



MARSHALLS ENERGY COMPANY, INC.

TECHNICAL SPECIFICATION

FOR

**13,800 VOLT & 4,160 VOLT
SINGLE-PHASE PAD MOUNT
DISTRIBUTION TRANSFORMERS**

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**SINGLE PHASE PAD MOUNTED
DISTRIBUTION TRANSFORMER
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1.0 SCOPE

This specification covers the minimum requirements for MEC' s pad mount, 60 Hertz, 1-phase, self-cooled, oil-immersed, outdoor distribution transformers, suitable for operation on the Company's various 13,800 Volt and 4,160 Volt distribution systems located on a number of atolls within the Republic of the Marshall Islands.

1. 1. This specification covers MEC requirements for single-phase, dead-front, radial or loop feed, 60 Hz. mineral oil filled, 65° C rise pad mounted type distribution transformers for use with separable insulated high-voltage connectors.

1.2. The transformer is intended for use in tropical weather conditions with a corrosive sea air atmosphere, sustained wind strengths of 155 MPH with gusts to 180 MPH.

2.0 APPLICABLE PUBLICATIONS

The transformers shall meet the requirements of the following and other standards, including the latest revisions with respect to material, design and tests plus the latest IEEE standards.

- 2.1. AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI)
 - C57 Requirements for Distribution Transformers
 - C68.1 Techniques for Dielectric Tests
 - C76 Apparatus Bushings
- 2.2. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA) STANDARDS
 - TR 1 Transformers, Regulators and Reactors
- 2.3. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS
 - D3487 Mineral Insulating Oil used in Electrical Apparatus
 - D92 Manual Cleveland Flashpoint Tester
 - D877 Dielectric Breakdown Voltage of Insulating Liquids
- 2.4. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
 - 70 National Electrical Code
 - 70B Electrical Equipment Maintenance

3.0 DEVIATIONS AND NON-CONFORMANCE REQUIREMENTS

3.1. Deviations from this specification or changes in the material or design after the purchase order has been placed must be approved by the MEC Engineering department and acknowledged by a Purchase Order Amendment issued by MEC.

3.2. Units received with deviations or non-conformances that are not acknowledged per Section 3.1 are subject to rejection. The Supplier of rejected units is responsible for any corrective action including but not limited to materials, labor and transportation necessary to dispose of or make the units conform to the specification.

3.3. Notification of defective units discovered before or after installation that are believed to be inherent to manufacturing problems or workmanship shall be made known and forwarded to the Supplier. The description of the item, documentation of the problem and the described information, disposition and/or follow-up (as appropriate) that MEC expects from the Supplier will be specified. The Supplier's response shall be made within thirty (30) days unless an extension is acknowledged and approved in writing by the MEC Manager of Engineering.

3.4. Warranty-the Supplier shall warrant the distribution transformer to be free from defects in material and workmanship under normal use and service conditions. The term of the Warranty shall be the lesser of twelve (12) months from the date of initial installation or eighteen (18) months from date of sale/purchase.

3.5. Statement of Compliance -The Supplier shall provide a signed statement verifying that the products being supplied fully comply with the specifications and drawings. Items not in full compliance with the specification and drawings will be identified with a description of the deficiency and any proposed substitutions. Items not in full compliance with the specifications and drawings must be approved by the MEC Engineering Department, as described in Section 3.1.

4.0 SUBMITTALS

4.1. The bidder shall provide with their bid the following data:

- a. Nameplate Data
- b. Connection diagrams
- c. Guaranteed total loss at 100% voltage and load
- d. Guaranteed no-load loss at rated voltage
- e. Shop Drawings
- f. Low voltage circuit breaker time-current characteristics curve

4.2. Information for shop drawings shall include:

- a. Mounting dimensions
- b. Location of equipment, devices and terminals
- c. Weights
- d. Number of gallons of oil
- e. Nameplate Data
- f. Connection diagrams
- g. Guaranteed total loss at 100% voltage and load
- h. Guaranteed no-load loss at rated voltage

4.3. After award of contract, shop drawings indicating details of construction and the outline of all connectors shall be submitted to MEC Engineering for review and approval.

