DISTRIBUTION TRANSFORMERS

SPECIFICATION #1212.01

12.47kV Grd Wye
Padmount & Polemount

TABLE OF CONTENTS

1 SCOPE

This specification is to cover minimum requirements for Polemount & Padmount type, outdoor, oil-immersed distribution transformers suitable for operation on the District's 60 Hz 12470GrdY/7200 Volt Distribution System. Transformers must be manufactured in North America.

2 STANDARDS

All material and equipment furnished under these specifications shall conform to the latest applicable approved standards of IEEE, ANSI, NEMA and DOE except as otherwise specified herein. All distribution transformers shall be manufactured in the North America.

2.1 **ANSI C37.47** Specifications for Distribution Fuse Disconnecting Switches, Fuse Supports, And Current Limiting Fuses.

2.2 **ANSI/IEEE C57.12.00** General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.

2.3 **ANSI/IEEE C57.12.01** General Requirements for Dry Type Distribution and Power Transformers.

2.4 **ANSI/IEEE C57.12.20** American National Standard for Transformers – Overhead Type Distribution Transformers, 500 kVA and smaller: High Voltage 34.5 kV and Below; Low Voltage 7970/13,800Y Volts and below.

2.5 **ANSI C57.12.22** Requirements for Pad Mounted, Compartmental Type, Self-Cooled, Three Phase Distribution Transformers with High Voltage Bushings: High Voltage, 34,500 GrdY/19,900 Volts and Below, 2500kva and Smaller. (only applicable for three phase pad mount transformers)

2.6 **ANSI C57.12.25** (only applicable for single phase pad mount transformers)

2.7 **ANSI C57.12.26** Requirement for Pad Mounted, Compartmental Type, Self-Cooled, Three Phase Distribution Transformers with High Voltage Bushings: High Voltage 24,940 GrdY/14,400 Volts and Below, 2500kva and Smaller. (only applicable for three phase pad mount transformers)

2.8 **ANSI C57.12.28** - Switchgear and Transformers - Pad-Mounted Equipment - Enclosure Integrity.

2.9 **ANSI C57.12.70** Terminal Markings and Connections for Distribution and Power Transformers.

2.10 **ANSI/IEEE C57.12.80** Terminology for Power and Distribution Transformers.

2.11 **ANSI/IEEE C57.12.90** Test Code for Liquid Immersed Distribution Power and Regulating Transformers.

2.12 **ANSI/IEEE C57.12.91** Test Code for Dry Type Distribution and Power Transformers.

2.13 **ANSI/IEEE 386** Separable Insulated Connector Systems for Power Distribution Systems Above 600v.

2.14 **ASTM D877** Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.

2.15 **ANSI Z535**.

2.16 **DOE** 2016 Medium Voltage Transformer Efficiencies.

2.17 **ANSI 70** National Electric Code

3 EVALUATION AND AWARD

See ITB-8, Evaluation of Bids. For the purpose of evaluating bids, consideration will be given to the following items.

- Delivery Date – Lead Time
- Product Quality
- Loss Evaluation (each individual transformer must meet or exceed DOE 2016)
- Adherence to Specifications

3.1 Product Quality

Product quality will be determined by the placement of the manufacturer in the most recent Washington PUD Design Committee (WAPUD) transformer teardown. Quality will be ranked by the manufacturer placement on the teardown.

3.2 Loss Evaluation

3.2.1 Losses furnished for evaluation shall be guaranteed maximum losses for each transformer bid. No individual delivered unit shall exceed the guaranteed maximum losses.

3.2.2 No load losses (NLL) shall be in watts, at 20^{o}C in accordance with ANSI C57.12.00 and shall be evaluated at $4.07 per watt.

3.2.3 Full-load losses (FLL) shall be in watts, measured at rated nameplate load at 85^{o}C in accordance with ANSI C57.12.00 and shall be evaluated at $1.79 per watt.

3.2.4 Evaluated Price Formula = [$4.07 x NLL] + [$1.79 x FLL] + Unit Price – evaluation credit

3.2.5 The manufacturer shall furnish with each transformer a certified test report of the no-load and full-load losses. The test report shall be submitted with the Contractor's invoice.

3.3 Adherence to Specifications

The District expects all bids to conform to these Specifications. Any exception is cause for rejection, at the District's discretion.

4 INFORMATION TO BE FURNISHED WITH BID OR QUOTE

See ITB-9, Bidder's Data, for required information. Technical information shall be provided by Bidder with their Bid in a Microsoft Excel Spreadsheet for all bid items.
Outline and nameplate drawings shall be submitted with bid package. An electronic copy of the form is available; a sample form is shown in Table 1.

