MARSHALLS ENERGY COMPANY, INC.
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TRANSMISSION & DISTRIBUTION SPECIFICATIONS
SPECIFICATION NO.: MEC-Dist-Xfmrs-05

FOR

POLE MOUNTED
MEDIUM VOLTAGE DISTRIBUTION TRANSFORMERS
for
13,800 & 4,160 HV SERVICE

Revision	Date	Reviewed	Approved
One	Sept 2019	sjw	SJW
Two	Sept 2020	TI	SJW

SINGLE PHASE POLE MOUNTED

DISTRIBUTION TRANSFORMER

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1.0 SCOPE

This specification covers the minimum requirements for MEC' s pole 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. The transformers are for single-phase, 60 Hz. mineral oil filled, 65° C rise pole mounted type distribution transformers.

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. Power lines are installed close to the ocean shorelines and are continually exposed to heavy salt spray environment. Ambient temperatures range from 86 – 100 degrees Fahrenheit, relative humidity of 90%, and a humid coastal environment.

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

2.5 National Electric Safety Code (NESC) Part 2: Safety rules for Overhead Lines.

Section 250 General Loading Requirements

2.6 DEPARTMENT OF ENERGY EFFICIENCY STANDARDS (US)

DOE 2016 Efficiency stands for Distribution Transformers

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. Bidder Checklist – attached to this specification document
b. Nameplate Data
c. Connection diagrams
d. Guaranteed total loss al 100% voltage and load
e. Guaranteed no-load loss at rated voltage
f. Shop Drawings
g. Low voltage circuit breaker time-current characteristics curve
h. Specification Checklist (included herein)

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 4.3 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

$$\mathbf{TCO = IC + A \times P_o + B \times P_k}$$

P_o = No Load Losses in kW (Provided by Bidder)
P_k=Load Losses in kW (Provided by Bidder)
IC= Initial Transformer Cost (Provided by Bidder)
$A= t \times C_{kwh} \times (1-(1/(1+i))^n)/i$
$B=u \times t \times C_{kwh} \times (1-(1/(1+i))^n)/i$
$u=k^2$
t= Operating Hours per Year (24 Hours/Day x 365 Days/Year=8760 Hours)

i= Discount Rate (5%)
n=Expected Lifetime of the Transformer in Years (20 Years)
C_{kwh}=Electricity price ($/kWh) (MEC Tariff rate: $0.346)
k = Is the Average Loading of the Transformer During its lifetime (60%)

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 MEC.

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. The required voltage will be advised in the procurement listing.

7.3. The insulation class is 15 kV and the primary-voltage BIL is 95 kV. The secondary voltage BIL shall be 30kV

7.4. Not used

7.5. The Laminated core shall be manufactured preferably using Amorphous Steel, however bidders may offer grain orientated steel as an alternative. The Core and Coil shall be vacuum processed to ensure maximum penetration of insulating fluid into the coil insulation system. While under vacuum, the transformer will be filled with preheated filtered degassed insulating fluid. The core shall be manufactured from burr-free, grain orientated silicon steel and shall be precisely stacked to eliminate gaps in corner joints. 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.

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:

5, 10, 15, 25, 37.5, 45, 50, 75, 100

7.7. The transformer guaranteed impedance shall be as indicated in table 1. ANSI tolerances may be applied to these values. The impedance value shall be provided on the nameplate.

TABLE 1. Transformer Impedance.

Size kVA	Min IMP %	Max IMP %
5 – 37.5	1.0	4.5
50+	1.5	4.5

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 the rated Primary 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.

I. 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 10.5 c shall be located adjacent to the handle which identities it as the tap changer handle and includes a warning to not operate energized.

8.2 Protection & Accessories

A. All transformers shall be furnished with the following requirements:

I. A single two-pole or two single-pole low voltage circuit breaker(s) with an overload setting. Circuit breaker calibration shall be verified after installation in the units. The breaker is internally mounted in oil with the operating handle externally operated. The switch position shall be clearly marked on the transformer.
2. An overload signal light
3. An automatic pressure relief valve.

B. If specified, transformers shall be provided with externally-mounted surge arrestors.
1. The arrestors shall be rated 12kV (MCOV 10.2 kV rms).
2. Two arrestors shall be required to be mounted onto mounting brackets fixed to the transformer body
3. Arrestor shall be provided with connectors for #4 to #2 aluminum or copper conductors.
4. Arrestors shall be normal duty constructed within a polymer housing.

C. All transformers shall be supplied with arrester mounting pads equipped with stainless steel 1-1/4" x ½" bolts and washers for mounting surge arresters.