4.4. MEC shall be allowed two (2) weeks to review and approve drawings provided in Section 4.2 without affecting the shipping date. Delays in delivery due to drawings that are disapproved during this review period are the responsibility of the Supplier.

4.5. Drawings returned to the Supplier as approved shall be considered authorization to proceed with the work. The approval of MEC shall in no way abrogate the requirements of this specification.

5.0 CERTIFIED LABORATORY TEST REPORTS

5.1. Certified tests shall be conducted in accordance with ANSI C57 plus a standard production impulse test. Transformers shall have passed all required tests demonstrating compliance with the design requirements and industry standards.

5.2. The Supplier shall also conduct tests to determine transformer load and no-load losses. This test data shall be certified as true and correct by an independent testing firm and submitted to the Authority.

5.3. The Supplier shall furnish two (2) copies of the certified test reports of all tests covered by this specification to the MEC Manager of Engineering prior to shipment.

6.0 LOSS EVALUATION

6.1. Each bidder shall submit with his bid the guaranteed load and no-load losses on each transformer submitted. Guaranteed load losses shall be provided at 85° C and shall be stated at the nominal voltage tap positions.

6.2. Guaranteed losses will be evaluated by MEC to determine the equivalent cost for owning and operating each transformer. The value of the transformer no-load and load losses will be determined by MEC at the time of purchase to arrive at the projected Total Cost of Ownership as follows:

Cost of Losses = Cost of No-Load Losses + Cost of Load Losses
Total Ownership Cost (TOC) = Purchase Price + Cost of Losses

6.3. not used

6.4. MEC will review actual, certified load and no-load losses for each transformer. In the event the actual losses exceed the guaranteed losses, the Supplier's contract will be reduced. The price reduction shall be the difference between the guaranteed losses and the actual losses at the rates indicated above. Load and no-load loss penalties will be assessed independently. Bonuses will not be awarded for actual losses which are less than guaranteed. Any transformer with no-load losses or total losses greater than the tolerances indicated in ANSI C57 shall be rejected by the Authority.

7.0 RATINGS

7.1. The primary voltage rating is 13,800 V or 4160 V. The required voltage will be advised in the procurement listing.

7.2. Secondary Voltage ratings shall be 120/240 volts as required.

7.3. The insulation class is 15 kV and the primary-voltage BIL is 95 kV.

7.4. Transformers shall be loop feed construction, in accordance with Fig. 2, IEEE C57.12.26. The primary voltage shall be loop fed into and out of the transformer, with the transformer capable of being isolated from the primary voltage via a load-break switch.

7.5. The laminated core shall be manufactured preferably using Amorphous steel; however, bidders may offer grain orientated steel as an alternative.

7.6. The required transformer kVA ratings will be indicated on the purchase order. The following kVA ratings are standard for MEC pad mounted transformers:

10, 15, 25, 37.5, 45, 50, 75, 100, 112.5, 150,

7.7. The transformer guaranteed impedance measured at 75 degsC and at rated voltage shall not exceed 3% for transformers 100kVA and below, or 5% for transformers greater than 100kVA. ANSI tolerances may be applied to these values. The impedance value shall be provided on the nameplate.

7.8. The transformer shall meet the latest energy efficiency standards for liquid immersed distribution pad mounted transformers required by the United States Department of Energy.

