REGIONAL PROCUREMENT HUB PROGRAM – REGION 8
SUPPLEMENTAL BID BULLETIN NO. 24-10
FOR THE
PROCUREMENT OF SUPPLY AND DELIVERY OF DISTRIBUTION TRANSFORMERS
(PB-ITB-R8-2-2024)

In accordance with Section 4.3.2 of Annex "B" of the NEA Memorandum No. 2024-06, this Supplemental Bid Bulletin is hereby issued to clarify, modify or amend the following items for PB-ITB-R8-2-2024:

Section/Item No.	Issue in the Bidding Documents / Technical Specifications	Clarification / Amendment
Section V. Terms of Reference		
TOR 6.1 to 6.2 (Detailed Technical Specifications for Items A to J)	With respect to TOR 6.1 and 6.2, **Construction**, *Nameplate,* First Bullet, clarification was sought on whether an Aluminum Nameplate (instead of Stainless Steel) is acceptable for the Distribution Transformers under Items A to J.	An Aluminum Nameplate is acceptable. TOR 6.1 and 6.2, **Construction**, *Nameplate,* First Bullet, are hereby ***amended*** as follows: "The transformer shall be provided with a nameplate in accordance with the latest revision of IEEE Std C57.12.00. The nameplate shall be made of stainless steel or aluminum with the technical information etched on the surface and coated with black enamel."
Section VII. Bid Forms		
Form#10 – Details of Technical Specifications	Bid Form#10 (Details of Technical Specifications) requires revisions for the purpose of consistency with the amendments to Clauses 6.1 and 6.2 of the TOR as provided above.	Bid Form#10 (Details of Technical Specifications) is ***amended*** to be consistent with the revisions to Clauses 6.1 and 6.2 of the TOR. Please see revised Details of Technical Specifications Form attached herein as **Annex "A"**. **Note:** The revised Bid Form#10 attached herein already incorporates the revisions previously made under SBB No. 24-08 for PB-ITB-R8-2-2024.

Issued this **16th day of August 2024** for the guidance and information of all concerned.

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CONFORME:

ATTY. MICHAEL EDWIN S. AMANCIO, CPA, MBM
President
RENAGMEC Power Corporation

Form#10: Details of Technical Specifications

(Letterhead of the Bidder)

Date: _____, 2024

NEA Special Bids and Awards Committee (NEA SBAC)
#57 NEA Building, NIA Road,
Barangay Pinyahan, Government Center Diliman,
Quezon City

Attention: **Engr. Ernesto O. Silvano, Jr.**
Chairperson of the NEA SBAC
for the RPH Program

Subject: Details of Technical Specifications of [Name of Bidder]

Detailed Technical Specifications for: *Items A to E (Transformers, Pole Type, Conventional, 10kVA to 50 kVA, Cu-Cu-Al Winding)*			
Particulars	**Specifications Prescribed in Bidding Documents**	**Statement of Compliance**	**Details of Added Technical Specifications (if any)**
Scope	This Technical Specification covers the single-phase, overhead-type, oil-immersed, self-cooled, silicon steel core, brand new and PCB-Free distribution transformers under Items A to E, with primary voltage rating of 7620/13200 V, and secondary voltage rating of 120/240 V.		
Site and Service Conditions	Transformers conforming to this specification shall be suitable for operation at rated kVA in a tropical environment and under the following service conditions: • Maximum altitude above sea level - 1000 m • Maximum ambient temperature - 40° C • Average ambient temperature - 30° C		

Applicable Standards	All transformers furnished under this specification shall be designed, manufactured and tested to meet or exceed the requirements of the latest revision of the following IEEE, ANSI/IEEE, NEMA and ASTM Standards or equivalent IEC standards: • IEEE Std C57.12.00 - Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers • IEEE Std C57.12.20 - Requirements for Overhead-Type Distribution Transformers, 500 kVA and Smaller; High-voltage, 13200 Volts and Below; Low-voltage, 7970/13800 Y Volts and Below • IEEE Std C57.12.70 - Terminal Markings and Connections for Distribution and Power Transformers • IEEE Std C57.12.90 - Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers and Guide for Short Circuit Testing of Distribution and Power Transformers • ANSI/IEEE Std C57.92 - Guide for Loading Mineral-Oil-Immersed Power Transformers • NEMA Standards Publication No. TR 1 - Transformers, Regulators and Reactors • ASTM D3487 - Specifications for Mineral Insulating Oil Used in Electrical Apparatus		
Environmental Compliance	PCB Free		