D. All transformers shall be supplied with a tank ground pad equipped with a ground nut with grounding connector for #4 to #2 copper wires.

E. 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.

F. Transformer oil shall be PCB free.

G. The oil shall be inhibited mineral oil containing 0.2 % by weight DBPC.

9.0 FUSING

9.1 Provisions:

Not used

10.0 ACCESSORIES

10.1 CONSTRUCTION

10.1.1 The transformer tank, cover, cover band, and associated hardware shall be made of stainless steel.

A. The manufacturer shall identify the type of steel, and the thickness of the metal in inches or in gage size, in which case they shall specify the gage name.

B. Stainless steel shall be of type 304L stainless steel and shall be identified by the addition of the words “Stainless Steel” to the nameplate and the stenciled letters “SS” 3 inches high (minimum) on the tank front below the KVA rating.

C. The transformer cover shall have an insulating type coating having a minimum dielectric strength of 15kV, 60 second withstand.

D. The tank shall have a recessed tank bottom which offers protection when sliding over rough surfaces.

E. The tank shall have an internal mark which indicates the proper oil level at 25 degs C per ANSI C57.

F. The cover shall be electrically bonded externally to the tank.

G. Lifting lugs conforming to ANSI C57 shall be integrally welded to the tank and finish coated with the tank assembly. Lifting provisions shall be arranged in such a manner that a lifting sling will not be in conflict with other transformer parts or accessories and shall permit reasonably balanced lift during handling and installation of the complete unit.

10.1.2. The transformer tank shall be constructed in such a manner as to remain leak proof throughout the life of the transformer.

10.1.3. Transformer covers shall be tightly gasketed and securely clamped to prevent entrance of moisture.

10.1.4. Single position upper and lower support lugs for direct-pole mounting shall conform to IEEE standard C57.12.20, except as otherwise specified below and to the requirements stated in section 1.2. Certified to withstand extreme wind loading for sustained wind speeds of 155MPH and 3 second gusts of 170MPH.

1. Type B support lugs are defined in IEEE C57.12.20 shall be installed on all transformer regardless of the kVA rating. Support lugs shall be angular and not rectangular. When viewed from the top of the transformer, the edges of the members of the support lug at the point of attachment at the transformer tank to the concavity shall form a 65 deg angle +/- 10 degs when measured at the concavity: edges that are parallel from the point of attachment at the transformer tank to the concavity are not acceptable.

2. Hanger brackets for all size transformers shall have a concavity at the contact area with the pole such that it conforms to the surface of a wood pole. The concavity shall comply with IEEE C57.12.20 for type B support lugs.

10.1.5. Approximate transformer weight and dimensions are provided in table 3

10.1.6. The transformer tank shall withstand a static pressure of 50psig while remaining intact.

A. A pressure relief cover design is acceptable relieved at a minimum of 8 psig if designed to reseal.

B. The tank may vent at the cover gasket at 15 psig or higher without resealing.

10.2 Bushings and Terminals

A High voltage bushings shall have a minimum creepage distance of 17 inches.

B. Transformer high voltage and low voltage bushings shall be glazed wet process porcelain. The color shall be ANSI Z55.1 No. 70 Gray.

C. Terminals on the high voltage bushings shall conform to ANSI C57. Terminals shall accommodate wire sizes from #4 to #2 copper or aluminum.

D. Transformers shall have a minimum clearance of 6 inches from the pole face to any energized part.

E. Low voltage terminals shall conform to ANSI C57 and shall be suitable for use with both copper and aluminum conductor sizes from #4 AWG to 250 kcmil.

F. The transformer shall consist of three low voltage terminals and shall be suitable for series, three wire, and parallel operation. The internal leads shall be long enough to easily allow the change of connections for the desired type of operation. The internal secondary leads shall be permanently embossed with the letters A, B, C, and D as per ANSI C57. The polarity of the transformer shall be subtractive.

10.3 Security Requirements

Not used

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 color shall be ANSI Z55.1 No. 70 Gray.
   2. The total external dry-film thickness of the paint shall be 3.5 mils minimum or equivalent protection as approved by MEC Engineering.
   3. Pressure relief valves may be painted to conform to ANSI Z55.1 No. 70 Gray provided painting does not alter the operating characteristics.

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).

3. ASTM D529, the Accelerated Test of Bituminous Materials.

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 clear and plainly visible.

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 be mounted 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.