7.9. The Average Winding Rise shall be 65°C.

8.0 DESIGN

8.1. Taps

- a. Unless otherwise specified, taps shall be furnished on the high voltage winding. Tap ratios shall conform to ANSI C57 for 13.8 kV transformers, with two 2 1/2 % taps above and below the rated voltage unless stated otherwise.
- b. Taps shall be full KVA rated and have short circuit capability noted in ANSI C57.
- c. The selection of the tap desired shall be obtained through the operation of an externally operated switch.
 1. The switch shall be designed for de-energized operation.
 2. The switch assembly shall be snap action or the handle designed to permit checking that a switching operation has been completed.
 3. The switch assembly shall be designed to prevent accidental operation.
 4. Tap positions shall be clearly marked near the switch handle and on the transformer nameplate.
 5. A clearly legible yellow sign in accordance with 9.12.c shall be located adjacent to the handle which identifies it as the tap changer handle and includes a warning to not operate energized.
- d. The tap changer operating handle shall be located either in the low-voltage compartment, above the low-voltage bushings or hot stick operable at the high voltage compartment without interfering with installed primary cables.

8.2 Protection & Accessories

- a. Transformers shall be supplied with primary bayonet-type, oil-immersed fuses with isolation links.
- b. Fuse links shall be replaceable without requiring cutting or grinding of the transformer tank.
- c. Bayonet fuses with isolation links shall meet the following requirements:
 1. A yellow sign in accordance with 10.5.c reading "CAUTION READ BAYONET OPERATING INSTRUCTION BEFORE RE-FUSING" shall be located adjacent to bayonet fuses.
 2. A closed-end trough or catch basin shall be provided to prevent oil dripping on cables and terminations.
 3. Free clearance shall be provided for hot stick operation of bayonet fuses.

4. Bayonet fuses with isolation links shall be sized in accordance with industry standard for the selected transformer voltages and configuration requested.
 5. Current Limiting fuses shall be sized in accordance with industry standard for the selected transformer voltages and configuration requested.
- d. Provide an externally operated load break oil rotary (LBOR) switch for radial feed on the primary side.
 - e. All transformers covered by this specification shall have an automatic pressure relief valve installed above the hottest temperature oil level in the low voltage compartment, near the right hand most edge to the right of the top bushing to prevent oil dripping on cables and terminations and to prevent spraying.
 - f. Transformers shall be insulated with new (unused) mineral oil, which meets the requirements of ANSI C57.12.00, Article 6.6.1 (1), ANSI C57.106 and ASTM 3487 Type II.
 - g. Transformer oil shall be PCB free.
 - h. The oil shall be inhibited mineral oil containing 0.2 % by weight DBPC.
 - i. Transformers rated 100 kVA and above shall come fitted with cooling radiators.
 - j. If required, transformers shall be equipped with internally mounted instrument class CT's suitably rated for the transformer's primary current, and providing a 5 Amp secondary current. As the CT's are intended to be connected to maximum demand metering, they are to be connected to an externally mounted terminal box complete with short-circuiting links.
 - k. If called for in the tender, transformers shall be equipped with single-phase Maximum Demand Meters (MDI's) on each phase, designed for outdoor applications and readily visible when the cubicle door is opened. MDI's shall be the dual needle type, one indicating instantaneous demand on the phase and the other, which can be manually reset, recording the maximum demand. Meter scales shall indicate primary amps.
 - l. Transformers shall be furnished with one ground lug for low-voltage grounding of the transformer and two ground lugs for high-voltage grounding of the transformer. Grounding lugs shall be of the 2-hole, horizontal NEMA type.

9.0 FUSING

9.1 Provisions:

- 9.1.1 Transformers shall be provided with Bay-O-Net type fuse holders.
- 9.1.2 Transformers shall be provided with Bay-O-Net, dual sensing, load break, externally removable fuses.
- 9.1.3 Transformers shall be provided with internally mounted partial range current limiting fuses which shall be placed in series with the Bay-O-Net fuse holder and be mounted internally under oil. Partial range current limiting fuses shall have a nominal voltage rating of 8.3kV.
- 9.1.4 Oil drip shields shall be provided with the Bay-O-Net fuse holder and be designed to catch and hold oil in preference to those oil drip shields that redirect oil.
- 9.1.5 The Bay-O-Net Fuse size and type shall be painted on the inside of the primary side cabinet door. In addition, the bayonet and current limiting fuse part numbers will be displayed on the nameplate.
- 9.1.6 Transformer fuses shall be Dual Sensing Bay-O-Net fuse Link as per industry standard for the transformer voltage, sizing and configurations requested.