4.1 Any requests for "approved equivalent" must be made to Chelan PUD engineer before submission of bid.

Table 1 : Technical Information Sample Form

EXHIBIT H TECHNICAL INFORMATION – This form must accompany your proposal in hard copy and electronically on a compact disc.

Technical Information – The following data must be provided for each Bid item in the following Excel format. It must be submitted in hard copy and electronically on a compact disc or thumb drive. Only one spreadsheet shall be submitted per bid.

Describe the coating system on separate sheets. Include the corrosion resistant material used on the bottom and lowest 2" of the sides.

BID ITEM - Line #:	Manufacturer	Vendor	KVA Size:	High Voltage (ANSI Designation) (kV)	Low Voltage (ANSI Designation) (volts)	Impedance Voltage: (%)	Maximum L.V. Short Circuit Current (kA)	Maximum L.V. Short Circuit Current is at: L-L or L-N	L.V. Windings (Interlaced or Non-interlaced):	Short Circuit Impedance: (%)	Total Weight: (lbs)
A-1											
A-2											
A-3											
A-4											
A-5											
A-6											
A-7											
A-8											
A-9											
A-10											
A-11											
A-12											
A-13											
A-14											
A-15											
A-16											
A-17											
A-18											
A-19											
B-1											
B-2											
B-3											
B-4											
B-5											
B-6											
B-7											
B-8											
B-9											
B-10											
B-11											
B-12											
B-13											
B-14											

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BID ITEM - Line #:	Oil: (Gallons)	H.V. Winding Metal:	L.V. Winding Metal:	Core Metal, Type: (Grain Oriented, Amorphous)	Minimum Primer Thickness: (Mils)	Minimum Paint Thickness: (Mils)	Base Dimensions: Overall Width: (Inches)	Overall Depth: (Inches)	Overall Height: (Inches)	Access Hole Width: (Inches)	Access Hole Depth: (Inches)	Core Loss: (Watts)	Copper (Winding) Loss: (Watts)
A-1													
A-2													
A-3													
A-4													
A-5													
A-6													
A-7													
A-8													
A-9													
A-10													
A-11													
A-12													
A-13													
A-14													
A-15													
A-16													
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B-10													
B-11													
B-12													
B-13													
B-14													

Sample Form

5 POLEMOUNT TRANSFORMERS

5.1 Ratings

5.1.1 All ratings shall be for 60 hertz alternating current, oil immersed, self-cooled transformers capable of continuous operation at rated KVA without exceeding either a 65^{O}C average temperature rise or an 80^{O}C hot spot temperature rise.

5.1.2 The basic impulse level (BIL) shall be 95 kV.

5.1.3 Overhead Polemount transformers shall have an impedance of 2.0%, ± 10% tolerance per C57.12.00

5.2 Pressure Relief Device

5.2.1 All transformers shall be designed such that all excessive pressure build-ups are released without damage to the tank in accordance with ANSI C57.12.25.

5.2.2 All transformers shall be equipped with a pressure relief device (Tomco Series 1776K or Qualitrol Model 202-032-1 or District approved equivalent). The threads shall be sealed with pipe dope.

5.3 Transformer Taps

5.3.1 No transformer taps are required.

5.4 Transformer Oil

5.4.1 Transformers shall be insulated with new (unused) mineral oil. The oil shall meet the requirements of ANSI C57.12.00, Article 6.6.1 (1), ANSI C57.106 and ASTM 3487 Type II. The transformer nameplate shall indicate that the PCB content of said transformer is less than 1 PPM, or at time of manufacture gas chromatographic analysis certified non-detectable PCB. The oil shall be inhibited mineral oil containing 0.2 % by weight DBPC. The nameplate shall show the gallons of oil and state the oil type as “Mineral Oil”.

5.5 High Voltage Bushings and Terminals

5.5.1 Transformers shall be equipped with cover-mounted, wet process porcelain high voltage bushings (two bushings) with clamp style terminals in accordance with ANSI C57.12.20, Table 7. The bushings shall be light gray in color. The clamp type terminal shall be capable of being tightened with a Fargo wrench (Fargo Manufacturing, Catalog No. GP-203).

5.5.2 High voltage bushings shall be equipped with fire resistant, hinged wildlife guards.

5.6 Low Voltage Bushings and Terminals

5.6.1 Transformers shall be equipped with side wall-mounted, low voltage bushings. Units 100 KVA and smaller shall have clamp type terminals in accordance with ANSI C57.12.20, Figure 4a. Units 167 KVA and larger shall have 4-hole square spade type terminals in accordance with ANSI C57.12.20, Figure 4b, Spade H.