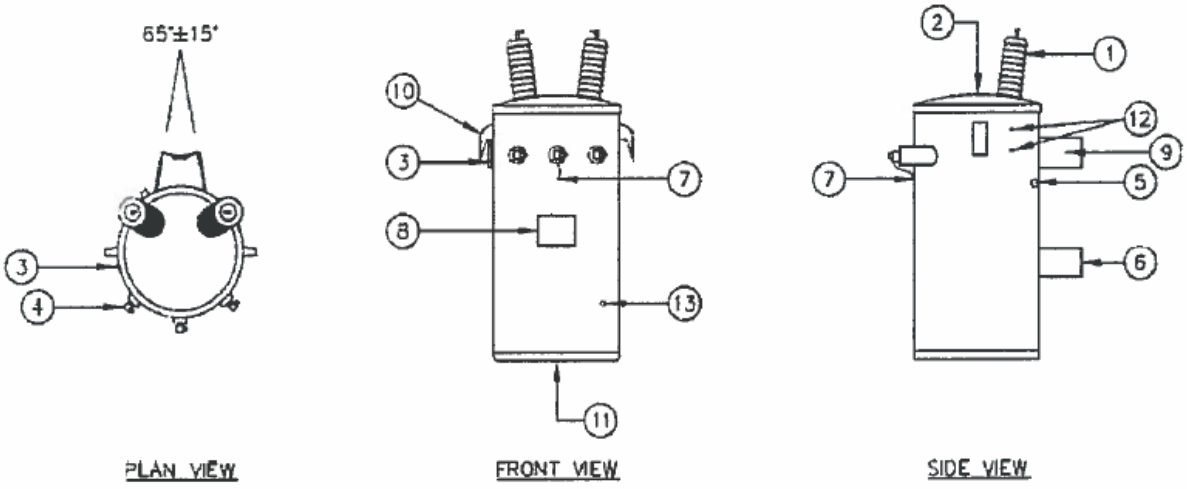
12.4 Transformers shall be shipped CIF Majuro, Republic of the Marshall Islands.

END OF SPECIFICATION.

TABLE3
Approximate Transformer Sizes
(See Figure 1 for Dimensions)

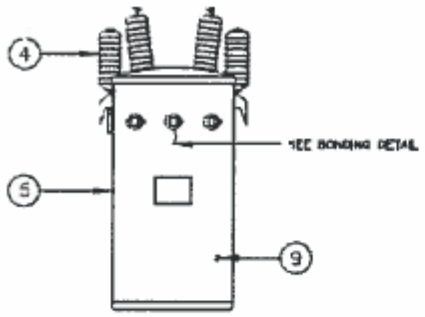
Size kVA	Dimensions (inches)				Weight (lbs.)	Gallons of Oil
	A	B	C	D		
5	34	16	19	22	220	6
10	37	16	19	26	233	9
15	39	18	20	23	317	11.5
25	43	20	24	32	410	14
37.5	48	20	24	37	539	16.5
50	49	23	37	33	650	23
75	55	23	28	44	881	34.5
100	55	28.5	31.5	35	1030	42
167	55	28.5	35	43	1340	46

FIGURE 1

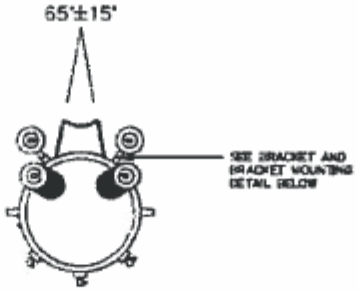


1. High Voltage Bushing
2. Cover
3. Secondary circuit breaker handle and light location
4. Low voltage eyebolt terminals
5. Tap Changer
6. Nameplate (attached to hanger bracket)
7. Secondary neutral bushing bonding to tank
8. Transformer size decal
9. Hanger bracket
10. Lifting lugs
11. Recessed bottom
12. Arrester mounting pads on both sides
13. Tank ground pad with grounding connector for #4 to #2 copper wire

