

**TECHNICAL SPECIFICATIONS OF THREE PHASE 11/0.433-0.250KV, STAR 1 (LEVEL-1),  
800KVA, 1000 KVA & 1250KVA WITH CRGO CORE.**

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**1.0 SCOPE:**

- 1.1. As per the Electrical Transformer (Quality Control) Order, 2014, it is mandatory that No Electrical Transformers shall be manufacture or store for sale, sell or distribute which do not confirm to the specified standard and do not bear standard Mark of the Bureau. Moreover, as per the Guidelines of Bureau of Energy Efficiency (BEE), labeling of distribution transformer is mandatory & cannot be sold in the market without star label. Accordingly, the bidder shall have to submit valid BIS license of the quoted item or higher as per approved scheme of BIS and star rating certificate from BEE for 800, 1000 and 1250KVA Transformers.
- 1.2. This specification covers, engineering, manufacture, assembly, stage testing, and inspection and testing before supply and delivery at site of mineral oil-immersed, natural air-cooled, outdoor type, double-wound, CRGO stack core; non-sealed type, 3 phase 11/0.433 kV, Energy Efficiency Level -1 (As per IS 1180-1+4 amendment), having rating of 800, 1000 and 1250 kVA Distribution Transformers for 11 kV, 50 Hz power distribution systems.
- 1.3. It is not the intent to specify completely herein all the details of the design and construction of equipment. However the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation up to the Bidder's guarantee, in a manner acceptable to the purchaser, who will interpret the meanings of drawings and specification and shall have the power to reject/accept any work or material which, in his judgment is there or not in accordance therewith. The offered equipment shall be complete with all components necessary for their effective and trouble free operation. Such, components shall be deemed to be within the scope of Bidder's supply irrespective of whether those are specifically brought out in this specification and / or the commercial order or not.
- 1.4. The transformer and accessories shall be designed to facilitate operation, inspection, maintenance and repairs. The design shall incorporate every precaution and provision for the safety of equipment as well as staff engaged in operation and maintenance of equipment.
- 1.5. All outdoor apparatus, including bushing insulators with their mountings, shall be designed so as to avoid any accumulation of water.
- 1.6. The Standard Ratings shall be 800 KVA, 1000 KVA, and 1250 KVA.

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## 2.0 STANDARDS:

The materials shall conform in all respects to the relevant Indian / International Standard Specification, with latest amendments thereof, some of them are listed below:

Indian Standard	Title	International & Internationally recognized standard
IS – 1180 / Part-I/ 2014 with latest amendments	Outdoor/Indoor type Oil immersed distribution Transformer up to and including 2500 kVA, 33KV Specifications Mineral Oil Immersed	
IS - 16585:2016	Magnetic materials - specifications for individual materials - Fe based amorphous strip delivered in the semi processed state	
IS 5484	Specifications for Aluminum wire rods	ASTM B-233
IS 649	Testing of Steel sheet and strips for magnetic circuits	
IS 191: 2007	Copper specifications	
IS 335 : 2018	New insulating oils	BS 148, D-1473, D-1533- 1934 IEC Pub 296-1969
IS 554 : 1999	Pipe threads where pressure-tight joints are made on the threads — Dimensions, tolerances and designation	
IS 1576 : 1992	Solid pressboard for electrical purpose	IEC 641
IS 1608 : 2005	Mechanical testing of metals — Tensile testing	
IS 1747 : 1972	Nitrogen	
IS 1885 (Part 38):1993	Electro technical vocabulary: Part 38 Power transformers and reactors	
IS 1897 : 2008	Copper strip for electrical purpose	
2026	Power transformers :	IEC 76
(Part 1) : 2011	General	
(Part 2) : 2010	Temperature rise	
(Part 3) : 2009	Insulation levels, dielectric tests and external clearances in air	
(Part 5) : 2011	Ability to withstand short circuit	
(Part 8) : 2009	Application guide	
(Part 10) : 2009	Determination of sound levels	
IS/IEC 60137	Bushings for alternative voltages above 1000 volts	
IS 3024 : 2015	Grain oriented electrical steel sheets and strips	
IS 3347	Dimensions for porcelain transformer bushings for use in lightly polluted atmospheres	DIN 42531,23,3

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(Part 1/Sec 1) : 1979	Up to and including 1 kV, Section 1 Porcelain parts	
(Part 1/Sec 2) : 1979	Up to and including 1 kV, Section 2 Metal parts	
(Part 2/Sec 1) : 1979	3.6 kV Bushings, Section 1 Porcelain parts	
(Part 2/Sec 2) : 1979	3.6 kV Bushings, Section 2 Metal parts	
(Part 3/Sec 1) : 1988	17.5 kV Bushings, Section 1 Porcelain parts	
(Part 3/Sec 2) : 1988	17.5 kV Bushings, Section 2 Metal parts	
IS 8603:2008	Dimensions for porcelain transformer bushings for use in heavily polluted atmospheres,12/17.5 KV,24 KV and 36 KV	
IS 5/1961	Specification for colors for ready mixed paints.	
IS 2026 (Part 7)	Guide for loading of oil Immersed Transformers	IEC 76
IS-10028	Installation, Maintenance of Transformers	
IS-4257	Dimension for clamping arrangement for bushings (for porcelain and metal parts)	
IS- 6160	Rectangular conductors for electrical machine	
IS- 3401	Silica gel	
IS-1866	Code of practice for maintenance & supervision of Mineral insulating oil in equipment	
IS 3639 : 1966	Fittings and accessories for power transformers	
IS 4253 (Part 2) : 2008	Cork composition sheet: Part 2 Cork and rubber	
IS 6162	Paper-covered aluminum conductors	
(Part 1) : 1971	Round conductors	
(Part 2) : 1971	Rectangular conductors	
IS 7404 (Part1) : 1991	Paper covered copper conductors: Part 1 Round conductors	
IS 7421 : 1988	Porcelain bushings for alternating voltages up to and including 1 000 V	
IS 8999 : 2003	Pipe threads where pressure tight joints are made on the threads — Verification by means of limit gauges	
IS 9335(Part 1) : 1979	Cellulosic papers for electrical purposes: Definitions and general requirements	IEC 554
(Part 2) : 1998	Methods of test	
(Part 3/Sec 1) : 1984	Specifications for individual materials, Section 1 General purposes electrical paper	
(Part 3/ Sec 3):1984	Specifications for individual materials, Section 3 Crepe paper	
(Part 3/ Sec 5) : 1985	Specifications for individual materials, Section 5 Special papers	
IS 11149 : 1984	Specification for rubber gaskets	
IS 12444 : 1988	Continuously cast and rolled electrolytic copper wire rods for electrical Conductors	ASTM B-49

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IS 13730	Specification for particular types of winding wires:	
(Part 0/ Sec 1) : 2012	General requirements Section 1, Enameled round copper wire	
(Part 0/ Sec 2) : 2011	General requirements Section 2, Enameled rectangular copper wire	
(Part 0/ Sec 3) : 2012	General requirements Section 3, Enameled round aluminium wire	
(Part 17) : 1996	Polyvinyl acetaleenamelled rectangular copper wire, Class 105	
(Part 27) : 1996	Paper covered rectangular copper wire	
IS/IEC 60947-2:2003 (Part-2)	Low voltage switchgear and control-gear - Circuit breakers	
16081 : 2013	Insulating liquids — Specification for unused synthetic organic esters for electrical purposes	
IS - 5561	Electrical power connector	
IS - 6103	Testing of specific resistance of electrical insulating liquids	
IS - 6262	Method of test for power factor and dielectric constant of electrical insulating liquids	
IS - 6792	Determination of electrical strength of insulating oil	
IS-10333:2004	Epoxy resin systems for cast resin insulated power and control cable joints and terminations up to and including 11 kV	
IS 3637 :1996	Gas operated relays (for Buchholz Relay)	

Material conforming to other internationally accepted standards, which ensure equal or higher quality than the standards mentioned above, would also be acceptable. In case the Bidders who wish to offer material conforming to the other standards, salient points of difference between the standards adopted and the specific standards shall be clearly brought out in relevant schedule. Four copies of such standards with authentic English translations shall be furnished along with the offer.

In case of conflict arising out due to variations between the applicable standard and standard specified herein the provisions of this specification should prevail.

### 3.0 SYSTEM DETAILS:

#### 3.1. SYSTEM PARTICULARS/DISTRIBUTION NETWORK PARAMETERS:

<b>Network</b>	3Phase-3wire
<b>Nominal System Voltage HV</b>	11 KV
<b>Corresponding Maximum System Voltage</b>	12 kV
<b>Rated system voltage (LV) : P-P and P-N</b>	433-250 Volts
<b>No of phases</b>	Three
<b>System Frequency</b>	50 Hz $\pm$ 3%

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<b>Neutral earthing</b>	Solidly Grounded
<b>Method of earthing</b>	Effectively earthed
<b>Fault Level (Minimum) for HV Network</b>	20 KA For 3 sec.

3.1.1. The distribution transformers shall be installed at outdoor locations on 11 kV distribution networks. The distribution network shall consist of either underground OR overhead system. The HV winding shall be connected with HT SFU/VCB/VCB of the ring main unit/ DO Fuse through 11kV (E) XLPE/PILC/AB cable/ bare conductor, etc. LV winding shall be connected to LV distribution box/switch type fuse section pillar through either single core OR 3.5 core LT PVC/XLPE Cable of 1.1 kV voltage rating of suitable size or through suitable size of Aluminum conductor.

3.1.2. The transformers shall be suitable for outdoor installation with 3 phase 50 Hz, 11 KV systems in which the neutral is effectively earthed and they should be suitable for service under fluctuations in supply voltage as permissible under Indian Electricity Rules.

### 3.2. ATMOSPHERIC PARTICULARS:

The Distribution Transformers to be supplied against this specification shall be suitable for satisfactory continuous operation under the following climatic conditions as per IS 2026 (Part- I) Latest Revision.

Sr. No	Parameters	Values
1.	Location	At various locations in the state of Gujarat
2.	Max ambient air temperature (Degree C)	50
3.	Min. ambient air temperature (Degree C)	(-5)
4.	Max average daily ambient air temperature (Degree C)	45
5.	Max. yearly weighed average ambient temperature (Degree C)	40
6.	Max. altitude above mean sea level (meter)	1000
7.	Maximum relative humidity (%age)	0 to 100%
8.	Average thunder storms (days/ Annum)	15
9.	Average rainy days (days/ Annum)	90
10.	Average annual rain fall (mm)	800/ 900 mm
11.	Number of months of tropical monsoon (months)	3 Months

The equipment shall be for use in moderately hot and humid tropical climate, conducive to rust and fungus growth.