5.6.2 Transformers of 100kVA and larger shall have a bracket centered below the secondary bushings for mounting cable supports for the secondary voltage wires.

5.6.3 Number and arrangement of low-voltage terminals shall be in accordance with ANSI C57.12.20, Table 9.

5.6.4 Polymer secondary bushings shall be used for transformers.

5.6.5 120/208Y and 277/480Y transformers shall be used exclusively in banks of three transformers for three phase installations. Transformers shall have two primary and two low voltage bushings. Impedances must be 2.0% and tested within +/- 7.5% per C57.12.00.

5.7 Transformer Tanks

5.7.1 Transformer tanks shall be of welded steel construction. The tank shall be a conventional, oil-filled, pole-type with only one pole-mounting position.

5.7.2 The tank covers shall have a slope of 10-15 percent for moisture run-off and shall have an insulated coating on the cover capable of withstanding a minimum of 10kV at a 2000 volt/second rate of rise, tested per ASTM D149 using ¼" diameter electrodes.

5.7.3 The overall size of the transformer and the weight of the transformers, once filled with oil, shall not exceed the following:

Table 2: Single Phase Pole Mount Transformers – Max Dimensions

Size (KVA)	Weight (lbs.)	Height (in.)*	Width (in.)**	Depth (in.)***
10	275	40	22	24
25	375	41	23	25
37.5	480	42	24	26
50	640	45	25	27
75	875	51	25	27
100	1000	50	32	30
167	1500	54	38	38

* Height shall be measured from bottom of tank to top of primary terminal at top of primary bushing.

** Width shall be measured from lifting hook to lifting hook.

*** Depth shall be measured from mounting bracket to outside of secondary terminal.

5.7.4 Lifting Lugs shall be at least ½ inch thick, with smooth edges, to reduce the wear on lifting straps.

5.7.5 Tanks shall have tank ground provisions and support lugs in accordance with ANSI Standard C57.12.20.

5.8 Grounding Lugs

5.8.1 Transformers shall be furnished with a minimum of 2 ground lugs. One installed in the transformer low-voltage ground provision, and a second on the opposite side of the tank. The ground lugs shall be a Maclean (Catalog No. BVC-207-FT with slim brass jam nut). Installed vertically on pole mount transformers.

5.9 TIF and RIV Requirement

5.9.1 TIF - Transformers shall be designed to meet REA Telephone Influence Factor (TIF) requirements, as detailed in REA Specifications D-10. TIF testing not required. Transformer I-T tests shall be made in accordance with the method described in IEEE Standard No. 469-1977, except as noted in REA Specifications D-10. REA Specification D-10 requires that the average overall I-T of the secondary windings per transformer nameplate KVA shall not exceed the following limits:

I-T per KVA	
120 Volts	132 Volts
22	66

5.9.2 RIV - The Radio Influence Voltage (RIV) shall not (per REA Specification D-10) exceed 100 µV (average measurement) at 1 MHz measured at 110% of rated voltage in accordance with the methods outlined in ASA Publication C63.2, 1950, Appendix A, Figure 5.

6 PAD MOUNT TRANSFORMER – *SINGLE PHASE*

6.1 Ratings

6.1.1 All ratings shall be for 60 Hertz alternating current, oil immersed, self-cooled transformers capable of continuous operation at rated KVA without exceeding either a 65^{O}C average temperature rise or an 80^{O}C hot spot temperature rise.

6.1.2 The electrical characteristics of the completely assembled high and low voltage terminals shall be in accordance with ANSI C57.12.25, Table 1 and Section 6.2.1.

6.1.3 The basic impulse level (BIL) shall be 95 kV.

6.2 Loop Feed

6.2.1 Transformers will be suitable for loop feed.

6.2.2 The minimum current-carrying capabilities of components for looped primary cable systems shall be 200 Amps (continuous) and 10,000 Amps rms symmetrical for 0.17 sec. (short-time current rating) for transformers with or without high-voltage switching.

6.3 Transformer Type

6.3.1 Single Phase Transformers shall be Type 2 in accordance with Figure 2a of ANSI C57.12.25 1990. The same figure is shown in C57.12.38 figure 3, type 2.

6.4 Pressure Relief Device

6.4.1 All transformers shall be designed such that all excessive pressure build-ups are released without damage to the tank in accordance with ANSI C57.12.25.