10.0 ACCESSORIES

10.1 CONSTRUCTION

10.1.1 The transformer shall consist of a welded transformer tank which shall be sealed with a welded cover. The enclosure, tank, doors and base of the transformer (the part that makes contact with the mounting surface) shall be made of Type 304L stainless steel.

10.1.2 The high and low voltage compartment including doors, door handles, hinges, base and other exterior parts and accessories on the high and low voltage compartment shall be made of Type 304L Stainless Steel. All transformer cubicles shall have a removable sill at the base and along the width of the access door face of the cubicle. The sill shall be 6 inch in height.

10.1.3 The manufacturer shall identify the type of steel and the thickness of the metal in inches or in gage size, in which case the gage name shall be specified.

10.1.4 The transformer shall be supplied with a high and low voltage compartment barrier. The compartment barrier shall extend from top to bottom of the cubicle and extend out to the door of the cubicle. It may be removable.

10.1.5 All transformers are to be fitted with lifting lugs and jacking point provisions.

10.1.6 The compartment with separable insulated high voltage connectors shall be covered by a single door.

10.1.7 No part of the transformer shall allow deformation or standing water. The top of the transformer shall be convex so water will run off the top.

10.1.8 The transformer shall have an oil level gauge, fill plug, drain valve, and self-actuating pressure relief device.

10.1.9 An indication shall be provided for signifying the correct oil level at 25° C if fill plug is not at this level.

10.2 Bushings and Terminals

- A High voltage separable insulated connector bushing.
 - 1 Integral bushings are required. The Supplier shall provide approved load break bushing insert, Elastimold 1601A3R 200 Amp or approved equal.
 - 2 Bushings shall be bonded to tank having a maximum resistance between high voltage bushing shielding and tank of 5000 ohms.
 - 3 Weatherproof protective caps shall be installed to remain in position during shipping and storage and not deteriorate prior to installation of transformer.
- B The low voltage neutral shall be fully insulated and provided with a connected, removable neutral ground strap, which shall be connected so as not to impair the bolted secondary connections.

- 1 Low voltage terminals shall be Four-hole spade for 10 to 45 KVA transformers and six-hole spade for 50 to 150 KVA transformers for bolting copper terminal lugs.
 - 2 Low voltage terminals shall be plated for copper or aluminum cable terminations.
- C The transformer shall have high and low voltage bushings which are externally clamped and replaceable without requiring access to the inside of the tank.
- D Ground nuts for grounding connection shall be provided with ground connector for #4 to 2/0 copper wires.

10.3 Security Requirements

Access to the transformer compartment shall be secured by a minimum of two independent locking arrangements.

- A. The transformer locking design shall meet the requirements of the Western Underground Committee Guide 2.13, latest revision, "Security for Pad Mounted Equipment Enclosures."
- B. The transformer shall be designed to prevent wire entry and pass the following production quality control and receiving inspection test procedure:
1. Any length of # 12 AWG medium hard drawn solid bare copper wires shall be inserted into each opening until the wire enters the compartment or reaches an obstacle.
 2. If the wire reaches an obstacle, it can be bent and extended a maximum of three times at which time it shall be considered that the wire cannot be inserted into the enclosure.
 3. Entry of the wire into a compartment shall constitute a lack of tamper resistance and shall be cause for rejection. It is not necessary for the wire to actually contact energized components since entry into the compartment can establish potential hazardous conditions.
- C. The locking design shall be adequately sized for a standard padlock. The padlock shall not protrude beyond the front of the hood when installed.

