

# T-Plant Pad-Mount 13.8kV-480V Transformer Purchase Specification

Prepared for the U.S. Department of Energy  
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy  
under Contract 89303320DEM000030



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Richland, Washington 99352**

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Project No: 84467      Document Type: SpecP      Program/Project: SWOC (T-Plant)

Date Published  
February 2024

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**APPROVED**  
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Release Approval

Date

Release Stamp

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Printed in the United States of America

Total pages: 15

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**Published Date: 2/20/24**

**Effective Date: 2/20/24**

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**1.0 SCOPE**

This specification provides the requirements for manufacturing and supply of a pair of 13.8 kV/480-volt, 3 phase, 1500 kVA, 60 HZ, ungrounded  $\Delta$  primary, and B-Phase corner grounded  $\Delta$  secondary, pad-mount transformers.

**2.0 APPLICABLE DOCUMENTS**

The following documents form a part of the Basis of Design to the extent specified in the applicable sections of this document. In the event of a conflict between documents referenced herein and the requirements of this specification, the requirements of this specification shall take precedence.

This specification along with the documents specified in this Section and as identified in Sections 2.1 and 2.2 provide the requirements for supplying a pair of 13.8 kV/480 V pad-mount transformers as described in section 1.0.

**2.1 Government Documents**

US Department of Energy, Richland Operations Office, 13.8 kV One-Line Diagram for 221T and 271T Buildings, Drawing H-2-841273-001.

**2.2 Applicable Standards**

The codes and standards are listed below, the latest versions shall be used unless noted otherwise.

American Society of Testing and Materials (ASTM)

ASTM D 877, Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes

ASTM D 1535, Standard Practice for Specifying Color by the Munsell System

**American Society of Civil Engineers (ASCE)**

ASCE/SEI 7-10 Minimum design Loads for Buildings and Other Structures

**Institute of Electrical and Electronics Engineers (IEEE)**

IEEE C37.47 Specifications for Distribution Fuse Disconnecting Switches, Fuse Supports, and Current-Limiting Fuses

IEEE C57.12.00 Standard General Requirements for Liquid-Immersed Distribution, Power and Regulating Transformers

IEEE C57.12.34 Standard Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-phase Distribution Transformers, 10 MVA and Smaller. Hi

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Voltage, 34,500 Nominal System Voltage and Below, Low Voltage, 15 kV  
Nominal System Voltage and Below

IEEE C57.12.28	Switchgear and Transformers, Pad-Mounted Equipment – Enclosure Integrity
IEEE C57.12.90	Standard Test Code for Liquid Immersed Distribution Power, and Regulating Transformers and Guide for Short-Circuit Testing of Distribution and Power Transformers
IEEE C57.13	Requirements for Instrument Transformers
IEEE C57.147	IEEE Guide for Acceptance and Maintenance of Natural Ester Insulating Liquid in Transformers
ANSI/IEEE 386	Separable Insulated Connector Systems for Power Distribution Systems above 600 Volts
IEEE-141	Electric Power Distribution for Industrial Plants

**International Organization for Standardization (ISO)**

ISO 9001	Quality Management Systems - Requirements
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**National Electrical Manufacturers Association (NEMA)**

NEMA TR1	Transformers, Regulators, and Reactors
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**National Fire protection Association (NFPA)**

NFPA 70	National Electrical Code
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**Factory Mutual (FM)**

FM 3990	Liquid-Insulated Transformers
FM 6933	Approval Standard for Less Flammable Transformer Fluids

**3.0 TECHNICAL REQUIREMENTS****3.1 Pad Mounted Transformers Liquid Filled**

- A. The transformer(s) shall be listed and labeled by a Nationally recognized Testing Laboratory (NRTL) per UL/FM Classification as applicable.
- B. The transformer shall be self-cooled and designed for mounting on a pad and comply with the latest applicable standards.
- C. Transformer efficiency shall be 99.48%.