6.4.2 All transformers shall be equipped with a pressure relief device (Tomco Series 1776K or Qualitrol Model 202-032-1 or District approved equivalent). The threads shall be sealed with pipe dope.

6.5 Transformer Taps

6.5.1 No transformer taps are required.

6.6 High Voltage Bushings

6.6.1 Transformers shall come equipped with two high voltage bushing wells and corresponding load break inserts for dead front application. The bushing wells shall be externally clamped, 200-amp rated, separable, and rated for primary switching per IEEE 386.

6.6.2 The bushings shall conform to ANSI C57.12.25, Type 2 arrangement.

6.6.3 The load-break bushing inserts shall be Eaton-Cooper Power Systems LBI 215 or Elastimold Catalog No. 1601A4.

6.6.4 Inserts shall be shipped with physically wired down & secured dust caps or use a dust cap equipped with a pressure relief hole to prevent pressure build up in the dust cap that would cause loss of the dust cap.

6.7 Low Voltage Bushings

6.7.1 Transformers shall be equipped with fully insulated, low voltage bushings with in-line NEMA standard stud terminals in accordance with Figure 4C of ANSI C57.12.25.

6.7.2 Transformers shall be furnished with the following terminals:

Table 3: Single Phase Padmount – Terminal Size

KVA	Secondary Voltage	Terminal Size
25-75	240/120	Stud, 5/8” – 11 UNC-2A
100 – 167	240/120	Stud, 1” – 14 UNC-2A

6.8 Grounding Lugs

6.8.1 Transformers shall be furnished with a minimum of 3 grounding lugs installed in the transformer high-voltage cabinet, centered near the bottom of the HV compartment and spaced horizontally 8 inches or more apart. Ground lug shall not be located under the H1A bushing to allow easy access to the lug when cable/elbow is installed.

6.8.2 The ground lugs shall be Maclean (Catalog No. BVC-207-FT) with thin brass jam nut, installed in horizontal position on pad mount transformers.

6.8.3 HOXO bushing shall be a fully insulated bushing with a removable copper ground strap bolted to a ground pad. The strap shall be connected to the bushing between two nuts on the bushing.

6.9 Compartmental Locking

6.9.1 The terminal compartment covers shall be secured with a captive nut and a captive recessed 9/16” stainless steel or silicon bronze Pentahead bolt, and provisions for padlocking. The Pentahead bolt shall be coordinated so that it must be engaged before a padlock can be inserted into or removed from the hasp. All transformers shall meet the requirements for tamper-resistance of NEMA TR-1 and Western Underground Guide No. 2.13.

6.10 Fusing

6.10.1 Transformers shall be provided with Eaton-Cooper Power Systems Bay-O-Net fuse holders. They shall be of the sidewall mount type with flapper, Cat. No. 40003616C99FV.

6.10.2 Transformers shall be provided with Eaton-Cooper Power Systems Bay-O-Net, dual sensing, load break, externally removable fuses, in series with under oil, internally mounted 8.3 kV partial range current limiting fuses (CLF). The partial range fuse shall be manufactured by Eaton-Cooper Power Systems (Type ELSP).

6.10.3 The partial range current limiting fuses 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.

6.10.4 Oil drip shields shall be provided and designed to catch and hold oil. Oil drip shields that redirect oil rather than catch and hold it will not be allowed.

6.10.5 The Bay-O-Net Fuse size and type for each voltage shall be painted on the inside of the primary side cabinet door utilizing yellow characters one (1) inch high. In addition, the bayonet and current limiting fuse part numbers will be displayed on the nameplate. Fuses shall meet the District's current fusing specifications which are shown in the table below.

6.10.6 Dual Voltage Units shall be delivered with fusing according to the lower voltage and include Bay-O-Net fuses for the higher voltage.

Table 4: 7.2 kV Single Phase Transformer Fusing

Stock #	KVA	Bay-O-Net Fuse (Dual Sensing)	Continuous Rating (A)	Current Limiting (ELSP Backup)	ELSP Rating (A)
88888	15	4000358C03M	3	3001861A01M (Isolation Link only)	N/A
88801	25	4000358C05M	8	CBUC08040C100	40
88802	50	4000358C08M	15	CBUC08080C100	80
88803	75	4000358C10M	25	CBUC08125C100	125
88804	100	4000358C10M	25	CBUC08125C100	125
88805	167	4000358C12M	50	CBUC08165D100	165

6.11 Transformer Tanks

6.11.1 Transformer tanks shall be constructed in accordance with ANSI C57.12.25. The primary and secondary bushing compartment shall have a hinged, vertical-swing cover. Both the cover and the tank shall be domed or sloped to prevent moisture collection.

