MINIMUM SPECIFICATIONS: Revision No: 43

NAME OF MATERIAL OR DEVICE: THREE-PHASE, CONVENTIONAL, DEAD-FRONT, RADIAL AND LOOP-FEED, PADMOUNTED TRANSFORMERS

REVISION DATE: November 16, 2023 APPROVED: */s/Roberto Ga* Engineer

DATE: May 21, 1990 REVIEWED BY STANDARDS COMMITTEE

1. SCOPE:

1.1 This specification describes the electrical and mechanical characteristics of three-phase, conventional, dead-front, radial and/or loop-fed, 2,500kVA and below padmounted transformers for the City of Farmington.

2. DATA TO BE SBMITTED WITH BID (INCLUDE IN RESPONSE ATTACHMENTS UNDER "OTHER ATTACHMENTS":

2.1 Basic Information:
- 2.1.1 kVA rating
- 2.1.2 Type: Radial- or Loop-Feed
- 2.1.3 High- and Low-voltage ratings
- 2.1.4 Impedance in percent (%)

2.2 Two (2) copies of outline drawings including overall height, overall width, overall depth, base dimensions, clearances required for opening doors, arrangement of bushings, and other appurtenances, and compartment dimensions.

2.3 Weight of tank, oil, transformer, total & shipping weight.

2.4 Test and Performance Data:
- 2.4.1 Exciting current at 100% of rated voltage.
- 2.4.2 Average excitation loss in accordance with ANSI C57.12.00-1980 (or latest edition), Section 9, Paragraph 9.3 and Table 16, Line 3.
- 2.4.3 Average load-loss derived from ANSI C57.12.00-1980 (or latest edition).
- 2.4.4 Percent impedance volts, of the low-voltage winding with respect to the high-voltage winding at rated self-cooled kVA.
- 2.4.5 Accuracy of production test loss measurements (±%) in accordance with National Bureau of Standards TN 1204.

2.5 All information and drawings shall be legible and assembled in a coherent format with due attention to Section 20.

2.6 Manufacturer shall supply transformers with oil that contains less than l ppm PCB.

3. GENERAL:

3.1 This specification is written for conventional three-phase, 60 hertz, 65°C temperature rise, mineral oil filled, self-cooled, padmounted, compartmentalized, distribution transformers rated 2,500 kVA and below, for use with 15kV class separable insulated high-voltage connectors rated 8.3/14.4kV.

3.2 All characteristics, definitions, terminology, and voltage designations, except as otherwise specified herein, shall be in accordance with applicable provisions of the latest edition of ANSI C57.12.26, or its successors and applicable ANSI C57 series specification including C57.12.00 - 1980, C57.12.90-1980, C57.12.80-1978, C57.12.28-1988 (or latest editions).

3.3 All distribution transformers shall comply with 2016 U.S. Department of Energy transformer efficiency standards.

TABLE I – Efficiency Standards

Single-Phase Transformer Efficiency		Three-Phase Transformer Efficiency	
kVA	Amended (%)	kVA	Amended (%)
10	98.70	30	98.83
15	98.82	45	98.92
25	98.95	75	99.03
37.5	99.05	112.5	99.11
50	99.11	150	99.16
75	99.19	225	99.23
100	99.25	300	99.27
167	99.33	500	99.35
250	99.39	750	99.40
333	99.43	1000	99.43
500	99.49	1500	99.48
667	99.52	2000	99.51
833	99.55	2500	99.53

4. ELECTRICAL CHARACTERISTICS:

4.1 High- and low-voltage ratings and kVA sizes shall be per Table I, Page 2. Minimum BIL rating shall be 95kV.

4.2 Transformers shall be of triplex or five-legged core design and connected wye-wye with primary and secondary neutrals internally connected and brought out to a neutral bushing in the secondary compartment.

4.3 High-Voltage Taps:
Two (2) 2-1/2% above and below high-voltage taps shall be provided. Taps shall be suitable for de-energized operation only. The tap-changer switch shall be ganged and shall be externally operable. The operating handle shall be located in the primary compartment above the high-voltage bushings. The tap changer shall be set on the 100% tap at the factory and shall be secured to prevent inadvertent change from this position.