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- D. The average temperature rise of the windings, measured by the resistance method, shall be 65°/55° C when the transformer is operated at rated kVA output in a 40deg. C ambient. The transformer shall be capable of being operated at rated load in a 30 deg. C average, 40 deg. C maximum ambient, as defined by IEEE C57.12.00 without loss of service life expectancy. Hot spot conductor temperature rise is to be 80 Deg. C and frequency is to be 60 Hz.
- E. The dielectric fluid shall be a listed less-flammable fluid meeting the requirements of NEC 450-23, including a minimum fire point of 300 degrees C. The fluid shall be biodegradable and non-toxic. The fluid shall be Factory Mutual Approved and UL Classified as applicable, Envirotemp FR3 or equal per NEC 450-23. As an option, non-flammable fluid meeting the requirements of NEC 450-24 shall be provided. Vendor shall provide all codes and standards applicable for this transformer fluid for review.
- F. If the lower-voltage compartment has exposed live parts that are over 600 V, a non-hygroscopic barrier shall be placed to require its removal or opening before access to the lower-voltage compartment can be attained.
- G. The transformer tank and compartment shall conform to IEEE C57.12.28 or C57.12.29, as appropriate and be so constructed as to limit disassembly, breakage, and prying open of any doors, panels, and sills when the doors are in the closed and locked position.
- H. The transformer(s) shall be rated 1500 kVA self-cooled (ONAN). Primary voltage 13.8 kV ungrounded Δ. Secondary voltage 480 volts, B-Phase corner grounded Δ, 3-wire, 60 Hz with two 2-1/2% full capacity above normal and two 2-1/2% below normal taps. Transformer impedance shall not be less than 4%. Basic impulse level of the primary winding shall be 95 kV as specified in IEEE C57.12.00 for comparable kV class. For the low voltage winding, the basic impulse level is 30 kV.
- I. The transformer shall be of sealed-tank construction of sufficient strength to withstand a pressure of 7 psi without permanent distortion. The cover shall be welded and the handhole fastenings tamper resistant. The transformer shall remain effectively sealed for a top oil temperature range of -5° C to 105° C continuous and under operating conditions as described in IEEE C57.91. When required, cooling panels will be provided on the back and sides of the tank. Lifting eyes and jacking pads will be provided.
- J. Coils shall be wound with copper conductors.
- K. The core shall be manufactured using high grade, grain-oriented silicon steel laminations carefully annealed after fabrication to restore high magnetic permeability. Magnetic flux is to be kept well below the saturation point.
- L. The high voltage terminations and equipment shall be dead front construction.
- M. Dead front bushing wells for the high voltage compartment shall be provided. They are to be rated 200 amperes, 15 kV class. Provide a bushing well insert for each bushing well. Incoming cables will be terminated using 200-amp load break elbows. The 200 ampere, 15 kV class bushing standoffs shall be provided with bleeder wire and with insulated dust covers, suitable for mounting to primary parking stands. Provide six high-

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voltage bushing wells inserts for each transformer to be located in the high-voltage compartment. One set of high-voltage bushing wells are to be used for the incoming 13.8 kV feed to the transformer and the second set of wells is to be used for surge arresters.