<table>
<tr>
<td rowspan="3">Electrical Characteristics</td>
<td><u>Voltage and Rating Taps</u>

• The transformer primary voltage rating shall be specified based on the rating shown in the Table below:

<table>
<tr><th colspan="3">Standard Primary Voltage Ratings of Transformers</th></tr>
<tr><th>Nominal System Voltage(V)[2]</th><th>Primary Voltage Rating(V)[3]</th><th>Secondary Voltage Rating(V)</th></tr>
<tr><td>7620/ 13200</td><td>7620/ 13200</td><td>120/240</td></tr>
</table>

• The transformer shall be provided with a no-load tap changer to provide Two (2) - 2 ½ % tap above and Two (2) - 2½ taps below rated primary voltage. Tap 3 shall be the nominal tap. All tap ratings shall be at rated capacity.</td>
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<tr>
<td><u>Frequency</u>

The transformer shall be designed to operate at 60Hz.</td>
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<td><u>KVA Ratings</u>

The kVA rating shall be continuous and based on not exceeding either a 65°C average winding temperature rise or an 80°C hottest-spot temperature rise above an ambient of 30°C. The temperature rise of the insulating oil shall not exceed 65°C when measured near the top of the tank.</td>
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</table>

Insulation Level

The transformer shall be designed to have coordinated insulation levels at its terminals not less than values specified in the Table below.

Transformer Dielectric Insulation Levels		
Insulation Level	**7620/ 13200 V**	**120/240 V**
Full Wave (BIL) in kV, crest	95	30
Chopped Wave in kV, crest	105	33
Min. time to Flashover in us	1.8	1.0
Applied Voltage Test (kV rms)	-	10
Induced Voltage Test (phase to ground) (kV rms)	17	1.4

Percent Impedance

- Transformers shall have impedance values as specified in the table below. Conformance shall be verified thru test reports to be submitted by the manufacturer.

Standard Primary Voltage Ratings of Transformers		
kVA Range	**% Impedance**	**% Tolerance**
3 thru 50	2.0	±10%

- Difference in impedance between transformers of the same rating, when two or more units are produced by one manufacturer at the same time, shall not exceed 7.5% of the specified value.

Losses

- Transformer losses shall be based on reference temperatures of 30°C for No-Load Losses and 85°C for Load Losses.

- The No-Load Losses and Load Losses of the transformer unit shall not exceed the values specified in Table below.

Transformer Maximum Losses				
Rated Capacity (KVA)	Silicon Steel Core		Total Losses	
	No-Load Losses (w)	Load Losses (w)	(Watts)	(% of Rated kVA)
10	36	120	156	1.56
15	50	195	245	1.63
25	80	290	370	1.48
37.5	105	360	465	1.24
50	135	500	635	1.27

- Actual transformer losses shall not exceed the values guaranteed in the bid by the manufacturer by 10% for No-Load Losses and 6% for Total Losses.

Short Circuit Characteristics

The transformer shall withstand the mechanical and thermal stresses produced by external short-circuit currents specified in IEEE Std C57.12.00, latest revision.

Loading Capability

The transformer shall be guaranteed to have the loading capability in accordance with ANSI/IEEE Std C57.92, latest revision.

<table>
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<td><u>Audible Sound Level</u>

Transformers shall be designed so that the average sound level does not exceed the values specified in the Table below.

<table>
<tr><th colspan="2">Transformer Audible Sound Level Limit</th></tr>
<tr><th>kVA Range</th><th>Average Sound Level (Decibels)</th></tr>
<tr><td>50 and below</td><td>48</td></tr>
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<td>Construction</td>
<td><u>Cooling Class</u>

The cooling method employed for transformers supplied under this specification shall be self-cooled (OA or ONAN).</td>
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<td><u>Core-Coil Assembly</u>

• Transformer core shall be manufactured using low-loss high-permeability grain-oriented silicon steel.

• Transformer Windings shall be of high-conductivity Copper or Aluminum [(Cu-Cu) or (Cu-Al)].

• The core and coil assembly shall be mounted rigidly in the tank. The assembly shall not shill in direction during shipping, handling, installation, or during normal operation due to vibrations.