6.11.2 The cover hinge pins and the threaded lifting inserts shall be stainless steel.

6.11.3 Grounding provisions shall consist of at least three grounding lugs, centered near the bottom of the HV compartment of the transformer and spaced horizontally 8 inches or more apart. The tapped holes shall be plugged during painting to prevent coating of the threads.

6.11.4 Drain and fill plugs shall be bronze, cadmium, or stainless steel. No galvanized hardware will be acceptable. Drain and fill plugs will be sealed with pipe dope.

6.11.5 Drain and fill plugs shall be a threaded plug, not a cap, located to minimize interference with anything inside the HV or LV compartments.

6.11.6 The overall maximum transformer size shall be within the following dimensional ranges:

Table 5: Single Phase Transformers - Tank Sizes				
Size (KVA)	**Height (in.)***	**Width (in.)****	**Depth (in.)*****	**Minimum Terminal Compartment Depth (in.)******
25 – 167	36" max.	31" min. 36" max.	40" max	15"
< 25	27" max	26" max	29" max	15"

* Height shall be measured from top of highest point to bottom of unit.

** Width shall be measured from left to right, when facing the lid, across widest part of unit.

*** Depth shall be measured from lid to rear, across deepest part of unit.

**** Depth shall be measured from lid to front of bushing well wall.

7 PAD-MOUNTED TRANSFORMERS – *THREE PHASE*

7.1 Ratings

7.1.1 All ratings shall be for 60 Hertz alternating current, oil immersed, self-cooled transformers capable of continuous operation at rated KVA without exceeding either a 65^{O}C average temperature rise or an 80^{O}C hot spot temperature rise.

7.1.2 The electrical characteristics of the completely assembled high and low voltage terminals shall be in accordance with IEEE C57.12.26, Table 3 and Table 4.

7.1.3 The basic impulse level (BIL) shall be 95 kV for 7.2/12.47Y kV transformers.

7.2 Transformer Type

7.2.1 Three Phase Transformers shall be loop feed construction, in accordance with Figure 2 of IEEE C57.12.26. The same figure is shown in C57.12.34 figure 16.

7.3 Core Construction

7.3.1 The core shall be either triplex or five-legged construction.

7.4 Pressure Relief Device

7.4.1 All transformers shall be designed such that all excessive pressure build-ups are released without damage to the tank in accordance with IEEE C57.12.26.

7.4.2 All transformers shall be equipped with a pressure relief device (Tomco Series 1776K or Qualitrol Model 202-032-1). The threads shall be sealed with pipe dope.

7.5 Transformer Taps and LBOR Switch

7.5.1 No transformer DETC taps are required.

7.5.2 A three-phase two-way hook stick one-man operated LBOR switch is required. The switch shall be load break and load make for energizing and deenergizing. The switch must have a nameplate labeling the open/closed positions. Eaton-Cooper or equivalent switch. LBOR switch not required on 75 kVA mini-pad transformers.

7.6 High Voltage Bushings

7.6.1 Transformers shall come equipped with high voltage bushing wells and corresponding load break inserts for dead front application. The bushing wells shall be externally clamped, 200-amp rated, separable, and rated for primary switching per IEEE 386.

7.6.2 The load-break bushing inserts shall be Eaton-Cooper Power Systems (Catalog No. LBI 215 or Elastimold (Catalog No. 1601A4).

7.6.3 The primary neutral shall be insulated and no H_0 bushing provided on Y-Δ transformers.

7.6.4 Inserts shall be shipped with physically wired down & secured dust caps or use a dust cap equipped with a pressure relief hole to prevent pressure build up in the dust cap that would cause loss of the dust cap.

7.7 Low Voltage Bushings

7.7.1 Transformers shall be equipped with fully insulated, low voltage bushings, in accordance with Fig. 8(a) of IEEE C57.12.26.

7.7.2 Transformers shall be furnished with the following NEMA standard stud or spade terminals as per IEEE C57.12.26 Fig. 9. Terminal connectors and supports shall be provided, and factory installed. Manufacturer recommended grease must be applied between the spade and the connector.