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#### 4.0 PRINCIPAL PARAMETERS:

Sr.No.	Item	Values		
		1	Continuous Rated Capacity (kVA)	800
2	Line current HV (Amps)	41.99	52.48	65.61
3	Line current LV (Amps)	1066.7	1333.3	1666.71
4	No. of Phases	Three		
5	Connection HV	Delta		
6	Connection LV	Star (Neutral brought out)		
7	Vector group	Dyn-11		
8	Type of cooling	ONAN		
9	Tap changing arrangement	-5 % to +10% in steps of 2.5 %		
10	Noise level at rated voltage and frequency	58 db	58 db	60 db
11	Permissible temperature rise over ambient temperature			
11.1	Of top oil measured by thermometer	40° C		
11.2	Of winding measured by resistance	45° C		
12	Minimum clearances in air of bushing terminals with connectors fitted in mm.			
12.1	HV Phase to Phase	255		
12.2	HV Phase to Earth	205		
12.3	LV Phase to Phase	75		
12.4	LV Phase/Neutral to Earth	55		
13	BIL in kV (Minimum)	95		

#### 5.0 TECHNICAL REQUIREMENTS :

##### 5.1. CRGO CORE:

5.1.1. Transformer core shall be stacked core type construction using new and high quality CRGO core with heat resistant insulating coating. Stampings/ laminations/ cores of transformers (with winding/ without winding) shall be made from BIS Standard marked Grain Oriented Electrical Steel Sheet and strip conforming to IS 3024:2015. The core shall be of NEW/Fresh high grade cold rolled grain oriented annealed lamination core having low loss and good grain properties, coated with hot oil proof insulation, bolted together

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and to the frames firmly to prevent vibration or noise. The complete design of core must ensure permanency of the core losses with continuous working of the transformers. The core shall be stress relieved by annealing under inert atmosphere if required. The value of the maximum flux density allowed in the design and grade of lamination used shall be clearly stated in the offer.

5.1.2. The bidder shall provide saturation curve and watt/KG curve of core material and shall also require to submit all necessary documents for utilization of prime material and laminations of same grade should be utilized.

5.1.3. The transformers shall be of CRGO stack core type only.

5.1.4. CORE CLAMPING:

- a) M.S. core clamps shall be painted with hot oil-resistant paint.
- b) MS channel of minimum size of 150x75x8 mm shall be used on top and bottom.
- c) Core Channel on LV side to be reinforced at equidistance, if holes / cutting is done for LT lead in order to avoid bending of channel.
- d) Clamping and Tie-rods shall be made from HT Bright Bars steel & shall be painted with hot oil resistant paint.(IS 1180 table 12). The center tie rod shall be of 20 mm (minimum) diameter and end tie rods of 16 mm (minimum) diameter each.

5.1.5. The transformers core shall be suitable for over fluxing (due to combined effect of voltage and frequency) up to 112.5% without injurious heating at full load conditions and shall not get saturated. The Bidder shall furnish necessary design data in support of this situation.

5.1.6. The nominal flux density in any part of the core and yoke shall not exceed 1.69 Tesla at 100% rated voltage and rated frequency and the maximum flux density in any part of the core and yoke at rated voltage and frequency shall be such that the flux density with 112.5 % combined voltage and frequency variation from rated voltage and frequency shall not exceed 1.9Tesla as per REF IS 1180 PART-1 2014 6.9.1&7.9.1.

NOTE: The design calculations in support of flux density shall be furnished by the manufacturer.

5.1.7. No load current shall not exceed the below mentioned percentage of full load current by energizing the transformer at rated voltage and frequency.

Particulars	For 800,1000 and 1250 kVA
At rated voltage and frequency	2%
At voltage by 112.5% of rated voltage and at rated frequency.	5%

5.1.8. Test for magnetic balance by connecting the LV phase by phase to rated phase voltage and measurement of un, vn, wn voltage will be carried out.

5.1.9. Suitable provision shall be made in the bottom core clamp / bottom plate of the transformer to arrest any kind of movement of active part during the handling and transportation. The

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supplier shall require to specify this arrangement in the submission of detailed drawings, which shall be verified during the drawing approval and proto testing. The core / coil assembly shall be securely held in position to avoid any movement under short circuit conditions.

**5.2. WINDINGS:**

- 5.2.1. The material for winding shall be Copper.
- 5.2.2. Disc type HV winding shall be used for transformers.
- 5.2.3. Pressure Ring of minimum 20 mm thickness of perma wood shall be provided on top coil.
- 5.2.4. LV winding shall be in form of even layers so that the neutral formation will be at top.
- 5.2.5. The winding shall be of one or more rectangular conductors insulated from each other to reduce eddy current losses. The tolerances on the size of the conductor shall be as per IS-6160, specification for rectangular conductors. If the active axial length of the coil is more than 350 mm, an axial duct, of minimum 4 mm is provided between the LV coil layers. The materials used for providing duct shall be non-compressible material such as treated wood per Mali, etc. Any joints in the HV/LV winding shall not be allowed.
- 5.2.6. Dimensional tolerances for winding coils shall be within limits as specified in GTP.

**A. MATERIALS:**

Double paper covered Electrolytic Copper conductor or class H Super enamel cover Electrolytic Copper conductor shall be used for both HV & LV winding. A mix of Electrolytic copper & aluminum conductors for HV & LV winding will not be permitted.

**B. CURRENT DENSITY (MAXIMUM):**

- i. ELECTROLYTIC COPPER CONDUCTOR: Shall not be more than 2.5 A/sq.mm.

**C. INTERNAL INSULATIONS AND CLEARANCES:**

- i. **Insulating material:** Electrical grade insulating craft paper of Triveni/Ballarpur/Cauvery or equivalent make subject to approval of the purchaser shall be used. Similarly Press Board of Senapathy, Whitelay or Raman make or equivalent subject to the approval of the purchaser shall be used. Perma wood or Haldi wood blocks shall be used for top and bottom yoke insulation.
- ii. All spacers, axial wedges / runners used in windings shall be made of pre-compressed Pressboard-solid, conforming to type B 3.1 of IEC 641-3-2. In case of disc Type coil winding of HV all spacers shall be properly sheared and dovetail punched to ensure proper locking. All axial wedges / runners shall be properly milled to dovetail shape so that they pass through the designed spacers freely. Insulation shearing, cutting, milling and punching operations shall be carried out in such a way, that there should not be any burr and dimensional variations. The axial wedges shall be placed in the oil duct such that at least 40% of the perimeter length of the outer diameter of the HV coil shall be covered.
- iii. An axial duct of 3 mm is to be provided if the radial thickness of coils is more than 50 mm and/or the axial length of the individual coil is more than 80mm. The radial duct shall be adequate for the free circulation of oil as well as to withstand voltage between adjacent coils.
- iv. Proper bonding of inter layer insulation with the conductor shall be ensured.

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v. Test for bonding strength shall be conducted.

vi. **Internal Clearances& Number of HV/LV coils:**

Parameters	800 KVA	1000 KVA	1250 KVA
Minimum Radial clearance of LV Coil to Core in mm	4	4	4
Minimum radial clearance between LV coil to HV coil in mm	11	11	11
Phase to phase clearance in mm between HV conductors with a provision of minimum of 2 x 1 mm press board to cover the tie rods.	15	15	15
Minimum electrical clearance between inside surface of the Tank and outside edge of the winding considering the tapings for Tap changer (mm)	30	30	30
End Insulation, Coil end to Earth in mm	25	25	25
No. of Coils LV per Phase	1	1	1
Minimum No. of HV Coils (DISC winding) – for Stack core	1	1	1
Minimum No. of axial wedges between LV and HV winding equi-spaced around	8	8	8

**D. OFF LOAD TAPS:**

- i. The off load tap changer shall be provided with the tapings on the HV winding for the variation of HV voltage within the range of (-) 5% to (+) 10% in steps of 2.5%.
- ii. Off circuit tap-changing arrangement shall be by means of an externally-operated rotary switch with mechanical locking device and a position indicator. Arrangement for pad-locking shall be provided. ( As per IS1180 (Part1):2014 Clause 7.7.2). Tap changing shall be carried out by means of an externally operated self-Position rotary type tap changer switch when the transformer is in de-energized condition. Tap changing rotary switch shall be side wall mounted. Switch position No.1 shall correspond to the maximum plus tapping. Each tap change shall result in variation of 2.5% in voltage. Provision shall be made for locking the taping switch handle in position. Suitable aluminum anodized plate shall be

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fixed for tap changing switch to know the position number of tap

- iii. The Transformer shall be capable of being operated without danger on any tapping at the rated kVA with voltage variation  $\pm 10\%$  corresponding to the voltage of that tapping.

**5.3. OIL :**

- 5.3.1. The insulating oil shall comply with the Type-II requirements of IS 335 with latest amendment. Use of recycled oil is not acceptable.
- 5.3.2. Oil shall be filtered and tested for break down voltage (BDV) and moisture content before filling.
- 5.3.3. The oil shall be filled under vacuum of 250 Torr OR 0.33 Bar with the tolerance of +/- 5 %.
- 5.3.4. The design and all materials and processes used in the manufacture of the transformer, shall be such as to reduce to a minimum the risk of the development of acidity in the oil.

**5.4. LOSSES & LABELLING:**

- 5.4.1. The maximum allowable losses at rated voltage and rated frequency permitted at 75°C and percentage impedance for 11/0.433 KV Transformers shall be as per Level-1 of IS 1180 (Part 1):2014 with its latest amendments and Star rating plan as per latest BEE guidelines, whichever applicable. However, rating wise total losses shall be limited to the values as per clause no: 5.4.3 as under.
- 5.4.2. Losses of the Transformer should not exceed following values and for transformers having tapings shall be guaranteed at maximum current tap and it should not exceed following values.

**5.4.3. LOSSES of LABELLED TRANSFORMERS IN WATTS:**

Description	BEE RATED STAR 1 (LEVEL-1 AS PER IS 1180 (PART 1) :2014) WITH LATEST AMENDMENTS		
Transformer Rating (kVA)	800	1000	1250
Maximum No Load Losses (Watts)	950	1210	1395
Maximum total losses at 50% loading (Watts)	2287	2790	3300
Maximum *total losses at 100% loading (Watts)	6403	7700	9200

(\*Total Losses in watt at 100 % loading = No Load losses in watt + Full Load losses in watt at 75 Deg. C)

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5.4.4. Bids with higher losses than above specified values would be treated as non- responsive. In case of transformer with tapings, Bids with higher losses than above specified values at maximum current tap, would be treated as non-responsive. However, the manufacturer can offer losses lower than above.

NOTE: Offer without BIS and BEE certification will be out rightly rejected without any correspondence.

**5.5. EVALUATION CRITERIA:**

5.5.1. The Tender price bids will be evaluated on the basis of firm Price End Cost including GST and cess,( if any).

5.5.2. Price matching will be carried out on the base of unit end cost including GST and cess, if any.

**5.6. PERCENTAGE IMPEDANCE:**

5.6.1. The percentage impedance at 75°C for 800 KVA, 1000 KVA & 1250 KVA shall be 5.0 %.

5.6.2. % impedance shall be subject to tolerance specified in IS: 2026.