• The core and coil assembly shall be vacuum processed to ensure maximum penetration of the insulating liquid to the coil insulation system.</td>
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</table>

Primary Bushings

- The transformer shall be furnished at the primary side with optional cover-mounted high-voltage bushing. The number and characteristics of bushing/s are shown in Table below.

Transformer Primary Bushing Number and Characteristics	
High-Voltage Bushing Number and Characteristics	**Transformer Primary Voltage Rating**
	7620/ 13200 V
Number	2
Voltage Class (kV)	15
BIL Withstand (kV, min.)	95
60 Hz Withstand, 1-min dry (kV, min.)	35
60 Hz Withstand, 10-s dry (kV, min.)	30
Minimum Creepage Distance, mm (in)	255(10)

- The high-voltage bushings shall be made from high-grade, wet- process porcelain with the entire exposed surface to be glazed. The color of the bushings shall be Light Gray ANSI 70, Munsell Notation 5BG 7.0/0.4.

- The high-voltage bushing/s shall be designated as HI (for single bushing transformer) or H1 & H2 (for double bushing transformer) and shall be arranged in accordance with the latest revision of IEEE Std C57.12.20.

Secondary Bushings

- The transformer shall be furnished at the secondary side with sidewall-mounted, low-voltage bushings. The number and characteristics of the low-voltage bushings are shown in the Table below.

Transformer Secondary Bushing Number and Characteristics	
Low-Voltage Bushing Number and Characteristics	**Transformer Secondary Voltage Rating**
	120/240 V
Number	3
Voltage Class (kV)	1.2
BIL Withstand (kV, min.)	30
60 Hz Withstand, 1-min dry (kV, min.)	10
60 Hz Withstand, 10-s dry (kV, min.)	6

- The low-voltage bushings shall be made from high-grade, wet- process porcelain with the entire exposed surface to be glazed. The color of the bushings shall be Light Gray ANSI 70, Munsell Notation 5BG 7.0/0.4.

- The low-voltage-bushings shall be designated as Xl, X2 and X3 depending on the transformer secondary voltage rating, and shall be arranged in accordance with the latest revision of IEEE Std C57.12.20.

Bushing Terminals

- The high-voltage bushing and high-voltage neutral bushing shall be equipped with eyebolt-type connectors made from tinned copper alloy material and provided with stainless steel spring washers. The terminal connectors shall accommodate 8 mm2 (AWG No. 8) solid to 30 mm^2 (AWG No. 2) stranded copper conductor. Terminal detail shall be in accordance with the latest revision of IEEE Std C57.12.20.

- The low-voltage bushings shall be equipped with tinned copper alloy, eyebolt-type connectors or tinned spade terminal pads, arranged for vertical

takeoff of cables. Size of terminal openings and cables, and type of spade terminal pads are shown in Table below.

Size of Low-Voltage Terminals and Conductor Range		
Size of Terminal Opening mm(in)	**Size of Conductor that the Terminal Will Accommodate mm^2 (AWG/kcmil)**	**kVA Range for Low-Voltage Rating of:**
		240 V
15.9 (5/8)	14 mm2 (AWG No. 6) solid to 100 mm^2 (AWG No. 4/0) stranded copper conductor	15& below
20.6 (13/16)	30 mm2 (AWG No. 2) solid to 700 mm^2 (350 kcmil) stranded copper conductor	25-50

- Terminal details shall be in accordance with IEEE Std C57.12.20, latest revision.
- Terminal markings shall be in accordance with IEEE Std C57.12.70, latest revision.

Polarity

Transformers supplied under this specification shall have the polarity specified in Table below.

Transformer Polarity	
KVA Range	**Transformer Primary Voltage Rating Primary 7620/ 13200 V**
50 kVA and below	Additive