TABLE II

TYPE	HIGH-VOLTAGE RATING (Volts)	LOW-VOLTAGE RATING (Volts)	kVA RANGE
Radial	13,800 GrdY/7970	208Y/120	75-750
Radial	13,800 GrdY/7970	480Y/277	150-2500
Loop-Feed	13,800 GrdY/7970	208Y/120	75-750
Loop-Feed	13,800 GrdY/7970	480Y/277	150-2500

4.4 Short Circuit Capability:

4.4.1 Mechanical short circuit capability shall be demonstrated by design compliance with ANSI C57.12.90-1980 (or latest edition).

4.4.2 Thermal capability shall be demonstrated by design compliance with ANSI C57.12.00-1980 (or latest edition).

5. COMPONENTS FOR PRIMARY CABLE SYSTEM:

5.1 Radial-feed transformers shall be provided with three (3) primary bolted type bushing wells and 200 ampere load-break bushing inserts.

5.2 Loop-feed transformers shall be provided with six (6) primary bolted type bushing wells and 200 ampere load-break bushing inserts.

6. OVERCURRENT PROTECTION:

6.1 Loop-feed and radial-feed 3-phase transformers shall be protected by a two-fuse protection scheme.

6.2 Supply three (3) Bay-O-Net fuse holders, side-wall mounted, each with a drip guard and a current sensing expulsion fuse link. The fuse links shall be properly sized for the full load of the transformer. Provide three (3) spare links.

6.3 A backup current-limiting fuse, liquid immersed, properly sized, and connected in series with each Bay-O-Net, shall be provided to isolate a faulted transformer winding.

6.4 The catalog number and size of the Bay-O-Net fuse link shall be stenciled in yellow on the inside of the primary compartment door.

7. CONSTRUCTION:

7.1 General:

7.1.1 Transformers shall be designed to protect people against accidental contact of energized parts, discourage unauthorized access and protect against weather.

7.1.2 The padmounted transformer shall consist of the transformer tank high-voltage cable terminating compartment and the low-voltage cable terminating compartment. The transformer tank and compartments shall be assembled as a raintight, weather-proof, and tamper resistant integral unit suitable for mounting on a flat surface.

7.1.3 There shall be no exposed screws, bolts, or other fastening or hinging devices (other than the pentahead specified in Section 7.6.5) which are externally removable. There shall be no opening through which foreign objects such as sticks or wires that might be inserted to contact energized parts. Suitable means for padlocking the compartment door(s) shall be provided. Normal entry shall be possible only with the use of proper access tools.

7.1.4 The high- and low-voltage compartments shall be located side by side on one side of the transformer tank. When facing the compartments, the low-voltage compartment shall be on the right.

7.1.5 Construction of the unit shall be such that it can be lifted, skidded, and slid into place on the mounting pad without disturbing the entrance cables.

7.2 Bottom Protection:

7.2.1 The transformer tank base shall be raised above the pad to protect the bottom finish during installation and to minimize corrosion due to moisture accumulation. The base shall be cross-braced to permit rolling in two directions.

7.2.2 All external surfaces of ferrous material used in the construction of the assembly shall have undercoating over the regular finish, applied to the bottom of the components and extending up the side to a point at 1 inch above the bottom of their bases.

7.3 Protective Coating:

7.3.1 All coated surfaces, both exterior and interior, shall be painted using a system which conforms to the requirements of ANSI C57.12.28-1988 (or latest edition).

7.3.2 The finish shall be weather-resistant, green color Munsell No. 7.0 GY 3.29/1.5.

7.4 All external surfaces shall be constructed of steel, 13 USS gauge or thicker.

7.5 The transformer and compartment hoods shall be crowned to insure water run-off.

7.6 High- and Low-Voltage Compartments:

7.6.1 Terminal compartments shall be full height, air-filled compartments with separate hinged doors. The compartments shall be completely isolated from each other by a steel barrier without opening or discontinuity of any kind.

7.6.2 The edge of the access doors shall be formed to provide a close fitting mating surface, with internal insertion-prevention lip that will be shaped to resist entry or prying by screwdrivers, wrecking bars, tire irons, single-socket lug wrenches, or other readily accessible tools.