Table 6: Three Phase Padmount Transformers – Terminal Sizes

KVA	Secondary Voltage	Terminal Size	Terminal Connector
75	480Y/277	Stud, 5/8" – 11 UNC – 2A (Fig. 9d)	6 position 350 MCM; CMC NSSM350-6I
75	240, 208Y/120		
150-300	240, 208Y/120	Stud, 1" – 14 UNC – 2A With 6-hole Spade	8 position 500 MCM ZeeBar style; CMC L8D10-5001
150-500	480Y/277		
500	240	Spade, 6 hole - (Fig. 9b)	10 position 750 MCM ZeeBar style; Homac ZBT50557DS
500	208Y/120		
750	240		
750-1500	480Y/277	Spade, 10 hole - (Fig. 9c)	12 position 750 MCM ZeeBar style; Homac ZBT 6067-DS
750-1500	208Y/120		
1000	240		
2000-2500	480Y/277		

7.7.3 All spade pads shall be furnished with additional support, as designed by the manufacturer. The supports shall be attached to the spade/pads at the farthest point from the tank wall and attached in a manner so as to not interfere with the use of any of the pad's holes. The supports shall be insulated, connected to a support at the top of the cabinet. Supports shall be installed by the manufacturer.

7.7.4 Transformers rated 150 kVA and larger shall have supports on the LV bushings or spades, for strength to support secondary conductors.

7.7.5 HOXO bushing shall be a fully insulated bushing with a removable copper ground strap bolted to a ground pad. The strap shall be connected to the bushing between two nuts on the bushing.

7.8 Grounding Lugs

7.8.1 Transformers shall be furnished with a minimum of five ground lugs: three ground lug installed in the transformer low-voltage ground provision and two ground lugs installed in the transformer high-voltage ground provision. Ground lugs shall be at the same height so a rigid ground bar will fit through all three lugs simultaneously.

7.8.2 The ground lugs shall be Maclean (Catalog No. BVC-207-FT) with thin bronze jam nut.

7.8.3 Each compartment's ground lugs shall be installed three inches from the compartment wall, one on each side of the compartment.

7.9 Compartmental Locking

7.9.1 All hinged or removable cabinet access lids or doors shall have a three-point latch and be provided with a 9/16" stainless steel or silicon bronze Pentahead captive bolt locking device and provisions for padlocking. The Pentahead bolt shall be coordinated so that it must be engaged before a padlock can be inserted into or removed from the hasp. All transformers shall meet the requirements for tamper-resistance of NEMA TR-1 and Western Underground Guide No. 2.13.

7.10 Hand Holes

7.10.1 Any bolted-on tank hand holes shall be secured against tampering by some means accessible only from the inside of the air terminal compartment.

7.11 Fusing

7.11.1 Transformers shall be provided with Eaton-Cooper Power Systems Bay-O-Net fuse holders. They shall be of the sidewall mount type with flapper, Cat. No. 40003616C99FV.

7.11.2 Transformers shall be provided with Eaton-Cooper Power Systems Bay-O-Net, dual sensing, load break, externally removable fuses. They shall also be provided with internally mounted partial range current limiting fuses (CLF) manufactured by Eaton-Cooper Power Systems.

7.11.3 The partial range current limiting fuses (type ELSP) 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.

7.11.4 Oil drip shields shall be provided with the Bay-O-Net fuse holder and be designed to catch and hold oil. Oil drip shields that redirect oil rather than catch and hold it will not be allowed.

7.11.5 The Bay-O-Net Fuse size and type for each voltage shall be painted on the inside of the primary side cabinet door utilizing yellow characters one (1) inch high. In addition, the bayonet and current limiting fuse part numbers will be displayed on the nameplate. Fuses shall meet the District's current fusing specifications which are shown in Table 7.

Table 7: 12.47 kV Three Phase Transformer Fusing					
Stock #	Three Phase KVA	Bay-O-Net Fuse (Dual Sensing)	Continuous Ampere Rating	Current Limiting (ELSP Backup)	ELSP Ampere Rating
88843 88845	75	4000358C05M	8	CBUC15030C100	30
88848 88849	150	4000358C08M	15	CBUC15080C100	80
88853 88854	300	4000358C10M	25	CBUC15100C100	100
88857	500	4000358C12M	50	CBUC15150D100	150
88858 88859	750	4000358C14M	65	CBUC15125C100*	250
88861	1000	4000358C14M	65	CBUC15125C100*	250
88862	1500	4038361C04CB	100	CBUC15125C100*	250
88863	2000	4038361C05CB	125	CBUC15125C100*	250
89007	2500	4038361C05CB	125	CBUC15125C100*	250

7.12 Transformer Tanks

7.12.1 Transformer tanks shall be constructed in accordance with IEEE C57.12.26. Bolted on lid design is acceptable if utilizing tamper resistant nuts.