**NOTE:** Bids not meeting the limits indicated above will be treated as non-responsive.

**5.7. TEMPERATURE RISE:**

The temperature rises over ambient temperature shall not exceed the limits described below (Total losses guaranteed offered in GTP shall have to be fed for Temperature rise test)

Description	Temperature Rise ((in °C)
Top oil temperature rise measured by thermometer	40
Winding temperature rise measured by resistance	45

**NOTE:** Bids not meeting the above limits of temperature rise will be treated as non-responsive.

**5.8. PENALTY FOR NON PERFORMANCE:**

5.8.1. FOR GUARANTEED LOSSES:

I. During testing, if it is found that the actual measured losses are more than the values quoted by the bidder, the purchaser will have right to exercise one of the following options;

II. Reject the complete lot OR Penalty shall be recovered from the bidder for the excess losses per watt as under,

a. Rs. 493.52 per Watt for No load loss.

b. Rs. 272.92 per Watt for Load loss.

5.8.2. FOR GUARANTEED TEMPERATURE RISE AND % IMPEDANCE:

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- i. If the temperature rise exceeds the guaranteed values in any sample of the transformer during testing, purchaser reserves the right to reject the available lot of the transformer.
- ii. If the impedance values differ from the guaranteed values including tolerance in any sample of the transformer during testing, purchaser reserves the right to reject the available lot of the transformer.
- iii. Purchaser also reserves the right to retain the rejected transformer and take it into service until the supplier replaces it with a new transformer at no extra cost. The delivery as per contract will be counted when the new transformer as per specification is provided by the manufacture.
- iv. Purchaser also reserves the right to utilize the rejected lot of transformers with a penalty maximum up to 30% as per the clause of commercial terms and condition.

**5.9. TANK :**

Transformer tank construction shall conform in all respect to clause 15 of IS 1180(Part-1):2014. Radiators shall be provided on both HV and LV bushing side of the transformer tank wall and shall be of fin type.

**A. FOR RECTANGULAR PLAIN TANK:**

- i. The transformer tank shall be of robust construction rectangular in shape and shall be built up of tested MS sheets.
- ii. The tank shall be made of prime quality MS sheet of thickness stated below with necessary stiffener to withstand the pressure built in during the expansion of oil due to temperature rise.
- iii. The exterior of the transformer tank and other ferrous fitting shall be thoroughly cleaned, scraped /sand blasted and given a priming coat and two finishing coats of durable oil and weather resistant paint of dark admiral grey conforming to color code No. 632 of IS-5/1961.
- iv. The internal clearance of tank shall be such that, it shall facilitate easy lifting of core with coils from the tank.
- v. All joints of tank and fittings shall be oil tight and no bulging should occur during service. The tank design shall be such that the core and windings can be lifted freely. The tank plate shall be of such strength that the complete transformers when filled with oil may be lifted bodily by means of lifting lugs. Inside of tank shall be painted with hot oil resistive paint.
- vi. Manufacturer should carry out all welding operations as per the relevant ASME standards and submit a copy of the welding procedure qualifications and welder performance qualification certificates to the customer.
- vii. The four walls of the rectangular tank shall be made of two “L” shaped sheets (without joints) fully welded at the corners from inside and outside of the tank for withstanding a pressure of 80 kPa for 30 minutes and vacuum of 500 mm of mercury for 30 Min.

(OR)

- viii. One “U” shaped bend sheet with straight plate and welded outside the tank at

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two corners, withstanding a pressure of 80 kPa for 30 minutes and vacuum of 500 mm of mercury for 30 Min .There should be no air leakage at any point.

- ix. Under operating conditions the pressure generated inside the tank should not exceed 0.4 kg/ sq. cm positive or negative. There must be sufficient space from the core to the top cover to take care of oil expansion.
- x. The permanent deflection of flat plate, after pressure/vacuum has been released, shall not exceed the values given below,

Length of Plate	Deflection
Up to 750 mm	5.0 mm
751 mm to 1250 mm	6.5 mm
1251 mm to 1750 mm	8.0 mm
Above 1751 mm	9.0 mm

- xi. The edges of cover plate should be bent downwards so as to avoid entry of water through the cover plate gasket. The width of bent plate should be 25 mm minimum.

Rating	Nominal thickness of plate in mm for Rectangular Tank (tolerance applicable as per relevant IS )	
	For sides (mm)	For Top & Bottom (mm)
800, 1000 and 1250 kVA	6.0	8.0

- xii. Top cover of the transformer tank shall be slanting minimum 10 to 15 mm towards HV Bushing so that entry of water can be avoided.
- xiii. The radiators can be of fin type to achieve the desired cooling to limit the specified temperature rise. The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. Bidder shall submit the calculation sheet for heat dissipation. The radiators shall be detachable type with oil valve. The radiators shall be provided on both the sides of the tank i.e. HV and LV sides.
- xiv. **Lifting lugs:** 4 Nos. lifting lugs are to be provided in Transformers. Lifting lugs of MS plate 16 mm thick (min) suitably reinforced by vertical supporting flat welded edgewise below the lugs on the side wall shall be provided. As per lifting devices standards the safety factor of 5 ensured in design of lifting lugs and with support stiffener at bottom taken to ensure longer life.
- xv. **Pulling lugs:** Four Nos. of welded heavy duty pulling lugs of MS plate 16 mm thick (min) with jacking pad shall be provided to pull the transformer horizontally.
- xvi. Top cover fixing bolts of Stainless Steel of grade 304 size 12mm dia. adequately spaced not more than 80 mm pitch and 10 mm Neoprene bonded cork gaskets conforming to type III as per IS 11149/ type-c as per IS 4253 (Part-2) shall be fixed with the appropriate adhesive material between tank and top cover. The adhesive material should not deteriorate the properties of the gasket.

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- xvii. The Stainless Steel bolts outside tank shall have 2 flat washers & one spring washer.
- xviii. Bolted inspection window shall be provided on top cover to inspect core, winding and have access to bottom of bushing. The inspection window shall be provided with turret height of minimum 30 mm and minimum 10 mm Neoprene bonded cork gaskets conforming to type III as per IS 11149/ type-c as per IS 4253 (Part-2) shall be placed between top cover and inspection window.
- xix. The top plate shall be made from single MS sheet only and no any other metal shall be allowed for LT bushing fitting.

**5.10. CONSERVATOR:**

- i. A Conservator shall be provided with each transformer.
- ii. When a conservator is provided, oil gauge and dehydrating breathing device shall be fixed to the conservator which shall also be provided with a drain plug and a filling hole (1¼" normal size thread) with cover. The capacity of a conservator tank shall be designed to contain 10% of the total quantity of oil and its contraction and expansion due to temperature variations. Normally 3% quantity of total oil will be contained in the conservator. In addition, the cover of the main tank shall be provided with an air release plug to enable air trapped within to be released unless the conservator is so located as to eliminate the possibility of air being trapped within the main tank.
- iii. The inside diameter of the pipe connecting the conservator to the main tank should be within 25 to 50 mm and it should be projected into the conservator so that its end is approximately 20 mm above the bottom of the conservator so as to create a sump for collection of impurities. The minimum oil level (corresponding to -5 deg C) should be above the sump level.
- iv. There shall be minimum -5deg, normal 30deg and maximum 90 deg marking on the oil gauge indicator of the conservator.
- v. **Buchholz Relay:** The buchholz relay above 1000 kVA transformer as per Clause 20.1 V of IS 1180 is mandatory. The buchholz relay complying with IS: 3637 shall be connected through a pipe between the conservator and transformer tank. The connecting pipe between the conservator and the main tank shall be arranged at angle of 3 to 9 degrees horizontally up to the Buchholz relay. Buchholz relay shall be provided with two potential-free contacts (Plug & socket type arrangement), one for alarm on gas accumulation and the other for tripping on the sudden rise of pressure. The installation shall be in such a way that no water seepage inside the relay.

**5.11. DEHYDRATING BREATHER:**

- i. Flange type dehydrating breather made from a transparent UV-protected seamless acrylic body having sufficient thickness shall be provided. The top and bottom cover shall be of die-cast aluminum only which shall be either powder-coated or polyurethane painted. The oil cup shall be of UV-protected acrylic or polycarbonate.

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- ii. An inverted U-shape pipe of a minimum 20 mm diameter shall be used for the connection of the breather.
- iii. The breather shall be preferably fixed at the height of 1.4 meters from the base channel of the transformer for easy access to the breather for periodic maintenance.
- iv. The dehydrating agent shall be silica gel. The moisture absorption shall be indicated by a change in the colour of the silica gel crystals which should be easily visible from a distance.
- v. The volume of breather shall be suitable for 1.0 kg silica gel confirming to IS up to 1MVA and 2 kg for more than 1 MVA.
- vi. The make and design of breather shall be subject to approval of DISCOM, Gujarat.

**5.12.SURFACE PREPARATION & PAINTING:**

**A. GENERAL :**

- i. All paints shall be applied in accordance with the paint manufacturer's recommendations. Particular attention shall be paid to the following:
  - a. Proper storage to avoid exposure as well as extremes of temperature.
  - b. Surface preparation prior to painting.
  - c. Mixing and thinning
  - d. Application of paints and the recommended limit on time intervals between coats.
  - e. Self-life for storage.
- ii. All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.
- iii. All primers shall be well marked into the surface, particularly in areas where painting is evident, and the first priming coat shall be applied as soon as possible after cleaning. The paint shall be applied by airless spray according to manufacturer's recommendations. However, wherever airless spray is not possible, conventional spray be used with prior approval of purchaser.
- iv. The Supplier shall, prior to painting protect nameplates, lettering gauges, sight glasses, light fittings and similar such items.

**B. CLEANING AND SURFACE PREPARATION:**

- i. After all machining, forming and welding has been completed, all steel work surfaces shall be thoroughly cleaned of rust, scale, welding slag or spatter and other contamination prior to any painting.
- ii. Steel surfaces shall be prepared by shot blast cleaning (IS9954) to grade Sq. 2.5 of ISO 8501-1 or chemical cleaning by Seven Tank process including phosphating of the appropriate quality (IS 3618).
- iii. The pressure and volume of the compressed air supply for blast cleaning shall meet the work requirements and shall be sufficiently free from all water

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contamination to ensure that the cleaning process is not impaired.

- iv. Chipping, scraping, and steel wire brushing using manual or power-driven tools cannot remove firmly adherent mill-scale shall only be used where blast cleaning is impractical. Manufacturer to explain such areas in his technical offer clearly.

**C. PROTECTIVE COATING**

As soon as all items have been cleaned and within four hours of the subsequent drying, they shall be given suitable anti-corrosion protection.

**D. PAINT MATERIAL:**

- i. The color of the finishing coats shall be dark admiral gray conforming to No. 632 of IS-5 of 1961.
- ii. Inside of the tank shall be painted with Thermo setting powder paint OR oil resistance paint of colour shade yellow/green. For external surfaces, one coat of thermosetting powder paint OR Liquid paint as mentioned in the table at point shall be used.
- iii. For highly polluted areas, chemical atmosphere or for places very near to the sea coast, paint as above with one coat of high build micaceous iron oxide (MIO) as an intermediate coat may be used.
- iv. To the maximum extent, practicable the coat shall be applied as a continuous film of uniform thickness and free of pores. Overspray, skips, runs, sags and drips should be avoided. Each coat of paint shall be allowed to harden before the next is applied.
- v. Particular attention must be paid to full film thickness at edges.
- vi. The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as given below.