7.6.3 Hinges and hinge pins shall be passivated AISI Type 304 stainless steel or equivalent corrosion-resistant metal. Hinges shall be so designed as to prevent removal of pin.

7.6.4 There shall be a threaded fastening device for the high-voltage door, accessible only through the low-voltage compartment. Screen door latches with wing nuts, gravity hooks, etc. are unacceptable. The compartment doors shall have a minimum of three point latching and the handle shall have provisions for padlocking.

7.6.4.1 The padlocking device shall be so designed and located as to resist prying or breaking off by screwdrivers, wrecking bars, tire irons, single-socket lug wrenches or other readily accessible tools and to inhibit removal of the padlock with a bolt cutting device or hacksaw.

7.6.5 In addition to the regular locking provisions above, the access doors shall be secured by a captive, recessed pentahead bolt as depicted in Figure 11, ANSI C57.12.26-1987 (or latest edition). Bolts and associated hardware must be rust and corrosion resistant and the design shall minimize the possibility of misalignment and cross-threading. The design must be such that wire entry through the bolt hole into the compartment(s) is prohibited when the bolt is removed. The non-rotating cup shall be permanently attached.

7.6.5.1 The captive pentahead bolt shall be coordinated with the latch and padlock to prevent unlatching and insertion of the padlock into the hasp when and until the bolt is completely threaded, respectively.

7.6.5.2 The captive pentahead bolt shall also function as an interlock device to pin the latch closed.

7.6.6 Both compartment doors shall be equipped with stops for holding each door in a 90° open position. The stops shall be captive to prevent loss of the device.

7.6.7 Doors on the high- and low-voltage compartments shall be of sufficient size as to provide adequate working space when open.

7.6.8 The bottom edge of the transformer shall provide for flush mounting on a flat mounting surface to prevent wire entry into the compartment.

7.6.9 The top of the high-voltage compartment shall be removable over the primary bushing to facilitate pulling cables.

7.7 Certification:
The design must meet the requirements of ANSI C57.12.28-1988 (or latest edition).

8. BUSHINGS AND TERMINALS:

8.1 Electrical characteristics of completely assembled low-voltage terminations shall comply with Table 3 of ANSI C57.12.26-1987 (or latest edition).

8.2 All low-voltage terminals shall be insulated from the tank with 1.2 kV class bushings. Terminals of low-voltage windings shall be arranged to the specific dimensions shown in Figure 7 and 8 (a) ANSI C57.12.26-1987 (or latest edition). In-line arrangements are unacceptable.

8.3 The high-voltage neutral shall be connected to the low-voltage neutral internally with provision for opening this connection for testing.

8.4 The low-voltage neutral shall be a fully insulated bushing. A ground pad shall be provided. A removable ground strap shall be provided and connected between the neutral bushing and ground pad. This connection shall not use any holes specified in Table IV below.

8.5 A hand hole shall be provided to access the removable connection specified in Section 8.3.

8.6 Low-voltage terminals shall be tinned copper spades with NEMA hole spacing to provide the number of holes given in Table IV. Secondary terminals with 8 holes or more shall have an insulated brace on the outside of the low-voltage terminal designed to support the secondary cables. Cabinet must be appropriately sized for larger terminals.

Table III - Secondary Terminals

Secondary	Transformer KVA Size								
Voltage	75	150	300	500	750	1000	1500	2000	2500
208Y/120V	6	6	8	8	10	10	12		
480Y/277V	6	6	6	8	8	8	10	10	12

8.7 High-voltage terminals.

8.7.1 For radial-feed transformers, high-voltage terminals shall be three bolted type bushing wells in accordance with Figure 3 of ANSI/IEEE 386-1985 and ANSI C57.12.26-1987 (or latest edition). Bushing wells shall be arranged in accordance with the specific dimensions of Figures 5A and 7 of ANSI C57.12.26-1987 (or latest edition).

8.7.2 Loop-feed transformers high-voltage bushings shall be supplied as specified in Section 5. Bushing arrangement shall be in accordance with Figure 6A, ANSI C57.12.26-1987.