FIGURE 2

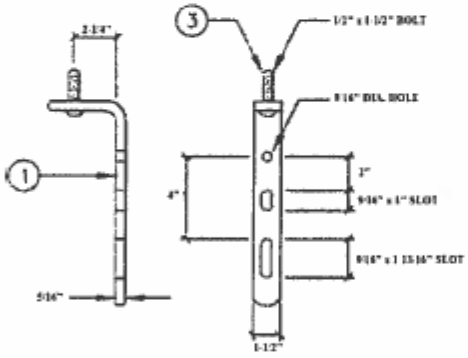


FRONT VIEW

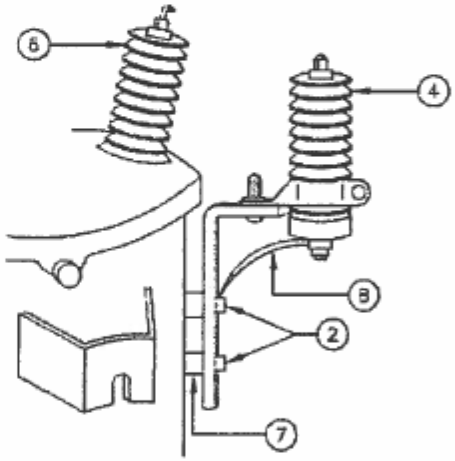


PLAN VIEW

BONDING DETAIL



BRACKET DETAIL



BRACKET MOUNTING DETAIL

1. Arrester Mounting Bracket
2. Bolt
3. Carriage Bolt
4. Surge Arrester
5. Transformer
6. High Voltage Bushing
7. Arrester Mounting Pads
8. Grounding Strap
9. Tank ground pad with grounding connector for #4 to #2 copper wire

CHECKLIST – Single Phase POLE MOUNTED Transformer Supply

THIS CHECKLIST MUST BE SUBMITTED WITH THE BID DOCUMENTS.

It is advised that bidders should highlight relevant text in their bid submission documents that meets each required spec # and write the spec # beside the text. This will aid in checking compliance.

Spec #	Specification Requirement	Evidence Provided with bid	Meets Spec. Y/N
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		
2.5	National Electric Safety Code (NESC) Part 2: Safety rules for Overhead Lines. Section 250 General Loading Requirements		
2.6	DEPARTMENT OF ENERGY EFFICIENCY STANDARDS (US) DOE 2016 Distribution Transformer Efficiency rating.		
4.1	The bidder shall provide with their bid the following data: a. This Bidder Checklist b. Nameplate Data c. Connection diagrams d. Guaranteed total loss al 100% voltage and load e. Guaranteed no-load loss at rated voltage f. Shop Drawings g. 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		

Spec #	Specification Requirement	Evidence Provided with bid	Meets Spec. Y/N
	g. Guaranteed total loss at 100% voltage and load h. Guaranteed no-load loss at rated voltage		
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.		
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. The required voltage will be advised in the procurement listing.		
7.3	The insulation class is 15 kV and the primary-voltage BIL is 95 kV. The Secondary voltage BIL shall be 30kV		
7.5	The laminated core shall be manufactured preferably using Amorphous steel; however, bidders may offer grain orientated steel as an alternative.		
7.7	The transformer guaranteed impedance shall be as indicated in table 1. ANSI tolerances may be applied to these values. The impedance value shall be provided on the nameplate.		
7.9	The Average Winding Rise shall be 65°C.		
8.1.A.	Unless otherwise specified, taps shall be furnished on the high voltage winding. Tap ratios shall conform to ANSI C57 for the rated Primary kV transformers, with two 2 1/2 % taps above and below the rated voltage unless stated otherwise.		
8.1.B.	Taps shall be full KVA rated and have short circuit capability noted in ANSI C57.		
8.1.C.	The selection of the tap desired shall be obtained through the operation of an externally operated switch. I. 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 10.5.C shall be located adjacent to the handle which identities it as the tap changer handle and includes a warning to not operate energized.		
8.2.A.	All transformers shall be furnished with the following requirements: I. A single two-pole or two single-pole low voltage circuit breaker(s) with an overload setting. Circuit breaker		

Spec #	Specification Requirement	Evidence Provided with bid	Meets Spec. Y/N
	calibration shall be verified after installation in the units. The breaker is internally mounted in oil with the operating handle externally operated. The switch position shall be clearly marked on the transformer. 2. An overload signal light 3. An automatic pressure relief valve.		
8.2.B.	If specified, transformers shall be provided with externally-mounted surge arrestors. 1. The arrestors shall be rated 12kV (MCOV 10.2 kV rms). 2. Two arrestors shall be required to be mounted onto mounting brackets fixed to the transformer body 3. Arrestor shall be provided with connectors for #4 to #2 aluminum or copper conductors. 4. Arrestors shall be normal duty constructed within a polymer housing.		
8.2.C.	All transformers shall be supplied with arrester mounting pads equipped with stainless steel 1-1/4" x ½" bolts and washers for mounting surge arresters.		
8.2.D.	All transformers shall be supplied with a tank ground pad equipped with a ground nut with grounding connector for #4 to #2 copper wires.		
8.2.E.	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.		
8.2.F.	Transformer oil shall be PCB free.		
8.2.G.	The oil shall be inhibited mineral oil containing 0.2 % by weight DBPC.		
10.1.1.	The transformer tank, cover, cover band, and associated hardware shall be made of stainless steel.		
10.1.1.A.	The manufacturer shall identify the type of steel, and the thickness of the metal in inches or in gage size, in which case they shall specify the gage name.		
10.1.1.B.	Stainless steel shall be of type 304L stainless steel and shall be identified by the addition of the words "Stainless Steel" to the nameplate and the stenciled letters "SS" 3 inches high (minimum) on the tank front below the KVA rating.		
10.1.1.C.	The transformer cover shall have an insulating type coating having a minimum dielectric strength of 15kV, 60 second withstand.		
10.1.1.D.	The tank shall have a recessed tank bottom which offers protection when sliding over rough surfaces.		