Sr. No	Paint Type	Area to be painted	No. of coats	Total Dry film thickness (min.)in microns
1.	Thermo setting powder paint OR Liquid paint	Outside	01	60
	a) Epoxy (Primer)	Outside	01	30
	b) Polyurethane (finished coat)	Outside	02	25 Each
2.	Thermo setting powder paint OR	Inside	01	30
	Liquid paint Hot oil resistant paint of colour shade yellow/green	Inside	01	35

**Note:** Supplier shall guarantee the painting performance requirement for a period of not less than 5 years.

**E. PAINTING PROCEDURE:**

- i. All painting shall be carried out in conformity with both Specification and with the

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paint manufacturer's recommendation. All paints in any one particular system, whether shop or site applied, shall originate from one paint manufacturer.

- ii. Particular attention shall be paid to the manufacturer's instructions on storage, mixing, thinning and pot life. The paint shall only be applied in the manner detailed by the manufacturer e.g. brush, roller, conventional or airless spray and shall be applied under the manufacturer's recommended condition.
- iii. All prepared steel surfaces should be primed before visible re-rusting occurs or within 4 hours, whichever is sooner. Chemical treated steel surfaces shall be primed as soon as the surface is dry and while the surface is still warm.
- iv. Where the quality of film is impaired by excess film thickness (wrinkling, mud cracking or general softness) the Supplier shall remove the unsatisfactory paint coating and apply another. As a general rule, dry film thickness should not exceed the specified minimum dry film thickness by more than 25%.
- v. Paint applied to items that are not be painted shall be removed at Supplier's expense, leaving the surface clean, unstained and undamaged.

**F. DAMAGED PAINTWORK:**

- i. Any damage occurring to painting of any part shall be made good to the same standard of corrosion protection and appearance as that originally employed, within guarantee/ warranty period at free of cost.
- ii. Any damaged paint work shall be made good as follows:
  - a. The damaged area, together with an area extending 25 mm around its boundary, shall be cleaned down to bare metal.
  - b. A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50 mm around the perimeter of the original damage.
  - c. The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

**G. TESTS FOR PAINTED SURFACE:**

- i. The painted surface shall be tested for paint thickness.
- ii. The painted surface shall be type tested for paint adhesion test as per the ASTM D 3359 standard.

**5.13. BUSHINGS AND TERMINALS:**

**A. TRANSFORMER BUSHINGS:**

The transformers shall be fitted on high voltage and low voltage sides with suitable bushings of appropriate voltage and current ratings. Bushing of the same voltage class shall be interchangeable. Dimensions of the bushings of the voltage class shall conform to the Standards specified and dimension of clamping arrangement shall be as per IS 4257. Embossing on bushing showing the Manufacturer's name, year of manufacturing shall be clearly visible, even after fixing the same on Transformer.

**a. HV Bushings:**

- i. Three nos. of High Voltage bushings of 17.5 KV class porcelain type shall be provided, confirming to IS/IEC 60137 and IS 3347 with its amendments; till date.

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- ii. HV Bushings shall be mounted on top plate only.
- iii. The HV bushings shall have to be installed on top plate on turret, flange and gaskets to prevent eventual entry of water. The turret height for HV bushing should be minimum 25 to 30mm.
- iv. For Porcelain type of bushings of Make mentioned in Schedule-A, or other makes having type tested as per IS/IEC 60137 and approved by the GUVNL/PGVCL/MGVCL/DGVCL/UGVCL shall only be used & are acceptable .
- v. The cross-section of the connecting rods on the HV side shall have diameter of not less than 12 mm and of tinned copper and shall be as per IS 3347 Part3/Sec 2: 1982.

**b. LV Bushings:**

- i. For the Low Voltage side of the transformer, LV bushings of 1.0 kV Voltage class and epoxy resin type or porcelain material shall be used and confirming to IS 3347 and its latest amendments.
- ii. Bushing of the same voltage class shall be interchangeable.
- iii. LV bushings of epoxy resin type or porcelain material of appropriate voltage and current rating shall be allowed.
- iv. The LV Bushings shall be side mounted with the appropriate cable box.
- v. The low voltage cable box shall be made suitable for adoption of single core XLPE cables OR 3.5/4 core PVC cable of appropriate sizes.
- vi. Separate Neutral Bushing shall be provided on cable box for neutral earthing provision. This separate Neutral Bushing shall be short internally with LV Neutral Bushing.
- vii. The cross-section of the connecting rods of tinned copper, on the LV side shall be as per IS 3347 Part1/Sec 2 1979 and shall be adequate for carrying the rated currents.
- viii. Bushings of Make mentioned in Schedule A or other makes having type tested as per IS 2099 and approved by the GUVNL/PGVCL/MGVCL/DGVCL/UGVCL shall only be used & are acceptable.
- ix. The cross section of the connecting rods on LV side shall be as per IS 3347 Part1/Sec 2 1979 and shall be adequate for carrying the rated currents.
- x. Embossing on bushing showing the Manufacturer's name, year of manufacturing shall be clearly visible, even after fixing the same on Transformer.

**B. HV AND LV TERMINALS:**

- i. The LV and HV bushing stems shall be provided with suitable Bimetallic terminal connectors as per IS 5082 to connect the jumper without disturbing the bushing stem. The HV terminal connector shall be suitable for AAA up to DOG Conductor and also suitable for underground XLPE cable up to 240 mm<sup>2</sup>.
- ii. Current density in HV and LV Copper Terminals shall not exceed 2 Amp/sq.mm.
- iii. The bi-metallic connectors shall have to be fitted on HV and LV terminals having

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capacity to withstand 1.5 times of rated HV and LV current of transformer.

**C. LV CABLE BOX FOR TRANSFORMERS**

- i. L. T. terminal for cable connections shall be brought out through side wall mounted Bushing to a cable end box.
- ii. The cable end box shall be self-supporting, weatherproof, air-filled type with sufficient space inside for the termination and connection of cables.
- iii. The cable end box shall be furnished complete with a non-magnetic removable gland plate, and double compression brass glands. Gland plates shall be mounted separately with nut bolt arrangement and gasket in between them.
- iv. The LV cable box shall be suitable for terminating the cable, which will approach the boxes vertically from the bottom. The cable box shall be suitable for being detached from the main body with the suitable mounting arrangement.
- v. The LV Bushings shall be provided with suitable tinned plated EC grade copper bus bar Extensions. The current density of the Bus bar shall not be more than 1.6 A/mm<sup>2</sup> to take off circuits with necessary nuts and bolts with resin cast support insulators. The extended bus bar shall be having the capacity to withstand 1.5 times of rated LV current of the transformer.
- vi. The LV bus bar shall have minimum clearances after considering termination between each phase to phase is 75mm and phase/Neutral to Earth is 55 mm. The dimension of holes on the busbars shall be as per the appropriate lug size according to the following sizes of cables. The No. and size of cables for installation on the LV side shall be as follows:

Transformer Rating (kVA)	Size of Cable	Nos of Runs per phase	Nos of runs of Neutral
800	1C* 630 Sq. mm & 1C* 150 Sq. mm (1.1KV, Al. XLPE Insulated)	01 of each cable	01 of each cable
1000	1C* 630 Sq. mm	2	2
1250	1C* 630 Sq. mm	2	2
	1C* 150 Sq. mm	1	0

- vii. Suitable cable clamping/cleating arrangement shall be provided to keep the cable straight and to support cables to avoid tension on bushings due to cable weight.
- viii. Support for the GI earth strip shall be provided to avoid tension on the secondary neutral bushing.
- ix. The cable box protection shall be at least IP 55.
- x. The resin cast ring type Current transformer for WTI of following details shall be
- xi. Installed inside of cable box confirming to IS 2705/ IS 16227.

Sr. No	Transformer rating (KVA)	CT ratio	Min. Accuracy Class
1	800	1200/5	1.0

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2	1000	1500/5	1.0
3	1250	2000/5	1.0

**D. INTERNAL CONNECTION:**

**a. HV WINDING:**

- i. In case of HV winding all jumpers from winding to bushing shall have cross section double the winding conductor.
- ii. Inter coil connection shall be done by brazing as per ASME, section-IX.
- iii. The Delta joint shall be with brazing only.
- iv. Lead from Delta joint shall be connected to bushing rod by brazing only.
- v. Current density in any of the conductor (in Delta connections also) shall not exceed 2 Amp/sq.mm.
- vi. Disc type winding of Copper material should be used.
- vii. The thickness of radial wedges between turns shall be minimum 4 mm in case of Disc winding.

**b. LV WINDING:**

- i. LV star point shall be formed of CU flat of sufficient size and length. Lead from winding shall be connected to the flat by crimping and brazing.
- ii. Firm connection of LV winding to bushing shall be made of adequate size of "L" shape flat. Connection of LV coil lead to "L" shape flat shall be made by brazing.
- iii. The "L" Shape flat shall be of copper only.
- iv. "L" shape flat/lug shall be clamped to LV bushing metal part by using nut, locknut and washer.

**5.14.TANK BASE CHANNEL:**

- i. The under-base of the transformer shall be provided as per clause 14.2 of IS 1180 (Part1):2014.
- ii. Two numbers of channels having minimum size of 150 x 75 mm are to be provided.
- iii. The under base of all transformers shall be provided with holes to make them suitable for fixing on a platform or plinth.
- iv. The under base channel for the transformers shall be suitable for mounting on the rollers. Also, the length of the channel shall be required to extend equally on both the sides of the tank and also the length shall be minimum 400 mm more than the width of the transformer tank.

**5.15.NAME PLATE &TERMINAL MARKINGS :**

- i. High voltage phase windings shall be marked both in the terminal boards inside the tank and on the outside with capital letter 1U, 1V, 1W and low voltage winding for the same phase marked by corresponding letter 2U, 2V, 2W. The neutral point terminal shall be indicated by the letter 2N. Neutral terminal to be brought out.

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- ii. Each Transformer shall be provided with rating plate having marking as per IS 1180 (part-I):2014 clause no 13 clearly indicating max. total losses at 50% rated load in watts and maximum total losses at 100% rated load in watts. Each Transformer shall be provided with combined non-detachable Name plate made of anodized aluminum/ stainless steel material securely fixed on the outer body. The fixing of the name plate on the transformer tank shall be through continuous welding so that it can be non-removable. The dimensions of the rating & terminal plate shall be sufficient enough so that during the fixing of the plate and afterwards, the details shall be visible and readable. (The thickness of name plate should be minimum 2 mm.) The information of rating and terminal markings as per IS 1180 (Part-I) 2014, Clause No. 13 shall be engraved (punched) on combined name plate. The Transformer shall be marked with the Standard Mark. Details of Guarantee Period shall also be mentioned in combined Name Plate being a special requirement of DISCOM.
- iii. On opposite side of the combined name plate, other plate made of stainless steel material shall be continuously welded on all its four sides with the tank of Transformer. The Transformer Identification Number (TIN) shall be engraved (punched) on plate & it shall be clearly visible. The Transformer Identification Number (TIN) of minimum nineteen digits/letters shall incorporate details of Name of DISCOM, Trans. KVA rating, supplier name code, month & Year of manufacturing, CPP tender no. and sr. no. given by supplier (Refer Annexure-II).