	Tank • The transformer tank shall be made of steel. It shall be of sealed type construction with a steel cover. The tank cover shall be provided with a reusable gasket. The tank cover shall be grounded to the tank body using a copper strap adequately sized for the short-circuit rating of the transformer. • The tank shall be provided with a tank grounding connector located near the base of the tank. The connector shall be eyebolt-type, made from tinned copper alloy material, and designed to accommodate 8 mm^2 (AWG No. 8) to 30 mm^2 (AWG No. 2) stranded copper conductors. • Standard support lugs shall be provided on-the tank wall for securely mounting the transformer on the pole. The type of support lug to be provided corresponding to the transformer size shall be as shown in IEEE Std C57.12.20, latest revision. • Lifting lugs shall be permanently attached near the top of the transformer tank to allow for a balanced vertical lift. The design of the lifting lugs shall incorporate a safety factor of 5. • Lifting facilities for the core-coil assembly shall be provided. • The tank should have surge arrester mounting for LA adjacent to the high-voltage bushing. It shall consist of two steel pads with a 1/2 inch-13 NC tapped holes 11 mm (0.44 in) deep and located on the side of the tank in line vertically with the high voltage bushing. The arrester mounting provisions shall have centerline-to-centerline spacing as shown in IEEE Std C57.12.20, latest revision. Corrosion-resistant flanged cup shall be installed to protect the threaded opening of the unused arrester mounting pads. • The correct oil level at 25 °C shall be marked inside the tank. • The tank shall be painted with two (2) coats of outdoor type, light gray paint conforming to Munsell Notation 5BG7.0/0.4, AN SI70 Gray, over a suitable prime coat.		

	Tank Markings • Transformer kVA rating shall be painted in black using 3-inch block letters and numerals. The location of the kVA marking shall be below the low-voltage bushings.		
	Tap Changer • The transformer shall be provided with a tap changer designed for de-energized operation only. The tap changer shall be provided with an external operating handle mounted on the tank wall that can be rotated in a clockwise direction from a high tap voltage to low tap voltage. It shall be provided with stops when rotating from the highest to the lowest tap positions and shall be designed to prevent accidental operation by requiring a preliminary step before the tap setting can be changed. A caution: "DO NOT OPERATE WHEN ENERGIZED" shall be marked near the tap changer operating handle, clearly visible to the operator. • Tap positions are painted and caution markings are marked with reflectorized, non-weathering decals at least 25 mm (1.0 inch) high. The numeral "1" shall be assigned to the highest tap.		
	Pressure Relief Valve • The transformer shall be provided with a pressure relief valve located on the tank above the expected 140 °C top-oil level to be determined by the manufacturer. • The pressure relief valve shall be provided with a pull ring which when pulled using a standard hot-stick, will vent out pressure to atmospheric level. It shall be capable of withstanding a static pull force of 11.34 kg (25 pounds) for one minute without permanent deformation. • The venting port on the outward side of the valve-head seat shall be protected from entry of dust, moisture, and insects before and after any		

	valve operation. An indicating device shall he provided to warn an observer on the ground that the pressure relief valve has operated. • The venting and sealing characteristic of the valve shall be as follows: a) Venting pressure: 69 kPa (10 psig) ± 13 kPa (gauge) (2 psig); b) Resealing pressure: 42 kPa (gauge) (6 psig) minimum; c) Zero leakage from reseal pressure to minus 56 kPa (gauge) (8 psig) d) Flow at 103 kPa (gauge) (15 psig) = 16.5 L/s (35 SCFM) minimum, corrected for air pressure of 101 kPa (14.7 psi) (absolute) and air temperature of 21°C.		
	Enclosure Integrity • The completely assembled transformer enclosure shall be of sufficient strength to withstand an internal pressure of 49 kPa (gauge) (7 psig) without permanent distortion to the enclosure. • The enclosure shall also be of sufficient strength to withstand an internal pressure of 138 kPa (gauge) (20 psig) without rupturing or displacing components (excluding the cover gasket and gasket oil leaks) of the transformer.		
	Insulating Liquid The transformer shall be filled with unused mineral oil meeting the requirements of the latest revision of ASTM D3487 (Specification for Mineral Insulating Oil Used in Electrical Apparatus).		
	Hardware All energized hardware, i.e., bolts, nuts and washers, shall be made of tinned copper alloy material such as silicon bronze or equivalent. All other hardware shall be hot-dip galvanized.		

	Nameplate • The transformer shall be provided with a nameplate in accordance with the latest revision of IEEE Std C57.12.00. The nameplate shall be made of stainless steel or aluminum with the technical information etched on the surface and coated with black enamel. • The following minimum information shall appear on the nameplate: a) Serial number; b) Class; c) Number of phases; d) Frequency e) Voltage rating f) kVA rating g) Temperature rise, °C h) Polarity; i) Percent Impedance; j) BIL; k) Total weight, kg; l) Connection diagram; m) Name of manufacturer; n) Installation and operating instructions reference; o) The word "Transformer"; p) Type of insulating liquid (generic); q) Conductor material for each winding; r) Equipment identification number.		