- N. The high-voltage compartment is to include a radial feed switch handle, access to oil-immersed fuses, dead-front surge arresters, tap changer handle, cable accessory parking stands and ground pads.
- O. The low-voltage compartment shall contain accessories and ground pads.
- P. The low voltage bushings (<600V) shall be molded polymer and provided with tin plated blade-type spade terminals with NEMA standard hole spacing arranged for vertical take-off, up to 6-750 kcmil cables per phase will be connected.
- Q. Provide a load break, gang operated, liquid immersed switch that is externally operable from the high voltage compartment using a distribution hot-stick. The on/off load break switch is to be an oil-immersed type switch to permit deenergizing the transformer. The switch shall be rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 200 amperes, and a make-and-latch rating of 10,000 rms amperes symmetrical. The switch handle shall be located in the high voltage compartment.
- R. Primary cabinet oil switch shall be 2-position "OFF-ON" type for use on a radial feed-system.
- S. Fusible Protection-Provide Bayonet oil-immersed expulsion fuses in series with oil-immersed current-limiting fuses. The Bayonet expulsion fuses shall be RTE10 Bay-O-Net fuse catalog numbers 4000353C\*\* or equivalent and labeled inside the primary compartment. The current-limiting fuses shall be RTE ELSP, or equivalent, and shall be coordinated with the Bay-O-Net fuses to protect the transformer from faults beyond their interrupting rating. To eliminate or minimize oil spills, Bay-O-Net fuse assembly shall include an oil retention valve inside the housing which closes when the fuse holder is removed as well as an external drip shield. A Warning label shall be conspicuously displayed within the high-voltage compartment cautioning against removing or inserting fuses unless the load-break switch is in the open position and the tank pressure has been released.
- T. Surge Protection - Provide three 18 kV, fully shielded, dead-front, metal-oxide varistor, elbow type with resistance-graded gap, suitable for plugging into inserts. Provide three arresters for each transformer provided.
- U. The following accessories shall be provided on all transformers:
  - 1. Tap changer with silver-plated stationary and movable contacts, for de-energized operation only, which is externally operable and padlockable.
  - 2. Nameplate in low voltage compartment.
  - 3. Pentahead bolts for compartment doors.

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4. Lifting lugs.
5. Keylocks to primary or secondary compartment door.
6. Mounting provisions for low voltage current transformers and potential transformers.
7. 1" globe valve to serve the upper filter press connection and vacuum pump connection and filling plug
8. 1" drain globe valve in the secondary compartment with sampling device located on the side of the drain valve.
9. Dial type thermometer without contacts.
10. Magnetic liquid-level gauge without contacts.
11. Pressure vacuum gauge.
12. Pressure relief valve.
13. Automatic pressure relief device (self-resealing with indicator).
14. Two - 2-hole ground pad
15. Danger High Voltage Warning Signs
16. Internal Fault Detector (IFD) device to be provided in accordance with IFD Corporation Service Information, Contact IFD Corp. for installation instructions. IFD shall meet IEEE C57.12.20 Standards.
17. KWH metering equipment on the 480-volt transformer secondary with all wiring, protective devices i.e., fuses, links etc. The KWH meter is to be located in a separate steel NEMA 4X box mounted on the side of the transformer for easy viewing.
  - (1) Metering Device – Ensure that a form 9S class 20 meter is used.
  - (2) CT's should be internal to the transformer secondary with a ratio of 2000:5, Minimum Continuous Thermal Rating Factor of 1.33 at 30 degree C ambient, TYPE-CMV.
18. All control wiring shall be secured in bundles using nylon ties and bundles

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anchored to the enclosures using pre-punched wire lances. Current transformer secondary leads are to be connected to accessible short-circuiting terminal blocks (via test switches) before connecting to any other device. All Control and communications wiring shall be terminated on terminal blocks with suitable numbering strips using crimp-on solderless lugs. Wire markers are to be provided at each end of all control and communications wiring.

**3.1.1 Item Diagram**

The configuration of the new transformers E-TR-N17-001 and E-TR-N17-002 is shown on drawing H-2-841273-001.

**3.1.2 Interface Definition**

The pad mount connection shall be designed for bottom entry and exit only. Bottom removable plates shall be provided to enable the installation contractor to drill and punch openings for installing conduit hubs to route cables into and out of the new transformers.

**3.2 Characteristics**

The two new pad-mount transformers are to have the characteristics identified in this section 3.0.

**3.2.1 Functional Characteristics**

Each new transformer is to be provided as a pad mounted design with separate high and low voltage compartments. The pad-mount transformers are to be rated 13.8 kV/480 volt, three phase, suitable for secondary B-Phase winding corner grounded  $\Delta$  connection.