**5.16. OTHER FITTINGS:**

The following mentioned fittings over and above standard fittings shall be provided.

- I. Earthing terminals having minimum size 1½” X ½” with 2 washers and nut and with earthing symbol for the seamless connection of G I Strip for earthing.
- II. HV bushings: 03 Nos.
- III. LV bushings: 04 Nos.
- IV. Terminal connectors on the HV bushings
- V. Terminal connectors on the LV bushings
- VI. Thermometer pocket with cap - 1 no. The length of the thermometer pipe shall be minimum 100 mm long from the inside of the top plate of the transformer and 25 mm of inner diameter.
- VII. Oil filling hole (1.25 Inch, nominal size thread)/ with protection net to prevent oil theft
- VIII. Stiffener angle of 75x40x8 mm and vertical strip of 65x8 mm shall be provided. It should be fitted with continuous welding.
- IX. The base channel with the minimum size of 150x75 and of sufficient length as mentioned in the clause no: 5.12.
- X. 4 No. bi-directional rollers for transformers of 800 kVA, 1000 and 1250 KVA as per IS 1180.
- XI. Radiators: No. & length may be mentioned (as per heat dissipation calculations) Support calculations for Radiator efficiency shall be required to submit.

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- XII. Arcing horns for HV bushings
- XIII. Breather
- XIV. Pressure Relief Device Valve (PRV) – 1 No of PRV having 70 kPa of rating for all types and rating of transformers to be provided on the top plate. (Make and Capacity of PRV shall be engraved on it). The PRV shall have one NO, NC contacts and shall also able to give Visual Indication of Valve Operation by Raising a Flag. The PRV shall seal off after excess pressure has been released.
- XV. Non return valve (NRV) -1 No (mandatory for sealed transformer with inert gas, otherwise optional).
- XVI. Anti-theft stainless steel fasteners with breakaway nut at Top Cover – 4 Nos. for 3 Phase and 2 nos. for 1 Phase
- XVII. Oil filter valve (1.25 Inch, nominal size thread) on upper side of tank-1 No.
- XVIII. Drain-cum-sampling metallic valve with plug(1.25 Inch, nominal size thread) - 1no. at bottom of tank with anti-theft protection cover (with locking arrangement)
- XIX. Off circuit tap changer switch with handle and locking device 1 No
- XX. LV Cable holding clamp with accessories
- XXI. Extra Neutral bushing (LV neutral terminal to be brought out for earthing)
- XXII. Inspection hole /window
- XXIII. Prismatic/Dial Oil level gauge indicating the position of oil marked with background of yellow color) as follows.
  - Min. (-5 deg.C), 30 deg. C, Max. 90 deg.C
  - Minimum and maximum positions correspond to the operating temperature of -5°C and 90°C respectively (for non-sealed type transformer).
- XXIV. Buchholz relay for transformers above 1000 kVA.
- XXV. Marshalling box with OTI and WTI as per annexure-IV
- XXVI. LV Cable box as per clause No. 5.13 (D)
- XXVII. CT for WTI

**5.17.FASTENERS:**

- I. All bolts/nuts/washers exposed to atmosphere shall be of stainless steel of grade 304 invariably and same will be verified during acceptance testing. All bolts/nuts of nominal thread diameter  $D \geq 5$  mm shall be clearly marked with steel grade SS 304(A2) as per ISO 3506-1&2 or other relevant standard.
- II. All bolts, studs, screw threads, pipe threads, bolt heads and nuts shall comply with the appropriate Indian Standards for metric threads, or the technical equivalent. Bolts or studs shall not be less than 6 mm in diameter except when used for small wiring terminals.
- III. All nuts and pins shall be adequately locked.
- IV. Wherever possible, bolts shall be fitted in such a manner that in the event of failure of locking resulting in the nuts working loose and falling off, the bolt will remain in

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position.

- V. Each bolt or stud shall project at least one thread but not more than three threads through the nut, except when otherwise approved for terminal board studs or relay stems. If bolts nuts are placed so that they are inaccessible by means of ordinary spanners, special spanners shall be provided.
- VI. Two bolts shall be provided diagonally with sealing facility at Top.
- VII. The length of the screwed portion of the bolts shall be such that no screw thread may form part of a shear plane between members.
- VIII. Taper washers shall be provided where necessary.
- IX. Protective washers of suitable material shall be provided front and back or the securing screws.

**5.18.OVERLOAD CAPACITY:**

The Transformers shall be suitable for loading as per IS 2026 (Part7) with latest amendment, if any.

**5.19.SUBMISSION OF DRAWINGS AND CALCULATION SHEET:**

The manufacturer has to submit the following details and drawings along with offer.

- i. General Arrangement.
- ii. Internal Construction.
- iii. Name Plate as per approved drawing.
- iv. Technical Details Sheet.
- v. HV Bi metallic connectors, clearly mentioned ampere capacity and type of material in the drawings.
- vi. LV Bi metallic connectors clearly mentioned ampere capacity and type of material in the drawings.
- vii. Month & Year of manufacture to be written on conservator tank & body.
- viii. Core details.
- ix. Metal part of HV/LV steams.
- x. Breather
- xi. Pressure Relief Device
- xii. Short circuit capacity calculation sheet.
- xiii. Cooling capacity calculation.
- xiv. Guaranteed technical particulars as per DISCOM's prescribed Performa for design & constructional details.
- xv. Flux density calculation sheet.
- xvi. Drawing of combined name plate (minimum size 105mm x 175 mm x 2.0 mm) showing: Name of Supplier, A/T No., KVA capacity, Month & year of manufacturing, Serial number of Transformer etc. as per cl.no. 5.15 of technical specifications

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- xvii. Drawing of Transformer Identification Number plate minimum size 150 mm x 20 mm x 1.5 mm) as per cl. no. 5.15 (iii) of technical specifications
- xviii. Heat dissipation calculation with radiator efficiency. Only side walls shall require to consider in heat dissipation calculation.
- xix. Off load Tap Changer switch.
- xx. Dimensional drawing of LV Epoxy Bushing or porcelain material
- xxi. Dimensional GA drawing of Marshaling box
- xxii. Electrical & Control wiring drawing of Marshaling box
- xxiii. Dimensional drawing of LV cable Box with bus bar arrangement
- xxiv. Buchholz relay (above 1000 KVA rating)
- xxv. WTI CT drawing

The above drawings/ details are illustrative. However, the bidder may submit their own drawing/ details if they so desires. Offer without drawings/ details shall not be considered.

After Placing of order by the respective DISCOM to successful bidder, supplier has to get approval of all above drawings before offering Prototype sample for inspection.

## 6.0 INSPECTION AND TESTING:

### A. INSPECTION OF PROTO TYPE TRANSFORMER :

- I. The Manufacturer shall have to offer one no of prototype transformer along with relevant approved drawings as stated above at clause 5.20.
- II. The proto type shall be subjected to following test conforming to IS 1180 Part-1 2014 & IS 2026 and all relevant IS with latest amendments.
  - a. Verification of core laminations material documents and quality.
  - b. Verification of internal parameters with respect to approved drawings and GTP.
  - c. All Routine tests/ acceptance test as per clause 6.0
  - d. Temperature rise test as per clause no.6.0
  - e. Verification of Air pressure and vacuum test certificate from manufacturer of tank.
  - f. Verification of radiator test certificate.
- III. During the proto inspection following sequence of test shall be followed;
  - a. Measurement of winding resistance (As per IS 2026, transformer should be discharged at least 3 to 4 hours before test)
  - b. Measurement of voltage ratio and check vector group
  - c. HV test
  - d. DVDF test
  - e. Measurement of no-load test and magnetizing current
  - f. Measurement of load loss, impedance voltage and short circuit impedance
- IV. On completion of proto type sample inspection and scrutinizing the reports, approval will be accorded by the respective DISCOM. On getting approval from respective DISCOM, bulk production shall be commenced by the supplier.

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- V. If any observation/ deviation found during proto inspection, supplier shall have to re-offer proto inspection with rectification/ new sample. However, inspection charges for un-successful proto sample will be borne by the supplier.

**B. TYPE TESTS:**

All the equipment offered shall be fully type tested by the bidder or his collaborator as per the relevant standards including the additional type tests mentioned in this specifications. The type test must have been conducted on a transformer of same design. The Bidder shall furnish four sets of type test reports along with the offer. All the required Type test reports for the tendered items as under should invariably furnish a Notarized Copy. Offers without type test reports will be treated as Non-responsive.

- I. Temperature rise test as per IS 2026 Part-2 for determining the maximum temperature rise after continuous full load run.  
**Note:** The above Test shall be conducted on maximum current tapping in case of transformer with taps and the measurement of winding resistance shall be conducted on middle phase.
- II. Lightning Impulse voltage test: As per Clause No. 13 (With chopped wave) of IS – 2026- part-III latest version. BIL for 11 kV shall be minimum 95 KV Peak.
- III. Vacuum Test: As per IS - 1180 / part-I/2014
- IV. Pressure Test: As per IS-1180/part-I/2014 with latest amendments as per the clause No: 21.5.2.1
- V. Short Circuit withstand test: Thermal and dynamic ability.
- VI. Magnetic Balance Test
- VII. Noise-level measurement.
- VIII. Measurement of zero-phase sequence impedance.
- IX. Measurement of Harmonics of no-load current.
- X. Pressure relief device test (if provided).The pressure relief device shall be subject to increasing fluid pressure. It shall operate before reaching the test pressure as specified in the above class. The operating pressure shall be recorded. The device shall seal-off after the excess pressure has been released.
- XI. Paint adhesion test
- XII. Test for Buchholz relay (above 1000 KVA)
- XIII. Special tests other than type and routine tests, as agreed between purchaser and Bidder shall also be carried out as per the relevant standards.

**C. ROUTINE TESTS:**

Following tests shall have to be carried out by manufacturers at their works (to be conducted on all units; before offering proto/lot acceptance tests and record of the same shall be maintained and produced at the time of acceptance tests for inspector's verification.

