3-Phase Distribution Transformers 11 or 33 kV/433-250V (Outdoor Type)

1. **SCOPE:**

i) This specification covers design, engineering, manufacture, assembly, stage testing, inspection and testing before supply and delivery at site of oil immersed, naturally cooled 3-phase 11 kV/433 - 250 V and 33 kV/433-250 V distribution transformers for outdoor use.

ii) 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, in a manner acceptable to the purchaser, who will interpret the meanings of drawings and specification and shall have the power to reject any work or material which, in his judgment is 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.

iii) 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.

iv) All outdoor apparatus, including bushing insulators with their mountings, shall be designed so as to avoid any accumulation of water.

2 STANDARD RATINGS:

The standard ratings shall be 16, 25, 63, 100,160, 200, 250, 315, 400, 500, 630, 1000, 1250, 1600, 2000 and 2500 kVA for 11 kV distribution transformers and 100, 160, 200, 315, 400, 500, 630, 1000, 1250, 1600,2000, 2500 kVA for 33 kV distribution transformers.

3 STANDARDS:

3.1 The major materials used in the transformer shall conform in all respects to the relevant/specified Indian Standards and international Standards with latest amendments thereof as on bid opening date, unless otherwise specified herein. Some of the applicable Indian Standards are listed as hereunder:

3.2

Indian Standard	Title	International
IS -2026	Specification for Power Transformers	IEC 76
IS 1180 (Part-I): 2014	Outdoor Type Oil Immersed Distribution Transformers upto and including 2500kVA, 33kV-Specification	
IS 12444	Specification for Copper wire rod	ASTM B-49
IS-335	Specification for Transformer/Mineral Oil	IEC Pub 296
IS-5	Specification for colors for ready mixed paints	
IS -104	Ready mixed paint, brushing zinc chromate, priming	
IS-2099	Specification for high voltage porcelain bushing	
IS-649	Testing for steel sheets and strips and magnetic circuits	
IS- 3024	Cold rolled grain oriented electrical sheets and strips	
IS - 4257	Dimensions for clamping arrangements for bushings	
IS - 7421	Specification for Low Voltage bushings	
IS - 3347	Specification for Outdoor Bushings	DIN 42531 to 33
IS - 5484	Specification for Al Wire rods	ASTM B - 233
IS - 9335	Specification for Insulating Kraft Paper	IEC 554
IS - 1576	Specification for Insulating Press Board	IEC 641
IS - 6600	Guide for loading of oil Immersed Transformers	IEC 76
IS - 2362	Determination of water content in oil for porcelain bushing of transformer	
IS - 6162	Paper covered Aluminium conductor	
IS - 6160	Rectangular Electrical conductor for electrical machines	
IS - 5561	Electrical power connector	
IS - 6103	Testing of specific resistance of electrical insulating	
IS - 6262	Method of test for power factor and dielectric constant of	
IS - 6792	Determination of electrical strength of insulating oil	
IS - 10028	Installation and maintenance of transformers.	

4 SERVICE CONDITIONS:

4.1 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).

i) Location : At various locations in the country

ii) Maximum ambient air temperature (^{0}C) : 50

iii) Minimum ambient air temperature (^{0}C) : -5

iv) Maximum average daily ambient air temperature (^{0}C): 40

v) Maximum yearly weighted average ambient temperature(^{0}C) : 32

vi) Maximum altitude above Altitude of 5000 meters mean sea level (meters) :

for HP, J&K, Uttrakhand, Sikkim , Assam, Meghalaya, Manipur, Nagaland, Tripura, Arunachal Pradesh and Mizoram

Note:

1. The climatic conditions specified above are indicative and can be changed by the user as per requirements.
2. The equipment shall generally be for use in moderately hot and humid tropical climate, conducive to rust and fungus growth unless otherwise specified.

5 PRINCIPAL PARAMETERS:

5.1 The transformers shall be suitable for outdoor installation with three phase, 50 Hz, 11 kV or 33 kV system in which the neutral is effectively earthed and they should be suitable for service with fluctuations in supply voltage upto plus 12.5% to minus 12.5%.