Spec #	Specification Requirement	Evidence Provided with bid	Meets Spec. Y/N
10.1.1.E.	The tank shall have an internal mark which indicates the proper oil level at 25 degs C per ANSI C57.		
10.1.1.F.	The cover shall be electrically bonded externally to the tank.		
10.1.1.G.	Lifting lugs conforming to ANSI C57 shall be integrally welded to the tank and finish coated with the tank assembly. Lifting provisions shall be arranged in such a manner that a lifting sling will not be in conflict with other transformer parts or accessories and shall permit reasonably balanced lift during handling and installation of the complete unit.		
10.1.2	The transformer tank shall be constructed in such a manner as to remain leak proof throughout the life of the transformer.		
10.1.3	Transformer covers shall be tightly gasketed and securely clamped to prevent entrance of moisture.		
10.1.4	Single position upper and lower support lugs for direct-pole mounting shall conform to IEEE standard C57.12.20, except as otherwise specified below and to the requirements stated in section 1.2. Certified to withstand extreme wind loading for sustained wind speeds of 155MPH and 3 second gusts of 170MPH. 1. Type B support lugs are defined in IEEE C57.12.20 shall be installed on all transformer regardless of the kVA rating. Support lugs shall be angular and not rectangular. When viewed from the top of the transformer, the edges of the members of the support lug at the point of attachment at the transformer tank to the concavity shall form a 65 deg angle +/- 10 degs when measured at the concavity: edges that are parallel from the point of attachment at the transformer tank to the concavity are not acceptable. 2. Hanger brackets for all size transformers shall have a concavity at the contact area with the pole such that it conforms to the surface of a wood pole. The concavity shall comply with IEEE C57.12.20 for type B support lugs.		
10.1.6	The transformer tank shall withstand a static pressure of 50psig while remaining intact. A. A pressure relief cover design is acceptable relieved at a minimum of 8 psig if designed to reseal. B. The tank may vent at the cover gasket at 15 psig or higher without resealing.		
10.2.A.	High voltage bushings shall have a minimum creepage distance of 17 inches.		

Spec #	Specification Requirement	Evidence Provided with bid	Meets Spec. Y/N
10.2.B.	Transformer high voltage and low voltage bushings shall be glazed wet process porcelain. The color shall be ANSI Z55.1 No. 70 Gray.		
10.2.C.	Terminals on the high voltage bushings shall conform to ANSI C57. Terminals shall accommodate wire sizes from #4 to #2 copper or aluminum.		
10.2.D.	Transformers shall have a minimum clearance of 6 inches from the pole face to any energized part.		
10.2.E.	Low voltage terminals shall conform to ANSI C57 and shall be suitable for use with both copper and aluminum conductor sizes from #4 AWG to 250 kcmil.		
10.2.F.	The transformer shall consist of three low voltage terminals and shall be suitable for series, three wire, and parallel operation. The internal leads shall be long enough to easily allow the change of connections for the desired type of operation. The internal secondary leads shall be permanently embossed with the letters A, B, C, and D as per ANSI C57. The polarity of the transformer shall be subtractive.		
10.4.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 color shall be ANSI Z55.1 No. 70 Gray. 2. The total external dry-film thickness of the paint shall be 3.5 mils minimum or equivalent protection as approved by MEC Engineering. 3. Pressure relief valves may be painted to conform to ANSI Z55.1 No. 70 Gray provided painting does not alter the operating characteristics.		
10.4.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 ASTMD 822, 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). 3. ASTM D529, the Accelerated Test of Bituminous Materials.		
10.5.A	High voltage and low voltage terminal designations shall be located directly above their respective terminals.		
10.5.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.		

Spec #	Specification Requirement	Evidence Provided with bid	Meets Spec. Y/N
10.5.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.		
10.5.D	For ease of identification, all transformers shall have an exterior label denoting the kVA rating of the transformer.		
10.5.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 be mounted so as not to constitute a personnel hazard during bare hand secondary make up.		