Tests	*Routine Tests* Each transformer shall be subjected to the following routine production tests in accordance with procedures specified in IEEE Std C57.12.00 and IEEE Std C57.12.90, latest revisions: a) Winding resistance measurement tests; b) Ratio Test; c) Polarity test and Phase Relation; d) No-Load Losses and Excitation Current at rated voltage and frequency; e) Impedance voltage and Load loss measurement; f) Induced Potential Test (Low-Frequency Dielectric Test) g) Mechanical (Leak Test) The manufacturer shall conduct the Routine and Design Tests to verify that the Distribution Transformers comply with the requirements of this standard. The Member ECs reserve the right to witness the Routine and Design Tests. and the Supplier shall notify the Member ECs **fifteen (15) days** before each test is to be conducted. The Supplier is required to furnish the Member ECs with copies of all test reports.		
	Design Tests Copies of certified test reports from a reputable, internationally-accepted testing facility shall be submitted as proof of meeting the requirements in the following design tests: a) Temperature Rise; b) Lightning Impulse; c) Insulation Power Factor; d) Insulation Resistance.		

Detailed Technical Specifications for: *Items F to J (Transformer, Pole Type, Conventional, Amorphous, 10 kVA to 50 kVA, Cu-Cu-Al Winding)*			
Particulars	**Specifications Prescribed in Bidding Documents**	**Statement of Compliance**	**Details of Added Technical Specifications (if any)**
Scope	This Technical Specification covers the single-phase, overhead-type, oil-immersed, self-cooled, amorphous core, brand new and PCB-Free distribution transformers under Items F to J, with primary voltage rating of 7620/13200 V, and secondary voltage rating of 120/240 V.		
Site and Service Conditions	Transformers conforming to this specification shall be suitable for operation at rated kVA in a tropical environment and under the following service conditions: • Maximum altitude above sea level - 1000 m • Maximum ambient temperature - 40° C • Average ambient temperature - 30° C		
Applicable Standards	All transformers furnished under this specification shall be designed, manufactured and tested to meet or exceed the requirements of the latest revision of the following IEEE, ANSI/IEEE, NEMA and ASTM Standards or equivalent IEC standards: • IEEE Std C57.12.00 - Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers • IEEE Std C57.12.20 - Requirements for Overhead-Type Distribution Transformers, 500 kVA and Smaller; High-voltage, 13200 Volts and Below; Low-voltage, 7970/13800 Y Volts and Below • IEEE Std C57.12.70 - Terminal Markings and Connections for Distribution and Power Transformers • IEEE Std C57.12.90 - Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers		

<table>
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<td>and Guide for Short Circuit Testing of Distribution and Power Transformers

• ANSI/IEEE Std C57.92 - Guide for Loading Mineral-Oil-Immersed Power Transformers

• NEMA Standards Publication No. TR 1 - Transformers, Regulators and Reactors

• ASTM D3487 - Specifications for Mineral Insulating Oil Used in Electrical Apparatus</td>
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<td>Electrical Characteristics</td>
<td><u>Voltage and Rating Taps</u>

• The transformer primary voltage rating shall be specified based on the rating shown in the Table below:

<table>
<tr><th colspan="3">Standard Primary Voltage Ratings of Transformers</th></tr>
<tr><th>Nominal System Voltage(V)[2]</th><th>Primary Voltage Rating(V)[3]</th><th>Secondary Voltage Rating(V)</th></tr>
<tr><td>7620/ 13200</td><td>7620/ 13200</td><td>120/240</td></tr>
</table>

• The transformer shall have a no-load tap changer to provide two (2) - 2 ½ % tap above and two (2) - 2½ taps below the rated primary voltage. Tap 3 shall be set as the nominal tap for the secondary voltage. All tap ratings shall be at rated capacity.</td>
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Frequency

The transformer shall be designed to operate at 60Hz.

KVA Ratings

The kVA rating shall be continuous and based on not exceeding either a 65°C average winding temperature rise or an 80°C hottest-spot temperature rise above an ambient of 30°C. The temperature rise of the insulating oil shall not exceed 65°C when measured near the top of the tank.