10.4 Finish Requirements

- A. The tank, compartment and all appurtenances shall be resistant to impact and corrosion under normal operating conditions in the Marshall Islands salt air environment.
- 1 The total external dry-film thickness of the paint shall be 3.5 mils minimum or equivalent protection and 2.0 mils minimum on the interior compartment surfaces.
 - 2 All mating surfaces shall be designed to prevent degradation of corrosion protection e.g. abrasion and impact. Mating surfaces at sill/hood/door junction shall be designed to prevent standing water corrosion.
 - 3 Surfaces in contact with, and a minimum of two inches above, the mounting surface shall be designed or treated to be resistant to corrosion and abrasion when unit is skidded and slid into place on the mounting pad.

- 4 The transformer shall have a corrosion resistant finish that shall be capable of meeting or exceeding the paint requirements of ANSI C57.12.28.
 - 5 Transformers shall be given a phosphatizing bath or blasted with sand, grit or shot, then primed with epoxy or vinyl prime no less than 2.5 mils dry thickness.
 - 6 The exterior finish coat shall be semi-gloss polymer no less than one (1) mil dry thickness, and free of runs and sags, and be of a semi-gloss olive-green gray color similar to Munsel no. 7GY3.29/1.5.
- B. The transformer shall withstand the following environmental tests for 2000 hours:
1. ASTM B117, Standard Method of Salt Spray (Fog) Testing.
 2. Ultraviolet Test, per ASTM D822, Standard Recommended Practice for Operating Light and Water Exposure Apparatus (Carbon-Arc type) for testing paint, varnish, lacquer and related products (ASTM G23 Type D or better).

10.5 Transformer Identification and Labeling Requirements

- A. High voltage and low voltage terminal designations shall be located directly above their respective terminals.
- B. Transformer KVA rating, high voltage nameplate designated voltage and low voltage nameplate designated voltage shall be located inside the door and plainly visible with door open.
- C. Signs shall be yellow stenciled or approved decals. Decals shall have yellow printing on a black or clear background, or black printing on a yellow background, reverse printed on Scotch Cal material with pressure sensitive adhesive or an equivalent approved by MEC Engineering.
- D. For ease of identification, all transformers shall have an exterior label denoting the kVA rating of the transformer.
- E. Nameplate
 1. The nameplate shall be made of corrosion resistant material and shall comply with applicable industry standards for distribution transformers.
 2. The nameplate shall be permanent showing all of the required information, including KVA, voltage rating, ratio, BIL, weight, winding material, month and year of manufacture, impedance, high voltage and low voltage material, etc.
 3. The nameplate shall have rounded comers, and shall not be mounted more than W' from the surface so as not to constitute a personnel hazard during bare hand secondary make up.

11.0 QUALITY CONTROL

11.1. The Supplier shall have a quality control program to ensure compliance with the requirements of this specification. The program shall be documented and available for MEC's review if requested.

11.2. Documentation of the quality control program shall indicate where in the production and manufacturing process the quality checks are taken, describe the purpose of the checks, and describe the nature of the check, e.g. if check is visual only or if electrical or mechanical testing is used.

11.3 MEC shall, at any reasonable time, be permitted to have a representative visit the Contractor's factory for the purpose of witnessing the manufacture of the transformers to ascertain if the materials and process used conform to this Specification; and to witness the factory testing.

12.0 PACKING AND SHIPPING

12.1 The supplier shall have adequate work and inspection instructions for handling, storage, preservation, packaging and shipping to protect the quality of the transformer and all attachments and to prevent damage, loss and deterioration of the transformer and its appurtenances.

12.2 The transformer shall be placed and crated with suitable material to prevent damage and injury during shipment and handling operations.

12.3 The transformer shall be securely blocked to prevent shifting during transit.

12.4 Transformers shall be shipped CIF Majuro, Republic of the Marshall Islands.

END OF SPECIFICATION.