(i) The transformers shall conform to the following specific parameters :

Sl.No.	**Item**	**11 kV Distribution Transformers**	**33 kV Distribution Transformers**
1	System voltage (Max.)	12 kV	36 kV
2	Rated Voltage (HV)	11 kV	33 kV
3	Rated Voltage (LV)	433 - 250 V*	433 - 250 V*
4	Frequency	50 Hz +/- 5%*	50 Hz +/- 5%
5	No. of Phases	Three	Three
6	Connection HV	Delta	Delta
7	Connection LV	Star (Neutral brought out)	Star (Neutral brought out)
8	Vector group	Dyn-11	Dyn-11
9	Type of cooling	ONAN	ONAN

Audible sound levels (decibels) at rated voltage and frequency for liquid immersed distribution transformers shall be as below (NEMA Standards):

kVA rating	Audible sound levels (decibels)
0-50	48
51-100	51
101-300	55
301-500	56
750	57
1000	58
1500	60
2000	61
2500	62

TECHNICAL REQUIREMENTS:

6.1.1 CORE MATERIAL

6.1.2.1 The core shall be stack / wound type of high grade Cold Rolled Grain Oriented or Amorphous Core annealed steel lamination having low loss and good grain properties, coated with hot oil proof insulation, bolted together and to the frames firmly to prevent vibration or noise. The core shall be stress relieved by annealing under inert atmosphere if required. The complete design of core must ensure permanency of the core loss with continuous working of the transformers. The value of the maximum flux density allowed in the design and grade of lamination used shall be clearly stated in the offer.

6.1.2.2 The bidder should offer the core for inspection and approval by the purchaser during manufacturing stage. CRGO steel for core shall be purchased only from the approved vendors, list of which is available at http://apps.powergridindia.com/ims/ComponentList/Power-former%20upto%20420%20kV-CM%20List.pdf

6.1.2.3 The transformers core shall be suitable for over fluxing (due to combined effect of voltage and frequency) up to 12.5% without injurious heating at full load conditions and shall not get saturated. The bidder shall furnish necessary design data in support of this situation.

6.1.2.4 No-load current up to 200kVA shall not exceed 3% of full load current and will be measured by energising the transformer at rated voltage and frequency. Increase of 12.5% of rated voltage shall not increase the no-load current by 6% of full load current.

or

No-load current above 200kVA and upto 2500kVA shall not exceed 2% of full load current and will be measured by energising the transformer at rated voltage and frequency. Increase of 12.5% of rated voltage shall not increase the no-load current by 5% of full load current.

6.1.2.5 Please refer to "**Check-list for Inspection of Prime quality CRGO for Transformers"** attached at Annexure-A. It is mandatory to follow the procedure given in this Annexure.

7 WINDINGS:

(i) Material:

7.1.1 HV and LV windings shall be wound from Super Enamel covered /Double Paper covered Aluminum / Electrolytic Copper conductor.

7.1.2 LV winding shall be such that neutral formation will be at top.

7.1.3 The winding construction of single HV coil wound over LV coil is preferable.

7.1.4 Inter layer insulation shall be Nomex /Epoxy dotted Kraft Paper.

7.1.5 Proper bonding of inter layer insulation with the conductor shall be ensured. Test for bonding strength shall be conducted.

7.1.6 Dimensions of winding coils are very critical. Dimensional tolerances for winding coils shall be within limits as specified in Guaranteed Technical Particulars (GTP Schedule I).

7.1.7 The core/coil assembly shall be securely held in position to avoid any movement under short circuit conditions.

7.1.8 Joints in the winding shall be avoided. However, if jointing is necessary the joints shall be properly brazed and the resistance of the joints shall be less than that of parent conductor. In case of foil windings, welding of leads to foil can be done within the winding.

8 TAPPING RANGES AND METHODS:

8.1.1 No tapping shall be provided for distribution transformers up to 100 kVA rating.

8.1.2 The tapping shall be as per provisions of IS: 1180 Part-I (2014).

8.1.3 Tap changing shall be carried out by means of an externally operated self-position switch and when the transformer is in de-energised condition. Switch position No.1 shall correspond to the

maximum plus tapping. Each tap change shall result in variation of 2.5% in voltage. Arrangement for pad locking shall be provided. Suitable aluminum anodized plate shall be fixed for tap changing switch to know the position number of tap.

9 OIL:

9.1 The insulating oil shall comply with the requirements of IS 335. Use of recycled oil is not acceptable. The specific resistance of the oil shall be as per IS 335.

9.2 Oil shall be filtered and tested for break down voltage (BDV) and moisture content before filling.

9.3 The oil shall be filled under vacuum.

9.4 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.

10 INSULATION LEVELS:

Sl. No.	Voltage (kV)	Impulse Voltage (kV	Power Frequency
1	0.433	-	3
2	11	75	28
3	33	170	70

11 LOSSES:

11.1 The transformer of HV voltage up to 11kV,the total losses(no-load + load losses at 75 ^{0}C) at 50% of rated load and total losses at 100% of rated load shall not exceed the maximum total loss values given in Table-3 upto 200kVA & Table-6 for ratings above 200kVA of IS 1180(Part-1):2014.

11.2 The maximum allowable losses at rated voltage and rated frequency permitted at 75 ^{0}C for 11/0.433 kV transformers can be chosen by the utility as per **Table-3 up to 200kVA** and **Table-6 for ratings above 200kVA** as per **Energy Efficiency Level-2 specified in IS 1180 (Part-1):2014** for all kVA ratings of distribution transformers.