**3.2.2 Physical Characteristics**

The vendor shall provide detailed drawings of each transformer to be supplied. Preliminary outline dimensioned drawings are to be supplied with the vendor's bid. Equipment weights and catalog cut sheets are also to be supplied as well as equipment anchoring requirements.

**3.2.3 Reliability**

Vendor to provide written warranties for performance of the equipment, indicating the warranty duration and provide customer support access during the warranty period.

**3.2.4 Maintainability**

The new transformers are to be maintainable. Connections, and equipment shall be easily serviceable. Panels shall be provided to access all connections and devices. All doors shall open easily and be accessible for maintenance. Access to oil and cable connections shall be easily accessible for inspection and to perform testing.

Vendor shall submit a list of recommended spare part for each transformer.

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**3.2.5 Environment**

The transformers are to be located outdoors and be capable of operating under the following environmental conditions.

- Average Temperature: 15 Deg. F to 104 Deg. F
- Humidity: 100%
- Wind: 115 MPH
- Elevation: 732 feet

**3.2.6 Transportability and Storage**

Vendor shall provide all shipping information including pallet sizes, weights (with & without oil), and heights. Vendor shall also provide storage information. The equipment shall be securely wrapped, packaged, and labeled for safe handling during shipment. The equipment shall be braced and packaged for handling. Any internal temporary bracing shall be clearly labeled "To be removed before operation". The transformers shall be shipped with oil.

**3.2.7 Safety**

The transformers are to be rated for a corner B phase grounded  $\Delta$  system. The transformers are to be properly designed, listed, and labeled for this type of service.

**3.3 Design and Construction**

The transformers are to be designed, assembled, and tested in accordance with the codes and standards cited in Sections 2.1 and 2.2 and conform to all specification requirements including attached drawings.

**3.3.1 Parts/Materials/Processes**

The transformers are to be rated for outdoor service. All parts and materials shall be new.

**3.3.2 Industry and Government Standards**

The equipment shall be designed and tested per the standards cited in Section 2.2.

**3.3.3 Cleanliness**

The transformers are to be completely cleaned prior to shipment. The units shall be free of all debris and be suitably protected for shipment.

**3.3.4 Corrosion of Parts**

The transformers are to be painted steel construction for outdoor service. All fasteners used shall be compatible so as not to create galvanic corrosion.

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**3.3.5 Protective Coatings**

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 electrodeposited powder epoxy to provide a barrier against moisture, salt, and corrosives. The top-coat shall be a liquid polyurethane coating to seal and provide ultraviolet protection. The transformers are to be painted the Munsell 7GY3.29/1.5 green as noted in ASTM D1535. Vendor to supply all coatings and application methods to be used to the Owner for review and approval.

**3.3.6 Interchangeability**

Like components are to be supplied for both transformers to minimize spare parts.

**3.3.7 Identification and Marking**

The transformers shall be marked with the Owner's tag number.

**3.3.8 Nameplate**

A nameplate shall be installed on each transformer as well as all pertinent transformer ratings including the requirement that the transformers are designed for a B-Phase corner grounded  $\Delta$  connection on the secondary side.

Transformer nomenclature shall match that as shown on drawing H-2-841273-001, as applicable.

Voltage warning signs shall be mounted on the transformer enclosure. They shall be clearly a clearly lettered warning sign for warning personnel. The signs shall be attached with stainless steel screws.

**3.3.9 Document Submittal****3.3.9.1 The following documents shall be submitted at time of bid.**

1. Transformer rating information including a statement of compliance with the equipment being rated for B-Phase corner grounding  $\Delta$  connection.
2. Transformer sizes and ratings & estimated impedance rating.
3. Codes and Standards applicable for transformer fluid as cited in Section 3.1.E.
4. Transformer one line diagram.
5. Catalog cut sheets of all equipment to be supplied.
6. Transformer foundation details.
7. Transformer Dimensional drawings.
8. Cable entry and exit drawings.
9. Transformer weights and center of gravity.