8.8 Transformer design shall allow field replacement of high-voltage bushing wells, bushing inserts, and low-voltage bushings by means of common hand tools and oil handling equipment, without totally untanking the transformer. Approved bushing inserts 200 Amp load break.

1) Elastimold Cat. #1601A4
2) RTE (Eaton Cooper Power) Cat. #LBI215

9. ACCESSORIES:

9.1 The following accessories are required on all transformers:
- 9.1.1 Pressure relief device. The following are approved:
  - Qualitrol 202-031-01
  - Qualitrol 202-030-01
  - Tomco/Beta 1712K-3
- 9.1.2 Upper filter valve or plug.
- 9.1.3 Combination drain, lower filter valve, and sampling device. Combination drain plug and sampling device may be substituted.

10. LIQUID LEVEL INDICATION:

10.1 A suitable marking inside the tank shall indicate the correct level at 25°C temperature.

11. JACKING, ROLLING, LIFTING, AND MOUNTING FACILITIES:

11.1 Suitable jack bosses or equivalent jacking facilities shall be provided on the tank. Vertical clearance for jack shall be l-l/2 inches minimum, 3-l/2 inches maximum.

11.2 Transformer base shall be arranged for rolling in two directions; parallel to and at right angles to the centerline of the high-voltage bushings.

11.3 These lugs shall be adequate strength and size and arranged on the tank to provide a suitable lift for the completely assembled unit.

11.4 A ¾" minimum and a l-1/2" maximum integral flange shall be provided at the base of the high-voltage and low-voltage compartments, to provide means of anchoring the unit to the pad.

12. TERMINAL MARKINGS:

12.1 External terminals shall be marked H1A, H2A, H3A, H1B, H2B, H3B, H0X0, X1, X2, X3 by stenciled yellow lettering on the tank.

12.2 A winding diagram with high- and low-voltage connections shall be shown on the instruction nameplate.

13. INSTRUCTION NAMEPLATE:

13.1 Instruction nameplate shall be located on the inside of the low-voltage compartment door.

13.2 Instruction nameplate shall contain the information specified in Paragraph 5.12 of ANSI C57.12.00-1980 (or latest edition), nameplate B.

13.3 Nameplate shall indicate that the transformer oil contained less than l ppm PCB at time of manufacture.

14. OIL PRESERVATION:

14.1 Transformers shall be of sealed tank construction, so designed that the interior is sealed from the atmosphere and the gas plus oil volume remains constant. The transformer shall remain effectively sealed for all temperatures to plus 105° C top oil.

15. TANKS:

15.1 The tank shall be of sufficient strength to withstand a pressure of 7 psi gauge, without permanent distortion.

15.2 Welded main cover construction shall be provided. Access to internal connection for test purposes shall be provided by means of a handhole, accessible only from the padlocked compartments.

15.3 Tank grounding provisions shall be as specified in ANSI C57.l2.26-1975 paragraph 6.6.4 (or latest edition).

16. UNDER OIL LIGHTNING ARRESTERS:

16.1 10kV under oil zinc oxide lightning arresters shall be furnished for application on a 13.8/7.97kV, 4-wire, multi-ground distribution system. The arrester shall be GE Tranquell IA1, or approved equal, with protective characteristics equal to or better than GE Cat. #9L25A-10kV. Rated minimum MCOV 8.4kV; 7000 feet elevation.

16.2 Protective characteristics shall be provided with each order.

16.3 Transformer nameplate shall indicate "10kV under oil arrester" and LA shall be stenciled on the upper left side of the transformer cabinet door.

16.4 Manufacture and testing of lightning arrester shall comply with the latest revision of ANSI/IEEE Standard C62.11-1987.

17. PRODUCTION TESTS:

17.1 The manufacturer shall perform all routine tests as defined in ANSI C57.12.00-1980 (or latest edition).

17.2 The manufacturer shall provide the following certified data by transformer serial number for each transformer shipped. Data shall be supplied for each production run:

17.2.1 Excitation loss, watts

17.2.2 Impedance, % IZ

17.2.3 Total loss, watts

18. SHIPPING:

The manufacturer shall provide adequate and necessary skids, crating, and packing for transformers to eliminate damage from reasonable handling while in transit to the City of Farmington's point of delivery. Units shall at no time be double stacked.