- I. Measurement of winding resistance (at all taps if applicable) [IS1180

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- II. Measurement of voltage ratio, polarity, phase sequence and vector group [IS1180 (Part1):2014].
- III. Measurement of short-circuit impedance (principal tapping, when applicable)
- IV. Load losses at rated current and normal frequency at 50 % and 100 % load [IS1180 (Part1):2014].
- V. Measurement of no-load loss and current [IS1180 (Part1):2014].
- VI. Measurement of insulation resistance [IS1180 (Part1):2014].
- VII. Induced over-voltage withstand test [IS1180 (Part1):2014].
- VIII. Separate-source voltage withstand test [IS1180 (Part1):2014]
- IX. Pressure test (as per IS: 1180-2014).
- X. Oil Leakage test (as per IS: 1180-2014).
- XI. Neutral current measurement, shall not be more than 2% of full load current (CEA Guideline 2008 clause no 34.9)
- XII. Oil samples (one sample per lot) to comply with IS 1866.
- XIII. Measurement of no load losses and magnetizing current at rated frequency and at 90%, 100% and 112.5% voltage.
- XIV. Calibration of WTI and OTI

**D. ACCEPTANCE TESTS :**

The following tests shall be carried out on transformers in the presence of purchaser's representative at the supplier's works before dispatch without any extra charges.

- I. The testing shall be carried out in accordance with IS: 1180 Part-1 2014 and IS: 2026 latest amendment & CEA Guideline as applicable.
- II. Valid calibration certificates from NABL lab of testing equipment's shall be available at supplier works for testing of transformers. Manufacturer shall possess 0.1 Class of accuracy instruments for measurement of losses.
- III. The bidder shall require to offer the stage inspection after the successful proto type inspection and as confirmed by the DISCOM. The stage inspection shall be carried out before oven/drying of the job and all the verification as per the below clause No: A shall be carried out at the time of inspection. The manufacturing of lot shall be carried out after successful confirmation of the stage inspection.

**a. Physical verification to be carried out on one transformer from offered lot:-**

- I. Checking of weights of individual components and total weight, dimensions, fitting and accessories, tank sheet thickness, oil quantity, materials, finish and workmanship as per GTP , QA Plan and approved drawings.
- II. Verification of thickness of paint coating.
- III. Physical verification of core coil assembly and measurement of flux density of one unit of

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each rating, in every inspection with reference to short circuit test report.

**b. Test to be carried out on all transformers:-**

- I. Measurement of load losses at 50 % and 100 % load at maximum current tap.
- II. Measurement of short-circuit impedance at principal tap, and on maximum and minimum current tapping as per IS 2026 Part-3.
- III. Neutral current to be measured by clamp-on meter, it shall not be more than 2% of full load current (CEA Guideline 2008 clause no 34.9). The supplier shall be required to confirm for the arrangement for the measurement of Neutral current through Ammeter installed in testing room so that inspector can monitor it.)
- IV. Measurement of no load losses & current at rated frequency and voltage. [IS1180 (Part1):2014].
- V. Measurement of over excitation current at rated frequency and at 112.5% voltage.
- VI. Induced over-voltage withstand test [IS1180 (Part1):2014].
- VII. Separate-source voltage withstand test [IS1180 (Part1):2014].
- VIII. Physical verification of finishing and workmanship as per GTP and QA Plan and approved drawings.
- IX. Verification of oil level through oil level gauge.

**c. Test to be carried out on one transformer from offered lot:-**

- I. Measurement of winding resistance [IS1180 (Part1):2014]]. The selected transformer shall not be in loading conditions at least for three hours.
- II. Measurement of voltage ratio (Of each tapings), polarity, phase sequence and vector group [IS1180 (Part1):2014]].
- III. Pressure test (as per IS: 1180-2014).
- IV. Measurement of insulation resistance [IS1180 (Part1):2014]].
- V. Oil leakage test (as per IS: 1180-2014) as per latest Amendment No-1, Annexure-E.
- VI. Collection of Oil samples from any transformer, to be sent for testing at NABL lab to comply with IS 1866. Testing charges will be borne by DISCOM.
- VII. Magnetic balance test.
- VIII. Temperature Rise Test on transformer having maximum load losses from each offered lot (Total losses guaranteed, offered in GTP at maximum current tap shall have to be fed for Temperature rise test). (Measurement of temperature rise on winding resistance shall be on middle phase)
- IX. To ascertain the quality of the transformer oil, the original manufacturer's tests report should be submitted at the time of inspection. Arrangements should also be made for testing of transformer oil, after taking out the sample from the manufactured transformers and tested in the presence of purchaser's representative.

**d. TOLERANCES:**

Unless otherwise specified herein the test value of the transformers supplied would be within the tolerance permitted in the relevant standards. **No positive tolerance is**

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**allowed on guaranteed losses.**

**7.0 INSPECTION:**

- I. All tests and inspection shall be made at supplier works mentioned in A/T. The manufacturer shall afford the inspector representing the purchaser all reasonable facilities, without charge to satisfy him that the material is being furnished in accordance with specification.
- II. The manufacturer shall provide all services to establish and maintain quality of workman ship in his works and that of his sub-contractors(for bought out material/equipment to ensure the mechanical / electrical performance of components, compliance with drawings, identification and acceptability of all materials, parts and equipment as per latest quality standards of ISO 9000.
- III. Along with the bid the manufacturer shall prepare Quality Assurance Plan identifying the various stages of manufacture, quality checks performed at each stage and the Customer hold points. The document shall also furnish details of method of checking, inspection and acceptance standards / values. However, purchaser or his representative shall have the right to review the inspection reports, quality checks and results of manufacturer’s in house inspection department which are not customer hold points and the manufacturer shall comply with the remarks made by purchaser or his representative on such reviews with regards to further testing, rectification or rejection etc. Manufacturer should submit the list of equipment for testing along with valid calibration certificates from NABL accredited laboratory to the purchaser along with the bid.
- IV. Purchaser shall have every right to appoint a third party inspection to carryout the inspection process. The purchaser has reserved the rights to have the test carried out at his own cost by an independent agency at NABL accredited laboratory, wherever the dispute regarding the quality of supplies arise.

**8.0 QUALITY ASSURANCE PLAN:**

- I. The Bidder shall invariably furnish following information along with their bid, failing which the bid shall be liable for rejection. Information shall be separately given for individual type of equipment offered.
  - a. Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards according to which the raw materials are tested. List of tests normally carried out on raw materials in the presence of Bidder’s representative, copies of test certificates.
  - b. Information and copies of test certificates as in (i) above in respect of bought out accessories.
  - c. List of manufacturing facilities available.
  - d. Level of automation achieved and list of areas where manual processing exists.
  - e. List of areas in manufacturing process, where stage inspections are normally

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carried out for quality control and details of such tests and inspection.

- f. List of testing equipment available with the bidder for final testing of equipment along with valid calibration reports shall be furnished with the bid. Manufacturer shall possess 0.1 class accuracy instruments for measurement of losses.
  - g. Quality Assurance Plan (QAP) with all points for purchaser's inspection.
- II. The successful Bidder shall within 30 days of placement of order, submit following information to the purchaser.
  - III. List of raw materials as well as bought out accessories and the names of sub-suppliers selected from those furnished along with offer.
  - IV. Type test certificates of the raw materials and bought out accessories.
  - V. The successful Bidder shall submit the routine test certificates of bought out accessories and central excise passes for raw material at the time of routine testing.
  - VI. The successful bidder shall have to submit the declaration on company letter head regarding utilization of bought out raw materials conforming to relevant IS/IEC and applicable rules & regulations with latest amendments during the inspection as per format attached as Annexure-III.

#### **9.0 DOCUMENTATION:**

The Bidder shall furnish along with the bid the dimensional drawings of the items offered indicating all the fittings. One copy of the dimensional drawing and internal construction drawing of each rating transformer shall be submitted with the tender. These drawings shall be of A-3(420 x 297 mm) size only. Guaranteed and other technical particulars of the transformers as per the A/T shall also be submitted in A-4 size for approval in the Performa attached with tender only. The bidder shall submit drawings and details along with offer as well as before offering the prototype transformer.

- i) Dimensional tolerances
- ii) Weight of individual components and total weight

#### **10.0 PACKING & FORWARDING:**

The packing shall be done as per the manufacturer's standard practice. However, it should be ensured that the packing is such that, the material would not get damaged during transit by Rail / Road / Sea. The marking on each package shall be as per the relevant IS.

#### **11.0 GTP: GUARANTEED TECHNICAL PARTICULARS FOR TRANSFORMERS:**

- I. GTP to be filled in and submitted by the tenderer in the Annexure-I attached with the tender. In Annexures, the specific values shall be furnished and only quoting of IS reference is not sufficient. If the Annexures are not submitted duly filled in with the offer, the offer shall be liable for rejection.

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- II. The discrepancies between the specification and the catalogues, literatures and indicative drawings which are subject to change, submitted as part of the offer, shall not be considered and representation in this regard will not be entertained.
- III. If it is observed that there are deviations in the offer in G.T.P. or those specified in the relevant Annexure of Commercial terms and Condition then such deviations shall be treated as deviations. The deviation brought out shall be supported by authentic documents, standards and clarifications, otherwise the offer may be liable for rejection.
- IV. The tenderer shall submit the list of orders for similar type of equipment, executed or under execution during last three years, with full details to enable the purchaser to evaluate the tender.

**12.0 AUDIT INSPECTION:**

- I. The representative of the Company may pick up samples from the lots supplied by the Supplier at the Stores location of the Company at random for quality check. The samples picked up will be tested for acceptance tests / type tests or as decided by DISCOM at Government approved laboratory in presence of representatives of supplier and DISCOM as per relevant ISS/BIS/ DISCOM P.O. specifications. In case if the materials does not confirm to specifications or fails at Government approved laboratory or other laboratory decided by DISCOM for testing and if subsequent testing are to be carried out (which will solely at DISCOM discretion), then all Testing fees, expenses of the inspector and other expenses incurred by DISCOM will be to supplier's account. The decision in this regard for acceptance as above of DISCOM shall be final and this will be binding on the supplier.
- II. The test results will be binding on the suppliers. DISCOM in general will not allow re-sampling. If the material fails in any of the acceptance tests/type tests carried out (except for no load and load losses), the full lot of materials will be considered as rejected, and if replacement is not possible due to consumption of the materials, in that case for whole of the rejected lot, DISCOM will deduct penalty as per below mentioned details. If the same are not utilized / consumed, Company at sole discretion may ask for replacement or may accept with penalty having details as under and all these will be binding on the supplier.
- III. In case of failure of sample in testing other than losses:  
To reject the complete lot OR recovery of penalty up to 30% in line with commercial condition clause of audit testing.

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- IV. In case of failure of sample in testing as well as losses:
- a. To reject the complete lot OR recovery of both type penalty as under.
    - Up to 30% penalty in line with commercial condition clause of audit testing.
    - Excess losses penalty as under.
      - Rs. 493.52 per Watt for No load loss.
      - Rs. 272.92 per Watt for Load loss.