7.12.2 Drain and fill plugs shall be bronze, cadmium, or stainless steel. No galvanized hardware will be acceptable. Drain and fill plugs will be sealed with pipe dope.

7.12.3 Drain and fill plugs shall be a threaded plug, not a cap, located to minimize interference with anything inside the HV or LV compartments.

7.12.4 For all three phase transformers (except 75kVA mini pads), the front cabinet apparatus compartment shall have side panels that open, extend, and lock allowing side entry to termination compartments and less restricted space.

7.12.5 For transformers 300 kVA and larger, Roof sections shall be able to be raised to allow vertical cable pulling and support.

7.13 Oil Drain Valve

7.13.1 Transformers shall come equipped with an oil drain valve installed at the bottom edge in the transformer secondary compartment, ¾" minimum diameter, gate or ball activated, with sampling device.

7.13.2 The threads shall be sealed with pipe dope.

7.14 Labeling

7.14.1 A danger label, complying with ANSI Z535, shall be located on the inside of the transformer and readily visible whenever the first equipment door is open.

7.15 Accessories

7.15.1 In addition to standard accessories, each transformer 1,000 KVA and larger shall be properly equipped with the following gauges mounted in the low voltage compartment.

7.15.1.1 Oil Level Gauge.

7.15.1.2 Dial thermometer with maximum top oil temperature indicator and magnetic reset.

7.15.1.3 Tank Pressure Vacuum Gauge.

7.16 Tank Dimensions

7.16.1 The maximum dimensions of the 3 phase Padmount transformers shall be as shown below. These dimensions do not include cooling fins.

Table 8: Three Phase Transformers – Maximum Dimensions

	75 KVA Mini-Pad	75 to 500 KVA	750 to 2500 KVA
Height	45” max, 40” min	70” max	89” max
Width	45” max, 40” min	72” max, 50” min	88” max
Depth	42” max, 35” min	62” max, 35” min	66” max

7.16.2 Depth of Apparatus Compartment. The minimum depth of the apparatus compartment (except 75KVA mini-pad) shall be 24 inches, as shown in Dimension F of Figure 7 of IEEE Standard C57.12.26 - 1992.

7.16.3 Cooling Fins - Cooling fins shall not extend further than 12 inches beyond the dimensions shown above.

8 TRANSFORMER OIL

8.1 Transformers shall be insulated with new (unused) mineral oil. The oil shall meet the requirements of ANSI C57.12.00, Article 6.6.1 (1), ANSI C57.106 and ASTM 3487 Type II. The transformer nameplate shall indicate that the PCB content of said transformer is less than 1 PPM or at time of manufacture gas chromatographic analysis certified non-detectable PCB. The oil shall be inhibited mineral oil containing 0.2 % by weight DBPC. The nameplate shall show the gallons of oil.

9 NOISE

9.1 Transformer sound levels shall not exceed the values specified in the latest revision of NEMA Publication TR 1-0.11.

10 PAINT FINISH

10.1 The transformer shall have a corrosion resistant finish that shall be capable of meeting the functional specifications or exceed paint requirements of ANSI C57.12.28, latest revision. The outside shall be properly prepared, primed and painted with highly weather resistant finish coat. All transformers shall have the manufacturer’s premium paint system.

10.2 Transformers shall be given a phosphatizing bath, or sand blasted, grit blasted or shot blasted, then primed with epoxy or vinyl primer. Transformers shall have a corrosion resistant finish that shall be capable of meeting the functional specifications or exceed ANSI C57.12.28. The exterior finish coat shall meet or exceed the following: be semi-gloss polymer, free of runs and sags, primed with a primer, no less than 2.0 mils dry thickness and a coat of semi-gloss polymer type enamel paint no less than one (1) mil dry thickness (total measured thickness 3 mils).

10.3 Pole Mounted Transformers – the finish coat shall be semi-gloss sky gray similar in color to ANSI Standard no. 70. The transformer top shall meet or exceed the following: have at least 10 mils of paint. The transformer sides and bottom shall have at least 3 mils of paint. The inside of the transformer shall have at least 3 mils of paint from a point 2 inches below the oil level up to and including the top. Complete painting of the inside is acceptable.

10.4 Pad Mounted Transformers - the finish coat shall be semi-gloss olive-green gray similar to Munsell no. 7GY3.29/1.5. The interior cabinet surfaces shall be primed and finished, with no less than 2.0 mils dry thickness.

11 NAMEPLATES

11.1 Nameplates shall be made of stainless steel or anodized aluminum and permanently marked with essential operating data meeting ANSI standard C57.12.00 for nameplates including city/country of manufacturer, Chelan PUD stock number, and weights of major components. Nameplate and outline drawings must be approved by Chelan PUD engineering prior to transformer manufacturing.