Insulation Level

The transformer shall be designed to have coordinated insulation levels at its terminals not less than values specified in the Table below.

Transformer Dielectric Insulation Levels		
Insulation Level	**7620/ 13200 V**	**120/240 V**
Full Wave (BIL) in kV, crest	95	30
Chopped Wave in kV, crest	105	33
Min. time to Flashover in us	1.8	1.0
Applied Voltage Test (kV rms)	-	10
Induced Voltage Test (phase to ground) (kV rms)	17	1.4

Percent Impedance

- Transformers shall have impedance values as specified in the table below. Conformance shall be verified thru test reports to be submitted by the manufacturer.

Standard Primary Voltage Ratings of Transformers		
kVA Range	**% Impedance**	**% Tolerance**
3 thru 50	2.0	±10%

- Difference in impedance between transformers of the same rating, when two or more units are produced by one manufacturer at the same time, shall not exceed 7.5% of the specified value.

Losses

- Transformer losses shall be based on reference temperatures of 30°C for No-Load Losses and 85°C for Load Losses.

- The No-Load Losses and Load Losses of the transformer unit shall not exceed the values specified in Table below.

Transformer Maximum Losses				
kVA Rating	**No-Load Loss (w)**	**Load Loss (w)**	**Total Losses**	
			Watts	**% of rate kVA**
10	12	120	132	1.32
15	15	195	210	1.40
25	18	290	308	1.23
37.5	30	360	390	1.04
50	32	500	532	1.06

- Actual transformer losses shall not exceed the values guaranteed in the bid by the manufacturer by 10% for No-Load Losses and 6% for Total Losses.

Short Circuit Characteristics

The transformer shall withstand the mechanical and thermal stresses produced by external short-circuit currents specified in IEEE Std C57.12.00, latest revision.

Loading Capability

The transformer shall be guaranteed to have the loading capability in accordance with ANSI/IEEE Std C57.92, latest revision.

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<td><u>Audible Sound Level</u>

Transformers shall be designed so that the average sound level does not exceed the values specified in the Table below.

<table>
<tr><th colspan="2">Transformer Audible Sound Level Limit</th></tr>
<tr><th>kVA Range</th><th>Average Sound Level (Decibels)</th></tr>
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<tr>
<td>Construction</td>
<td><u>Cooling Class</u>

The cooling method employed for transformers supplied under this specification shall be self-cooled (OA or ONAN).</td>
<td></td>
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<td></td>
<td><u>Core-Coil Assembly</u>

• Transformer core shall be manufactured using amorphous metal core.

• Transformer Windings shall be of high-conductivity Copper or Aluminum [(Cu-Cu) or (Cu-Al)].

• The core and coil assembly shall be mounted rigidly in the tank. The assembly shall not shill in direction during shipping, handling, installation, or during normal operation due to vibrations.

• The core and coil assembly shall be vacuum processed to ensure maximum penetration of the insulating liquid to the coil insulation system.</td>
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</table>

Primary Bushings

- The transformer shall be furnished at the primary side with optional cover-mounted high-voltage bushing. The number and characteristics of bushing/s are shown in Table below.

Transformer Primary Bushing Number and Characteristics	
High-Voltage Bushing Number and Characteristics	**Transformer Primary Voltage Rating**
	7620/ 13200 V
Number	2
Voltage Class (kV)	15
BIL Withstand (kV, min.)	95
60 Hz Withstand, 1-min dry (kV, min.)	35
60 Hz Withstand, 10-s dry (kV, min.)	30
Minimum Creepage Distance, mm (in)	255(10)

- The high-voltage bushings shall be made from high-grade, wet- process porcelain with the entire exposed surface to be glazed. The color of the bushings shall be Light Gray ANSI 70, Munsell Notation 5BG 7.0/0.4.

- The high-voltage bushing/s shall be designated as HI (for single bushing transformer) or H1 & H2 (for double bushing transformer) and shall be arranged in accordance with the latest revision of IEEE Std C57.12.20.

Secondary Bushings

- The transformer shall be furnished at the secondary side with sidewall-mounted, low-voltage bushings. The number and characteristics of the low-voltage bushings are shown in the Table below.