**13.0 GUARANTEE FOR THE TRANSFORMERS:**

- I. Guarantee period shall be 60 months from the date of installation or 66 months from the date of receipt by purchaser whichever is earlier. If the goods, stores and equipment found defective due to bad design or workmanship, to be technically evaluated as per the detailed guidelines issued vide letter no. GUVNL/Tech-3/DE-1/Transformer/2204 DTD. 24.09.2018, the same should be repaired or replaced by you free of charge if reported within 66 months of their receipt at site or 60 months from the date of commissioning of equipment whichever is earlier. You will be responsible for the proper performance of the equipment / materials for the respective guarantee period.
- II. The supplier shall return guarantee failed transformers duly repaired and tested as per approved GTP and tender specification within 45 days from the date of receipt at repair shop without any cost. If the same is not repaired / replaced within stipulated period, then the end cost of such equipment will be retained by way of recovering the amount from Suppliers pending / ensuing bills with the Company / other subsidiary Companies of GUVNL against any of the order, and / or by encashing Bank Guarantee available with the Company / other subsidiary Companies of GUVNL against any of the order, till the return of the equipment. No interest will be paid on the amount so retained / recovered. In case of material / item not returned duly repaired within 45 days, penalty shall be imposed @ 0.5% per week or part thereof, maximum up to 10% of the cost of undelivered material / equipment beyond specified time limit. In case of material / item not returned duly repaired within 5 months, total cost of the material/ item along with penalty will be adjusted/recovered from the pending bills of the supplier or encashing available performance bank guarantee submitted against guarantee period. This clause itself shall be the notice to the supplier about encashment of Bank Guarantee in case of his failure to adhere to timelines & no separate notice will be served. The outage period i.e. period from the date of failure till unit is repaired/ replaced shall not be counted for arriving at the guarantee period.
- III. After intimation of failure of transformer failed within guarantee period, DISCOM will arrange for the dispatch of guarantee period failed transformer to firm’s works at the cost of DISCOM. On receipt of guarantee period failed transformer at firm’s works, the external inspection will be carried out by the representative of DISCOM not below the rank of Junior Engineer. The cost of any outer component damage not

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because of supplier's fault and required to be provided will be reimbursed to the supplier as per the approved rate of DISCOM on the strength of joint external inspection report.

- IV. No internal inspection of failed unit is to be carried out in presence of representative of DISCOM. However, the supplier may prepare an internal inspection report of failed unit for his study and analysis. If required, such analysis shall be furnished to DISCOM.
- V. Testing of transformer will be done in presence of company's Engineer to ensure losses as per GTP, Transformer found with higher losses than GTP will not be accepted and cost thereof will be recovered. The new Transformers supplied in this circumstances must as per GTP submitted with tender and shall match the losses offered by the supplier as per Tender.
- VI. The testing of each G.P.failed transformers will be carried out for all acceptance tests as per the relevant standard where no load losses and load losses are also required to be maintained identical as per GTP.
- VII. The supplier situated outside Gujarat State shall have to establish suitable and adequate arrangement for repairing and testing of failed transformer in Gujarat State at his cost. This arrangement shall have to be continued up to the completion date of guarantee period of supply of last lot.
- VIII. In case of effect of major natural calamity conditions, like transformer submerged in the water, or /and fall down in mass quantity, free repairing of the failed transformer during the guarantee period shall not be applicable. This natural calamity conditions will be decided by the concerned DISCOM."
- IX. For the Transformer failed during Guarantee period on account of technical reasons mentioned in detailed guidelines issued vide letter No. GUVNL/Tech-3/DE-1/Transformer/2204 dated 24/09/2018, DISCOMs may get such transformers repaired at any supplier's work, if deemed fit.
- X. The cost of repairing, as per prevailing rates of repairing orders placed to repairing agencies for repairing of OGP failed Transformers, will be paid to such supplier.
- XI. The cost for transportation from suppliers' manufacturing unit to respective Division Office of DISCOM will be borne by the Supplier, while other clauses of repairing orders will be applicable to suppliers for repairing of such transformers.
- XII. The suppliers have to submit consent for repairing of above mentioned failed Transformers with bids in case they are willing for the same in the format mentioned as Annexure-X as under. If bidder does not submit consent along with technical bid, it will be presumed that bidder is not interested for repairing of failed transformers.

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## Schedule A

### **A. H.V. BUSHINGS**

- I. JAYASHREE
- II. BEPCO.
- III. W.S. INSULATORS
- IV. ASSOCIATED PORCELAIN (11KV ONLY)
- V. JAIPUR GLASS
- VI. SESHASAYEE
- VII. LUSTER CERAMICS
- VIII. AGRAWAL SALT CO., BIKANER.
- IX. B.P.P.L., BIKANER.
- X. VENKATESHWARA CERAMICS P.
- XI. CJI PORCELAIN INDIA LTD.
- XII. MAXWELL CERAMIC, WADHWAN, (ONLY 11KV)
- XIII. RAVIKIRAN (ONLY 11KV)
- XIV. VISHAL MALLEABLE LTD.
- XV. AS INSULATOR
- XVI. REAL INSULATOR
- XVII. REDIANANT CERAMIC
- XVIII. SUN INSULATOR
- XIX. PRIME INSULATOR
- XX. GENESIS ENTERPRISES PRIVATE LIMITED
- XXI. SURAJ CERMAICS INDUSTRIES, BIKANER, RAJASTHAN
- XXII. GUJARAT HEAVY ELECTRICAL & INSULATORS PVT LTD, SURENDRANAGAR

### **L.V. BUSHINGS (porcelain material):**

- 1) J.S.I. (RISHRA)
- 2) LUSTER CERAMICS
- 3) JAIPUR GLASS
- 4) AGRAWAL SALT CO., BIKANER.
- 5) B.P.P.L., BIKANER.
- 6) VENKATESHWARA CERAMICS, PVT. LTD.
- 7) CJI PORCELAIN
- 8) MAXWELL CERAMIC, WADHWAN.
- 9) RAVIKIRAN
- 10) VISHAL MALLEABLE LTD.
- 11) AS INSULATOR
- 12) REAL INSULATOR
- 13) REDIANANT CERAMIC
- 14) SUN INSULATOR
- 15) PRIME INSULATOR
- 16) GENESIS ENTERPRISES PRIVATE LIMITED
- 17) M/s Suraj Cermaics Industries, Bikaner, Rajasthan
- 18) M/s Gujarat Heavy Electrical & Insulators Pvt Ltd, Surendranagar

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**Annexure-X**

**(CONSENT FOR REPAIRING OF FAILED DISTRIBUTION TRANSFORMERS)**

Sub. : Consent for repairing of failed distribution transformers by bidder.

Ref.: 1.GUVNL letter no. GUVNL/Tech-3/DE-1/ Transformer/2204 dtd.24.09.2018

2. Tender No. \_\_\_\_\_

I (full name)\_\_\_\_\_ authorized signatory of M/s\_\_\_\_\_ on behalf of our company interested to repair failed distribution transformers and hereby giving our consent for repairing of distribution transformers failed during Guarantee period on account of technical reasons mentioned in detailed guidelines issued vide letter no. GUVNL/Tech-3/DE-1/ Transformer/2204 dtd.24.09.2018 at our works (for Gujarat based bidders)/repairing unit situated in Gujarat(for outside Gujarat based bidders) of all DISCOMs (i.e. PGVCL/MGVCL/UGVCL/DGVCL) at the prevailing rates and all other terms and conditions of repairing orders placed to repairing agencies for repairing of OGP failed transformers by respective DISCOMs.

We also agree that cost of transportation from our works to respective Division office of the concern DISCOMs will be borne by us.

Address of works in case of Gujarat based bidder:

Address of repairing unit in case of outside Gujarat based bidder:

Seal of the Firm

Signature of the Tenderer

Signature of Tenderer	Company's Round Seal	Date	Place
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**Annexure-I**

**GUARANTEED TECHNICAL PARTICULARS**

<b>Sr. No.</b>	<b>Particulars</b>	<b>Unit / Type</b>	<b>As per Firm's Offer</b>
<b>1</b>	<b>Name of manufacturer</b>		
<b>2</b>	<b>Place of Manufacturing</b>		
<b>3</b>	<b>Transformer capacity</b>	KVA	
<b>4</b>	<b>Voltage</b>	11/0.433-0.250 KV	
	<b>Rated current in Amps</b>		
	<b>HV Winding</b>		
	<b>LV Winding</b>		
<b>5</b>	<b>No. of Phases</b>	3 No.	
<b>6</b>	<b>Vector Group</b>	DYn-11	
<b>7</b>	<b>Type of Cooling</b>	ONAN	
<b>8</b>	<b>Type of Transformer</b>	Unsealed	
<b>9</b>	<b>Off Load Tap Details</b>		
	a) No. of tap positions in HV winding		
	b) Voltage variation		
<b>10</b>	<b>Energy Efficiency Level</b>	Level-1	
<b>11</b>	<b>Losses</b>		
<b>i</b>	<b>Core loss</b>	Watts	
	a) at Normal Voltage	Watts	
	b) at Maximum Voltage	Watts	
<b>ii</b>	a) Full Load losses at 75 deg.C (Normal Tap)	Watts	
	b) Full Load losses at 75 deg.C (Maximum current Tap) For 200KVA & above rating Transformers	Watts	
<b>iii</b>	a) Total losses at 50 % loading at 75 deg.C. (Normal Tap)	Watts	
	b) Total losses at 50 % loading at 75 deg.C. (Maximum current Tap) For 200KVA & above rating Transformers	Watts	
<b>iv</b>	a) Total losses at 100 % loading at 75 deg. C (Normal Tap)	Watts	
	b) Total losses at 100 % loading at 75 deg.C (Maximum current Tap) For 200KVA & above Transformers	Watts	
<b>12</b>	<b>Percentage Impedance at 75 deg.C.</b>	%	
<b>I.</b>	Principal tap		
<b>II.</b>	Maximum Current Tap		
<b>III.</b>	Minimum current Tap		

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Sr. No.	Particulars	Unit / Type	As per Firm's Offer
<b>13</b>	<b>Maximum temperature rise of</b>		
	a) Windings by resistance method	40 deg C , 45 C (35 deg C for 5KVA)	
	b) Oil by Thermometer	35 deg C , 40 C (30deg C for 5KVA)	
<b>14</b>	<b>Clearances</b>		
	a) Core & LV	mm	
	b) LV & HV	mm	
	c) HV Phase to Phase	mm	
	d) End insulation clearance to Earth	mm	
	e) Any point of winding to tank	mm	
	f) HV to earth creepage distance	mm	
	g) LV to earth creepage distance	mm	
	h) Clearance between yoke to top plate	mm	
	i) Clearance between yoke to tapping switch	mm	
<b>15</b>	<b>Efficiency at 75 deg.C.</b>		
	<b>a) Unity P.F.</b>		
	1) 125% load	%	
	2) 100% load	%	
	3) 75% load	%	
	4) 50% load	%	
	5) 25% load	%	
	<b>b) 0.8 P.F.</b>		
	1) 125% load	%	
	2) 100% load	%	
	3) 75% load	%	
	4) 50% load	%	
	5) 25% load	%	
<b>16</b>	<b>Regulation at</b>		
	a) Unity P.F.		
	b) 0.8 P.F. at 75 deg.C.		
<b>17</b>	<b>CORE</b>	<b>CRGO</b>	
<b>i</b>	Core Grade		To be declared
<b>ii</b>	Core diameter	mm	
<b>iii</b>	Gross Core area	Mtr <sup>2</sup>	
<b>iv</b>	Net Core area	Mtr <sup>2</sup>	
<b>v</b>	Flux density	Wb/Mtr <sup>2</sup>	
<b>vi</b>	Wt. of Core	Kg	