11.3 The above losses are maximum allowable and there would not be any positive tolerance. Bids with higher losses than the above specified values would be treated as non-responsive. However, the manufacturer can offer losses less than above stated values. The utility can evaluate offers with losses lower than the maximum allowable losses on total owning cost basis in accordance with methodology given in Annex-I.

12 TOLERANCES:

12.1 No positive tolerance shall be allowed on the maximum losses displayed on the label for both 50% and 100% loading values.

13 PERCENTAGE IMPEDANCE:

The percentage impedance of transformers at 75 ^{0}C for different ratings upto 200 kVA shall be as per Table 3 and for ratings beyond 200 kVA shall be as per Table 6 of IS 1180(Part-1):2014.

14 Temperature rise: The temperature rise over ambient shall not exceed the limits given below:

14.1 The permissible temperature rise shall be as per IS: 1180 (Part-I):2014.

14.2 The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. Bidder shall submit the calculation sheet in this regard.

15 PENALTY FOR NON PERFORMANCE:

15.1 During testing at supplier"s works if it is found that the actual measured losses are more than the values quoted by the bidder, the purchaser shall reject the transformer and he shall also have the right to reject the complete lot.

15.2 Purchaser shall reject the entire lot during the test at supplier"s works, if the temperature rise exceeds the specified values.

15.3 Purchaser shall reject any transformer during the test at supplier"s works, if the impedance values differ from the guaranteed values including tolerance.

16 INSULATION MATERIAL:

16.1 Electrical grade insulation epoxy dotted Kraft Paper/Nomex and pressboard of standard make or any other superior material subject to approval of the purchaser shall be used.

16.2 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 cross-over 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.

17.1 TANK:

- Transformer tank construction shall conform in all respect to clause 15 of IS 1180(Part-1):2014.
- The internal clearance of tank shall be such, that it shall facilitate easy lifting of core with coils from the tank without dismantling LV bushings.
- All joints of tank and fittings shall be oil tight and no bulging should occur during service.
- Inside of tank shall be painted with varnish/hot oil resistant paint.
- The top cover of the tank shall be slightly sloping to drain rain water.
- The tank plate and the lifting lugs shall be of such strength that the complete transformer filled with oil may be lifted by means of lifting shackle/Hook Type.
- Manufacturer should carry out all welding operations as per the relevant ASME standards and submit a copy of the welding procedure and welder performance qualification certificates to the customer.

i) PLAIN TANK:

17.2.1 The transformer tank shall be of robust construction rectangular/octagonal/round/ elliptical in shape and shall be built up of electrically tested welded mild steel plates of thickness of 3.15 mm for the bottom and top and not less than 2.5 mm for the sides for distribution transformers upto and including 25 kVA, 5.0 mm and 3.15 mm respectively for transformers of more than 25 kVA and up to and including 100 kVA and 6 mm and 4 mm respectively above 100 kVA. Tolerances as per IS1852 shall be applicable.

17.2.2 In case of rectangular tanks above 100 kVA the corners shall be fully welded at the corners from inside and outside of the tank to withstand a pressure of 0.8 kg/cm^2 for 30 minutes. In case of transformers of 100 kVA and below, there shall be no joints at corners and there shall not be more than 2 joints in total.

17.2.3 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. The space above oil level in the tank shall be filled with dry air or nitrogen

conforming to commercial grade of IS 1747 for DT up to 63 KVA. For DT of 63 KVA and above rating, conservator shall be provided.

(i) The tank shall be reinforced by welded flats on all the outside walls on the edge of the tank.

(ii) Permanent deflection: The permanent deflection, when the tank without oil is subjected to a vacuum of 525 mm of mercury for rectangular tank and 760 mm of mercury for round tank, shall not be more than the values as given below:

(All figures are in mm)

Horizontal length of flat plate	**Permanent deflection**
Up to and including 750	5.0
751 to 1250	6.5
1251 to 1750	8.0
1751 to 2000	9.0

17.2.4 The tank shall further be capable of withstanding a pressure of 0.8kg/sq.cm and a vacuum of 0.7 kg/sq.cm (g) without any deformation.

17.2.5 The radiators can be tube type or fin type or pressed steel type to achieve the desired cooling to limit the specified temperature rise.

17.3 CORRUGATED TANK:

17.3.1 The bidder may offer corrugated tanks for transformers of all ratings.

17.3.2 The transformer tank shall be of robust construction corrugated in shape and shall be built up of tested sheets.

17.3.3 Corrugation panel shall be used for cooling. The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. Bidder shall submit the calculation sheet in this regard.

17.3.4 Tanks with corrugations shall be tested for leakage test at a pressure of 0.25kg/ sq cm measured at the top of the tank.