Transformer Secondary Bushing Number and Characteristics	
Low-Voltage Bushing Number and Characteristics	**Transformer Secondary Voltage Rating**
	240 V
Number	3
Voltage Class (kV)	1.2
BIL Withstand (kV, min.)	30
60 Hz Withstand, 1-min dry (kV, min.)	10
60 Hz Withstand, 10-s dry (kV, min.)	6

- The low-voltage bushings shall be made from high-grade, wet- process porcelain with the entire exposed surface to be glazed. The color of the bushings shall be Light Gray ANSI 70, Munsell Notation 5BG 7.0/0.4.

- The low-voltage-bushings shall be designated as Xl, X2 and X3 depending on the transformer secondary voltage rating, and shall be arranged in accordance with the latest revision of IEEE Std C57.12.20.

Bushing Terminals

- The high-voltage bushing and high-voltage neutral bushing shall be equipped with eyebolt-type connectors made from tinned copper-alloy material and provided with stainless steel spring washers. The terminal connectors shall accommodate 8 mm^2 (AWG No. 8) solid to 30 mm^2 (AWG No. 2) stranded copper conductor. Terminal detail shall be in accordance with the latest revision of IEEE Std C57.12.20.

- The low-voltage bushings shall be equipped with tinned copper alloy, eyebolt-type connectors or tinned spade terminal pads, arranged for vertical takeoff of cables. Size of terminal openings and cables, and type of spade terminal pads are shown in Table below.

Size of Low-Voltage Terminals and Conductor Range		
Size of Terminal Opening mm(in)	**Size of Conductor that the Terminal Will Accommodate mm^2 (AWG/kcmil)**	**kVA Range for Low-Voltage Rating of:**
		240 V
15.9 (5/8)	14 mm^2 (AWG No. 6) solid to 100 mm^2 (AWG No. 4/0) stranded copper conductor	15& below
20.6 (13/16)	30 mm^2 (AWG No. 2) solid to 700 mm^2 (350 kcmil) stranded copper conductor	25-50

- Terminal details shall be in accordance with IEEE Std C57.12.20, latest revision.

- Terminal markings shall be in accordance with IEEE Std C57.12.70, latest revision.

Polarity

Transformers supplied under this specification shall have the polarity specified in Table below.

Transformer Polarity	
KVA Range	**Transformer Primary Voltage Rating Primary 7620/ 13200 V**
50 kVA and below	Additive

	Tank • The transformer tank shall be made of steel. It shall be of sealed-type construction with a steel cover. The tank cover shall be provided with a reusable gasket. The tank cover shall be grounded to the tank body using a copper strap adequately sized for the short-circuit rating of the transformer. • The tank shall be provided with a tank grounding connector located near the base of the tank. The connector shall be eyebolt-type, made from tinned copper alloy material, and designed to accommodate 8 mm^2 (AWG No. 8) to 30 mm^2 (AWG No. 2) stranded copper conductors. • Standard support lugs shall be provided on-the tank wall for securely mounting the transformer on the pole. The type of support lug to be provided corresponding to the transformer size shall be as shown in IEEE Std C57.12.20, latest revision. • Lifting lugs shall be permanently attached near the top of the transformer tank to allow for a balanced vertical lift. The design of the lifting lugs shall incorporate a safety factor of 5. • Lifting facilities for the core-coil assembly shall be provided. • The tank should have surge arrester mounting for LA adjacent to the high-voltage bushing. It shall consist of two steel pads with a 1/2 inch-13 NC tapped holes 11 mm (0.44 in) deep and located on the side of the tank in line vertically with the high voltage bushing. The arrester mounting provisions shall have centerline-to-centerline spacing as shown in IEEE Std C57.12.20, latest revision. Corrosion-resistant flanged cup shall be installed to protect the threaded opening of the unused arrester mounting pads. • The correct oil level at 25 °C shall be marked inside the tank. • The tank shall be painted with two (2) coats of outdoor type, light gray paint conforming to Munsell Notation 5BG7.0/0.4, ANSI70 Gray, over a suitable prime coat.		