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10. Document submittal Schedule for documents cited in Section 3.3.9.2.
11. Vendor warranty information including duration and customer support access as cited in Section 3.2.3.
12. Coating and application methods to be used as cited in Section 3.3.5.
13. Equipment Manufacturing Schedule.

**3.3.9.2 The following documents are to be submitted after award and upon delivery of products.****1. Transformer Data**

- a. Final Transformer shop drawings.
- b. Submit certificate of Conformance demonstrating compliance with drawings and specifications including assembly ratings, major component ratings.
- c. Additionally, submit the following data:
  - 1) Foundation dimensions.
  - 2) Voltage and impedance ratings.
  - 3) Safety precautions and warnings.
  - 4) Accessories and nameplate data and schedules.
  - 5) Transformer one line diagram, showing all ratings, phasing, corner B-Phase grounding, high and low voltage sections etc.
  - 6) Technical data for each component.
  - 7) Dimensioned views of the Transformers.
  - 8) Dimensioned section views of the transformers.
  - 9) Floor plan of the transformers.
  - 10) Foundation plan for the transformers.
  - 11) Provisions and required locations for external conduit and wiring entrances.
  - 12) Approximate design weights (with and without oil).
  - 13) Transformer damage and inrush curves.
  - 14) Component/Spare parts list
  - 15) Pre-Installation storage requirements as cited in Section 3.2.6.

**2. Transformer Manuals:**

- a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
  - 1) Schematic diagrams, with all terminals identified, matching terminal identification in the transformer.

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- 2) Include information for testing, repair, trouble shooting, assembly, disassembly, and factory recommended/required periodic maintenance procedures and frequency. Provide a replacement and spare parts list. Include a list of tools and instruments for testing and maintenance purposes.
- 3) Provide a replacement and spare parts list. Include a list of tools and instruments for testing and maintenance purposes.
- 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 final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following:
  - a. Certification by the manufacturer that the transformers conform to the requirements of the drawings and specifications.

**3.3.10 Personnel and Training**

Vendor shall offer separate pricing for the training of Owner's personnel for operating the specified equipment with their bid. The Buyer may or may not procure this service at its discretion.

**4.0 QUALITY ASSURANCE REQUIREMENTS**

As identified in Section 4.1.1, a certificate of conformance with this specification is required to be submitted that the transformers conform to the requirements of this specification.

**4.1 General**

The Buyer may request and the vendor shall allow for a Buyer's representative to attend, inspect, and witness the final testing and inspection of the equipment at the vendor's manufacturing site prior to shipment. The Vendor is to notify the Owner 2 weeks in advance in order to schedule this final inspection.

**4.1.1 Certificate of Conformance**

The vendor is responsible for providing a certificate of conformance clearly indicating that the equipment being supplied meets this specification. Equipment test data after reviewed and approved by the Vendor is to be submitted to the Buyer for approval.

**4.2 Inspections and Tests**

- A. Factory Tests shall be performed, and test reports will be requested by the Buyer and shall be provided by the vendor.
- B. Factory Tests shall include but not be limited to the following:
  1. Tests shall be conducted per IEEE C57.12.00 and IEEE C57.12.90.
  2. Verify tightness of bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.

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3. Verify transformer connections, phasing and components correspond to the drawings.
4. Exercise all active components and ensure all compartment doors open and close freely.
5. Perform an insulation-resistance test, phase to ground on each bus section, with phases not under test grounded, in accordance with manufacturer's published data

**5.0 PREPARATION FOR DELIVERY**

**5.1 General**

Contact the Buyer's technical representative (BTR) 3 weeks in advance to inform of the delivery scheduled date. Make proper and final arrangements with the BTR for delivery instructions.

**5.2 Preservation and Packaging**

Equipment to be packaged and properly protected prior to shipment to avoid shipping damage. Damaged equipment will not be accepted.