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Sr. No.	Particulars	Unit / Type	As per Firm's Offer
vii	Loss per kg. of Core at the specified Flux density	Watts	
viii	Core window height	mm	
ix	Centre to centre distance of the core	mm	
x	The nominal flux density at		
	a) 100% rated voltage	$\leq 1.69 \text{ Wb/Mtr}^2$	
	b) 112.5% of rated voltage	$\leq 1.9 \text{ Wb/Mtr}^2$	
xi	% No load current of full load current at rated voltage and frequency on the secondary and Increase of voltage by 112.5%		
	(i) CRGO Core: at 100% and 112.5% of rated Voltage		
	a) Up to 200 KVA Transformer	$\leq 3\%$ and $\leq 6\%$	
	b) Above 200 KVA Transformer	$\leq 2\%$ and $\leq 5\%$	
	(ii) Amorphous Core: at 100% and 112.5% of rated Voltage		
	a) All Ratings	$\leq 2\%$ and $\leq 5\%$	
<b>18</b>	<b>WINDINGS</b>	<b>Copper</b>	Yes/No
i	No. of L.V. Turns	No.	
ii	No. of H V turns	No.	
iii	Size of LV Conductor bare/ covered	mm	
iv	Size of HV conductor bare/covered	mm	
v	No. of parallels	No.	
vi	Resistance of HV winding at 20 deg.C	Ohm	
vii	Resistance of LV winding at 20 deg.C	Ohm	
viii	Current density of LV winding	Amps/sq.mm.	
ix	Current density of HV winding	Amps/sq.mm.	
x	Wt. of the LV winding for Transformer	kg.	
xi	Wt. of the HV winding for Transformer	kg.	
xii	No. of LV Coils/phase	No.	
xiii	No. of HV coils / phase	No.	
xiv	Height of LV Windings	mm	
xv	Height of HV winding	mm	
xvi	ID/OD of LV winding	mm	
xvii	ID/OD of HV winding	mm	
xviii	Size of the duct in LV winding	mm	
xix	Size of the duct in HV winding	mm	
xx	Size of spacers provided b/w HV coils of same phase	mm	

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Sr. No.	Particulars	Unit / Type	As per Firm's Offer
xxi	Size of spacers provided b/w HV turns of same phase	mm	
xxii	Size of the duct between HV & LV	mm	
xxiii	Inter layer insulation provided in design for		
	1) Top & bottom layer		
	2) In between all layer		
	3) Details of end insulation		
	4) Whether wedges are provided at 50% turns of the HV coil		
xxiv	Insulation materials provided		
	a) For Conductors		
	(1) HV		
	(2) LV		
	b) For Core		
xxvi	Material and Size of the wire used		
	1) HV a) SWG	No.	
	b) Dia.	mm	
	2) LV a) Strip size	mm X mm	
	b) No. of Conductors in parallel	No	
	c) Total area of cross section	sq.mm.	
xxvii	Is pressure ring provided		Yes/No
	a) size of the pressure ring		
	b) Material of pressure ring		
<b>19</b>	<b>Weight content of</b>		
	a) Core lamination (min)	KG	
	b) Windings (min) Aluminium/Copper	KG	
	c) Tank & Fittings	KG	
	d) Oil	KG	
	e) Oil qty (min)	Litre	
	f) Total Weight	KG	
<b>20</b>	<b>Oil Data</b>		
	1. Qty for first filling (min)	Litre	
	2. Grade of oil used		
	3. Maker's name		
	4. BDV at the time of filling	KV	
<b>21</b>	<b>Transformer</b>		
	1) Overall length x breadth x height	mm X mm X mm	
	2) Shape of Tank		
	2) Tank length x breadth x height	mm X mm X mm	
	3) Thickness of plates for		
	a) Side plate (min)	mm	

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	b) Top & Bottom plate (min)	mm	
	4) Conservator Dimensions	mm X mm	
	5) Tank base channel dimensions	mm X mm X mm	
<b>22</b>	<b>HV Bushings &amp; Terminals</b>		
	1) Make of HV bushing		
	2) Rating in KV	KV	
	3) Turret Height	mm	
	4) Material of HV terminal	Brass/Copper	
	5) Current Density of HV terminal	Amps/sq.mm.	
	6) Material of Bushing		
	7) Creepage factor	KV/mm	
<b>23</b>	<b>LV Bushings &amp; Terminals</b>		
	1) Make of LV bushing		
	2) Rating in KV	KV	
	3) Turret Height	mm	
	4) Material of LV terminal	Brass/Copper	
	5) Current Density of LV terminal	Amps/sq.mm.	
	6) Material of Bushing		
	7) Creepage factor	KV/mm	
<b>24</b>	<b>LV Cable Box:</b>		
	<b>1) Material of construction</b>		
	<b>2) Gland plate material for cable box</b>		
	3) Clearance in cable box (mm) a) Ph-ph b) Ph-n c) Ph-E		
	4) Bus bar material & size		
	5) Bus bar current density		
	6) WTI CT a) Type b) Ratio c) Accuracy class		
	7) Cable Box IP		
<b>24</b>	<b>Radiators</b>		
	1) Heat dissipation by tank walls exclusive top & bottom		
	2) Heat dissipation by cooling tube		
	3) Dia. & thickness of cooling tube		
	4) Whether calculation sheet for selecting cooling area to ensure that the transformer is capable of giving continuous rated output without exceeding temperature rise is enclosed.	Yes/No	

Signature of Tenderer

Company's Round Seal

Date

Place



<b>25</b>	Whether the name plate gives all particulars as required in Tender	Yes/No	
<b>26</b>	Whether the transformer offered is already type tested for the design and test reports enclosed	Yes/No	

Signature of Tenderer

Company's Round Seal

Date

Place

## Annexure - II

Digit/letter No.	Details	TIN	Remark
1	Name of Company	M	First letter of DISCOM name
2	KVA rating	5	for 5/10/16/25/63/100/200/500/800/1000/1250 KVA ratings digits will be respectively 1/2/3/4/5/6/7/8/9/10/11
3	Type of Core Material	1	CRGO-1, Amorphous-2
4	Core construction	1	Stack-1, Wound-2
5	Supplier Name Code	1	each supplier will be given 2 digit code no. e.g. M/s XYZ given code no.15
6		5	
7	Month of manufacturing	0	2 digits for Month of manufacturing
8		2	
9	Year of manufacturing	1	2 digits for Year of manufacturing
10		7	
11	CPP Tender No	9	4 digits for CPP tender no.
12		0	
13		3	
14		2	
15	Sr. No. of transformer given by Supplier	0	5 digits for transformer sr. no. given by supplier (e.g. M/s XYZ will give transformer sr. no. from 00001 to 00260 for P.O. of 260 no. transformers issued to them vide CPP tender no.9032 )
16		0	
17		0	
18		0	
19		1	

Signature of Tenderer

Company's Round Seal

Date

Place

**Annexure-III**

(ON COMPANY LETTER HEAD)

DECLARATION REGARDING UTILIZATION OF BOUGHT OUT RAW MATERIALS  
CONFORMING TO RELEVANT IS/IEC AND APPLICABLE RULES & REGULATIONS WITH  
LATEST AMENDMENTS

Reference: (1) Master LOA no. \_\_\_\_\_

(2) DISCOM LOA no. \_\_\_\_\_

(3) AT no. \_\_\_\_\_

(4) Supplier inspection call letter no. \_\_\_\_\_

In connection with the above subject and reference I/ We declare & undertake the following.

I / We, \_\_\_\_\_ the under signed & authorized signatory of the Company have confirmed the technical specification & GTP of the tender no. \_\_\_\_\_ in all respect during tender process.

Accordingly, I / We hereby declare & undertake that all the bought out raw materials which are utilized in the manufacturing of the distribution transformers supplied against AT and inspection call mentioned under references are conforming to relevant IS/IEC and applicable rules & regulations with latest amendments.

I / We, declare that our supplied material is strictly in line with the tender technical specifications and GTP requirements.

(Signature of the Authorised Signatory of the Supplier Seal of the Supplier)

Name:

Designation:

Date:

Name of the Supplier:

Address of works at which inspection conducted:

Signature of Tenderer	Company's Round Seal	Date	Place
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#### Annexure-IV

➤ **MARSHALLING BOX:**

- I. Marshalling Box of suitable size, made up of Mild Steel and with theft proof locking arrangement shall be provided.
- II. Marshalling box shall have IP 55 protection.
- III. The box shall have a sloping roof.
- IV. The box shall have hinged door with locking arrangement
- V. Marshalling Box shall have provision for wiring the WTI, OTI, MoG, PRV, Buchholz relay and LT CT terminals. The terminals shall be as per following table :

Sr. No	Particulars	Device	To (droppable TBs)
1	WTI -Alarm	WTI	T-1,2
2	OTI -Alarm	OTI	T-3,4
3	Buchh- Alarm	Buchholz Relay	T-5,6
4	MoG -Alarm	MOG	T-7,8
5	WTI-Trip	WTI	T-9,10
6	OTI-Trip	OTI	T-11,12
7	Buchh- Trip	Buchholz Relay	T-13,14
8	PRV-Trip	PRV	T-15,16
9	Door sensor	Door	T-17,18
10	NCT	Neutral CT	T-19,20, 21 (GROUND)
11	WTI CT	WTI CT	T-22,23, 24 (GROUND)
12	AC Aux Supply	AC source	T-24,25
13	Heater & Light Socket	Loop	T-26,27
14	Spare		T28 to T36

Note:

- I. Conservator and Buchholz contacts are applicable for Transformers above 1000 kVA. For Transformers rating less than 1000 kVA, these contacts shall be spare contacts.
- II. Neutral CT (NCT) is not under the scope of the supplier

- VI. WTI/OTI Meter shall be installed/wired in the marshalling box
- VII. Wiring in Marshalling box shall be done by 2.5 sq.mm Cu FRLS PVC stranded panel

Signature of Tenderer	Company's Round Seal	Date	Place
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wires.

- VIII. Plastic ferrules engraved with black letters shall be used to mark the wires in the marshalling box.
- IX. The schematic diagram of circuitry inside the marshalling box be prepared and fixed inside the door.
- X. To prevent internal condensation, a space heater with thermostat shall be provided and heater shall be controlled by MCB.
- XI. All the flexible Mattel conduits cables between the transformer and control cabinet shall be included in the scope of supply by the bidder.

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Signature of Tenderer

Company's Round Seal

Date

Place