11.2 The transformer nameplate shall specifically state that the transformer is filled with “Mineral Oil” and the number of gallons of oil it contains.

11.3 Nameplate impedance must be the actual tested impedance on all units.

11.4 The nameplate shall indicate that the PCB content of said transformer is less than 1 ppm or that at the time of manufacture gas chromatographic analysis certified non-detectable PCB.

11.5 Each nameplate shall contain a transformer bar code. The bar code label shall meet all requirements of IEEE standard C57.12.35.

11.6 The bayonet and current limiting fuse part numbers will be displayed on the nameplate for all Padmount units.

11.7 Nameplates shall be mechanically fastened with rivets, bolts, or screws. Glue, adhesives, or double-sided tape are not acceptable.

12 INSPECTION

12.1 The purchaser shall, at any reasonable time, be permitted to have a representative visit the Contractor’s factory for the purpose of witnessing manufacture of the transformers to ascertain if the material and process used in the manufacturing conform to the Specifications.

13 TESTS

13.1 Each transformer shall receive complete tests at the factory in accordance with latest ANSI standards. At the option of the district, transformers may be tested for acceptance upon receipt.

13.2 All transformers manufactured under this specification shall be tested for core and winding (copper) losses at 85^{o}C, percent impedance at 85^{o}C, and exciting current (*designed* for 100% voltage and a full wave voltage impulse; impulse testing not required). Actual loss data shall be prepared in accordance with the bid form.

13.3 Vendor shall supply calculations showing a representative design from the factory will pass short circuit criteria per ANSI C57.12.00 and C57.12.90 latest revision.

13.4 Guaranteed losses: the losses submitted by the bidder for bid evaluation shall be considered as guaranteed losses by the district. DOE efficiencies will be calculated from these quoted losses.

13.5 Certified test reports shall be furnished to the district at time of delivery. Invoices must reference serial number of transformer(s), bid item and quoted losses.

14 WORKMANSHIP, MATERIAL, AND FINISH

14.1 All workmanship and material used on the equipment shall be first class, the best of their respective kinds and shall be in full accordance with the most modern manufacturing practices for distribution transformers.

15 DELIVERY METHODS

15.1 Destination

15.1.1 The transformers shall be shipped f.o.b. destination to 203 Olds Station Road, Wenatchee, WA 98801, U.S.A. The delivery will be accepted Monday through Friday between the hours of 9:00 am and 2:00 pm. No delivery of transformers will be accepted on weekends or holidays (New Year's Day, President's Day, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving & day after, and Christmas). Please call the Warehouse Foreman at (509) 661-4893 or (509) 661-4287, at least 24 hours prior to delivery. Transformers must arrive on the same trailer from the factory to Chelan PUD. No moving of transformers from one trailer to another during shipment.

15.2 Methods

15.2.1 All transformers shall be shipped in a covered trailer, preferably on a curtain style trailer. Transformers greater than 6,000 pounds must be shipped on a curtain style trailer because a large forklift will not fit into an enclosed trailer. Single phase transformers can be stacked with prior written approval by Chelan PUD prior to shipment.

15.2.2 Polemount transformers shall be filled with the proper amount of transformer oil and shipped, completely assembled, in an enclosed van on individual pallets.

15.2.3 Three phase Padmount transformers rated up to 300 KVA shall be shipped on individual pallets made with 4" x 4" lumber (or equivalent pallet), one transformer per pallet, and securely attached to the pallets to facilitate handling with forklift and shipped, completely assembled, in an enclosed van.

15.2.4 Padmount transformer rated 500-2500 KVA shall be capable of being unloaded with an overhead crane and must be shipped on flatbed curtain van style trailers to be protected from the elements during shipping. These transformers shall be shipped on individual pallets made with 6" x 6" lumber to allow for large forks to fit under the transformer.

15.2.5 Transformers must be oriented on the truck with the heavy side of the transformer facing the direction that will be picked up by offloading forklift. If shipped in enclosed van, the heavy side of the transformer must be oriented towards the back door of the trailer.

15.2.6 All pallets or mounting timbers the transformers are shipped on must be good quality, to reduce breakage during shipment and storage. Overhead transformers shall be strapped to the pallet. Broken pallets are unacceptable.

15.3 Rejection of Shipment

15.3.1 Transformers exhibiting damaged parts, broken securing devices, or are dirty from lack of proper shipping, shall be cause for rejection of shipment.