	Tank Markings • Transformer kVA rating shall be painted in black using 3-inch block letters and numerals. The location of the kVA marking shall be below the low-voltage bushings.		
	Tap Changer • The transformer shall be provided with a tap changer designed for de-energized operation only. The tap changer shall be provided with an external operating handle mounted on the tank wall that can be rotated in a clockwise direction from a high tap voltage to low tap voltage. It shall be provided with stops when rotating from the highest to the lowest tap positions and shall be designed to prevent accidental operation by requiring a preliminary step before the tap setting can be changed. A caution: "DO NOT OPERATE WHEN ENERGIZED" shall be marked near the tap changer operating handle, clearly visible to the operator. • Tap positions are painted and caution markings are marked with reflectorized, non-weathering decals at least 25 mm (1.0 inch) high. The numeral "1" shall be assigned to the highest tap.		
	Pressure Relief Valves • The transformer shall be provided with a pressure relief valve located on the tank above the expected 140 °C top-oil level to be determined by the manufacturer. • The pressure relief valve shall be provided with a pull ring which when pulled using a standard hot-stick, will vent out pressure to atmospheric level. It shall be capable of withstanding a static pull force of 11.34 kg (25 pounds) for one minute without permanent deformation. • The venting port on the outward side of the valve-head seat shall be protected from entry of dust, moisture, and insects before and after any		

	valve operation. An indicating device shall he provided to warn an observer on the ground that the pressure relief valve has operated. • The venting and sealing characteristic of the valve shall be as follows: a) Venting pressure: 69 kPa (10 psig) ± 13 kPa (gauge) (2 psig); b) Resealing pressure: 42 kPa (gauge) (6 psig) minimum; c) Zero leakage from reseal pressure to minus 56 kPa (gauge) (8 psig) d) Flow at 103 kPa (gauge) (15 psig) = 16.5 L/s (35 SCFM) minimum, corrected for air pressure of 101 kPa (14.7 psi) (absolute) and air temperature of 21°C.		
	Enclosure Integrity • The completely assembled transformer enclosure shall be of sufficient strength to withstand an internal pressure of 49 kPa (gauge) (7 psig) without permanent distortion to the enclosure. The enclosure shall also be of sufficient strength to withstand an internal pressure of 138 kPa (gauge) (20 psig) without rupturing or displacing components (excluding the cover gasket and gasket oil leaks) of the transformer.		
	Insulating Liquid The transformer shall be filled with unused mineral oil meeting the requirements of the latest revision of ASTM D3487 (Specification for Mineral Insulating Oil Used in Electrical Apparatus).		
	Hardware All energized hardware, i.e., bolts, nuts and washers, shall be made of tinned copper alloy material such as silicon bronze or equivalent. All other hardware shall be hot-dip galvanized.		

	Nameplate • The transformer shall be provided with a nameplate in accordance with the latest revision of IEEE Std C57.12.00. The nameplate shall be made of stainless steel or aluminum with the technical information etched on the surface and coated with black enamel. • The following minimum information shall appear on the nameplate: a) Serial number; b) Class; c) Number of phases; d) Frequency e) Voltage rating f) kVA rating g) Temperature rise, °C h) Polarity; i) Percent Impedance; j) BIL; k) Total weight, kg; l) Connection diagram; m) Name of manufacturer; n) Installation and operating instructions reference; o) The word "Transformer"; p) Type of insulating liquid (generic); q) Conductor material for each winding; r) Equipment identification number.		

Tests	*Routine Tests* Each transformer shall be subjected to the following routine production tests in accordance with procedures specified in IEEE Std C57.12.00 and IEEE Std C57.12.90, latest revisions: a) Winding resistance measurement tests; b) Ratio Test; c) Polarity test and Phase Relation; d) No-Load Losses and Excitation Current at rated voltage and frequency; e) Impedance voltage and Load loss measurement; f) Induced Potential Test (Low-Frequency Dielectric Test) g) Mechanical (Leak Test) The manufacturer shall conduct the Routine and Design Tests to verify that the Distribution Transformers comply with the requirements of this standard. The Member ECs reserve the right to witness the Routine and Design Tests. and the Supplier shall notify the Member ECs **fifteen (15) days** before each test is to be conducted. The Supplier is required to furnish the Member ECs with copies of all test reports.		
	Design Tests Copies of certified test reports from a reputable, internationally-accepted testing facility shall be submitted as proof of meeting the requirements in the following design tests: a) Temperature Rise; b) Lightning Impulse; c) Insulation Power Factor; d) Insulation Resistance.		

Company Name:

_____[Name of Bidder]_____

Authorized Representative:

_____[Name and Signature of Authorized Representative]_____

Contact Details:

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