard features shall be provided:
   1. De-energized Tap Changer
   2. 1.0" Upper Fill Plug with Filter Press Connection
   3. 1.0" Drain/Sampling Valve
   4. Automatic Pressure Relief Device
   5. Lifting Lugs (4)
   6. Liquid Level Gauge
   7. Dial Type Thermometer
   8. Pressure/Vacuum Gauge
   9. SS Ground Pads (4)
   10. Any additional accessories will be specified on the inquiry.

2.14 ACCESSORIES

A. The following accessories may be provided if specified herein:
   1. ***[Low Voltage 6-Hole Spade] [Low Voltage 12-Hole Spade]***
   2. ***[Copper Low Voltage Bushings (standard with all-copper windings)]***
   3. ***[Bleeder Valve (Std on > 2500kVA)]***
   4. ***[Nitrogen Blanket with Bleeder and Purge Valve]***
   5. ***[Pressure Relief Device - 5000 cfm (Std on > 2500kVA)]***

6. *[Touch-up Paint]*
7. *[NEMA 4 Control Box (standard with fan package)]*
8. *[Rapid Pressure Rise Relay*
   a. *Seal-In Panel for Rapid Pressure Rise Relay [120V] [240V] [24VDC] [48VDC] [125VDC]]*
9. *[Globe Type Upper Fill Valve]*
10. *[Arrester - [Provisions only] [Distribution Class] [Elbow Type MOVE] [Intermediate Class] [Station Class]]*
11. *Auxiliary Contacts - [Liquid Level Gauge] [Dial Type Thermometer (standard with fan package)] [Pressure/Vacuum Gauge] [Pressure Relief Device]*
12. *[Touch-up Paint]*
13. *[All Copper Windings]*
14. *[Primary Air Disconnect Switch*
    a. *[1200A Loadbreak Rating (requires 1200A copper bus bar)]*
    b. *[Outer Front Door (covers viewing area and switch)]*
    c. *[Key Interlocks for interlocking switch with secondary]*
    d. *[Porcelain Bus Insulators]*
    e. *[Copper Bus Transition to Transformer (required for 600A and greater)]*
    f. *[Auxiliary Switch (remote indication of primary switch position)]*
    g. *[Line-side Bus (bottom entry only)]*
    h. *[Thermostat for Space Heater]]*
15. *[Vacuum Fault Interrupter, 600 Amp Cont, 12,000 Amp RMS Interrupting]*
16. *[Dead Front HV Termination*
    a. *[Loop Feed]*
    b. *[Radial Feed]]*
17. *[Sectionalizing Switch, 4-position T-Blade, 600 Amp, with make before break option]*
18. *[Stainless Steel Cabinet (Note: All SS Tank is not available)*
    a. *[Tank Base]*
    b. *[Primary Enclosure]*
    c. *[Secondary Enclosure]]*
19. *[Detachable Radiators]*
20. *[K-Factor Transformer - [K4] [K9] [K13] [K20]]*
21. *[Positive Nitrogen Pressure Oil Preservation System]*
22. *[Current Transformers for [Relaying] [Metering] - Quantity_____ Bushing_____ Ratio_____ Accuracy Class_____]*
23. *[Containment Pan for 100% fluid containment]*
24. *Colors: - [ANSI #61 Light Gray] [ANSI #70 Sky Gray] [Standard Munsell No. 7GY3.29/1.5 Green] [ANSI #24 Dark Blue Gray] [ANSI # 49 Medium Gray] [Other: _____]*
25. *Testing - [Routine (ANSI Standard)] [Special:_____] [Certified Test Results]*
26. *Drawings – Provide the following type(s) of drawings:*
    a. *[___ Sets of Approval Drawings]*
    b. *[___ Sets of Record Drawings]*
    c. *[___ Sets of Construction Drawings]*
    d. *[___ Sets of CAD Drawings on diskette]*

2.15 BAR CODING

A. A temporary bar code label shall be attached to the exterior of the transformer in accordance with ANSI C57.12.33.

2.16 DRAWINGS

A. The following will be provided by request in electronic format:
   1. Construction Drawings
   2. Record Drawings

3. Approval Drawings
4. CAD Drawings
5. CD available upon request

2.17 LOSS EVALUATION:

A. The loss evaluation shall be:
   1. ***[Dollars/Watt (No Load): _____] [Dollars/Watt (Load): _____]***

2.18 ARRESTERS:

A. The arresters shall be:
   1. [Heavy Duty MOV Distribution Class Arrester] [Elbow Type Distribution MOVE Arrester] [MOV Intermediate Class Arrester] [Station Class Arrester] [Arrester Mounting Provisions]

2.19 ARRESTER RATING:

A. ***[__]kV***

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. ***[Additional testing shall include _____ and 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