19. EXCEPTIONS AND CHANGES:

19.1 The manufacturer must state specifically, in writing with the bid, any exceptions made to the specification.

19.2 The supplier may not alter or change the design of the transformer submitted to the Farmington Electric Utility System under this specification.

20. APPROVED TRANSFORMER MANUFACTURERS:

20.1 All transformers bid must be supplied by manufacturers as approved by the Farmington Electric Utility Standards Committee (FEUSC). Manufacturers must be approved by three (3) of five (5) major Southwest Utilities contacted and by the FEUSC. Utilities are contacted upon request for input to update our approved Manufacturers list. Sample transformers (one or two) must be provided, if requested, for a tear down as part of the approval process by the Standards Committee. Manufacturers may contact FEUSC Electrical Engineer at (505) 599-8321 for details.

20.2 Following is a list of manufacturers approved by the FEUS Committee for supplying three-phase, pad-mounted transformers:

General Electric Company (USA manufacturers only)
ABB Power T & D Co., Inc.
Eaton Cooper Power
Howard Industries
Ermco, Inc.

20.3 All other manufacturers should contact the Electrical Engineering Department of the City of Farmington at (505) 599-8321 for requirements that must be met before being included on approval list.

21. INVENTORY ITEM:

21.1 This specification is applicable to the following City of Farmington stock numbers:

285 084 7475	Transformer, Padmount,	75kVA, 3 Phase, Radial,	13,800/7,970-208/120V
285 084 7485	Transformer, Padmount,	150kVA, 3 Phase, Radial,	13,800/7,970-208/120V
285 084 7490	Transformer, Padmount,	300kVA, 3 Phase, Radial,	13,800/7,970-208/120V
285 084 7495	Transformer, Padmount,	500kVA, 3 Phase, Radial,	13,800/7,970-208/120V
285 084 7530	Transformer, Padmount,	75kVA, 3 Phase, Loop,	13,800/7,970-208/120V
285 084 7550	Transformer, Padmount,	150kVA, 3 Phase, Loop,	13,800/7,970-208/120V
285 084 7600	Transformer, Padmount,	300kVA, 3 Phase, Loop,	13,800/7,970-208/120V
285 084 7650	Transformer, Padmount,	500kVA, 3 Phase, Loop,	13,800/7,970-208/120V
285 084 7677	Transformer, Padmount,	75kVA, 3 Phase, Radial,	13,800/7,970-480/277V
285 084 7685	Transformer, Padmount,	150kVA, 3 Phase, Radial,	13,800/7,970-480/277V
285 084 7690	Transformer, Padmount,	300kVA, 3 Phase, Radial,	13,800/7,970-480/277V
285 084 7695	Transformer, Padmount,	500kVA, 3 Phase, Radial,	13,800/7,970-480/277V
285 084 7700	Transformer, Padmount,	750kVA, 3 Phase, Radial,	13,800/7,970-480/277V
285 084 7710	Transformer, Padmount,	1000kVA, 3 Phase, Radial,	13,800/7,970-480/277V
285 084 7750	Transformer, Padmount,	1500kVA, 3 Phase, Radial,	13,800/7,970-480/277V
285 084 7760	Transformer, Padmount,	2000kVA, 3 Phase, Radial,	13,800/7,970-480/277V
285 084 7770	Transformer, Padmount,	2500kVA, 3 Phase, Radial,	13,800/7,970-480/277V
285 084 7807	Transformer, Padmount,	75kVA, 3 Phase, Loop,	13,800/7,970-480/277V
285 084 7800	Transformer, Padmount,	150kVA, 3 Phase, Loop,	13,800/7,970-480/277V
285 084 7830	Transformer, Padmount,	300kVA, 3 Phase, Loop,	13,800/7,970-480/277V
285 084 7850	Transformer, Padmount,	500kVA, 3 Phase, Loop,	13,800/7,970-480/277V
285 084 7875	Transformer, Padmount,	750kVA, 3 Phase, Loop,	13,800/7,970-480/277V

------- End of Specification------