17.3.5 The transformers with corrugation should be provided with a pallet for transportation, the

dimensions of which should be more than the length and width of the transformer tank with corrugations.

18 CONSERVATOR:

(i) Transformers of rating 63 kVA and above with plain tank construction, the provision of conservator is mandatory. For corrugated tank and sealed type transformers with or without inert gas cushion, conservator is not required.

(ii) When a conservator is provided, oil gauge and the plain or dehydrating breathing device shall be fitted to the conservator which shall also be provided with a drain plug and a filling hole [32 mm (1¼")] normal size thread with cover. In addition, the cover of the main tank shall be provided with an air release plug.

(iii) 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. Volume of breather shall be suitable for 500g of silica gel conforming to IS 3401 for transformers upto 200 kVA and 1 kg for transformers above 200 kVA .

(iv) The capacity of a conservator tank shall be designed keeping in view the total quantity of oil and its contraction and expansion due to temperature variations. The total volume of conservator shall be such as to contain10% quantity of the oil. Normally 3% quantity the oil shall be contained in the conservator.

(v) The cover of 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.

(vi) The inside diameter of the pipe connecting the conservator to the main tank should be within 20 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^{0}C) should be above the sump level.

19 SURFACE PREPARATION AND PAINTING:

(i) GENERAL

19.1.1 All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

19.1.2 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, where ever airless spray is not possible, conventional spray be used with prior approval of purchaser.

19.2 CLEANING AND SURFACE PREPARATION:

a) 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.

b) Steel surfaces shall be prepared by shot blast cleaning (IS9954) to grade Sq.
2.5 of ISO 8501-1 or chemical cleaning including phosphating of the appropriate quality (IS 3618).

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

19.3 PROTECTIVE COATING:

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

19.4 PAINT MATERIAL:

i) Following are the types of paint which may be suitably used for the items to be painted at shop and supply of matching paint to site: Heat resistant paint (Hot oil proof) for inside surface

ii) For external surfaces one coat of thermo setting powder paint or one coat of epoxy primer followed by two coats of synthetic enamel/polyurethene base paint. These paints can be either air drying or stoving.

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.

19.5 PAINTING PROCEDURE:

i) 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.

ii) 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 coating. As a general rule, dry film thickness should not exceed the specified minimum dry film thickens by more than 25%.

19.6 DAMAGED PAINTWORK:

(i) Any damage occurring to any part of a painting scheme shall be made good to the same standard of corrosion protection and appearance as that was originally applied.

(ii) Any damaged paint work shall be made good as follows:

19.6.2.1 The damaged area, together with an area extending 25 mm around its boundary, shall be cleaned down to bare metal.

19.6.2.2 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.

19.6.2.3 The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

19.6.2.4 The paint shade shall be as per Annexure-Paint which is attached herewith.

19.7 DRY FILM THICKNESS:

19.7.1 To the maximum extent practicable the coats shall be applied as a continuous film of uniform thickness and free of pores. Overspray, skips, runs, sags and drips should be avoided. The different coats may or may not be of the same colour.

19.7.2 Each coat of paint shall be allowed to harden before the next is applied as per manufacturer"s recommendation.

19.7.3 Particular attention must be paid to full film thickness at the edges.

19.7.4 The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as given below:

Sl. No.	Paint type	Area to be painted	No. of coats	Total dry film thickness (min.) (microns)
1.	Thermo setting powder paint	inside outside	01 01	30 60
2.	**Liquid paint** a) Epoxy (primer) b) P.U. Paint (Finish coat)	outside outside inside	01 02	30 25 each

19.8 TESTS FOR PAINTED SURFACE:

19.8.1 The painted surface shall be tested for paint thickness.

19.8.2 The painted surface shall pass the cross hatch adhesion test and impact test as acceptance tests and Salt spray test and Hardness test as type test as per the relevant ASTM standards.

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

20 BUSHINGS:

20.1 The bushings arrangement shall be decided by utility during detailed engineering.

20.2 For 33 kV-36 kV class bushings shall be used for transformers of ratings 500 kVA and above. And for transformers below 500 KVA, 33 kV class bushings, for 11 kV -12 kV class bushings and for 0.433 kV- 1 kV class bushings shall be used.

20.3 Bushing can be of porcelain/epoxy material. Polymer insulator bushings conforming with relevant IEC can also be used.

20.4 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

20.5 Minimum external phase to phase and phase to earth clearances of bushing terminals shall be as follows:

Voltage	Clearance	
	Phase to phase	Phase to earth
33 kV	350mm	320mm
11 kV	255mm	140mm
LV	75mm	40mm

For DTs of 200 KVA and above, the clearances of cable box shall be as below:

Voltage	Clearance	
	Phase to phase	Phase to earth
33 kV	350mm	220mm
11 kV	130mm	80mm
LV	25mm	20mm

20.6 Arcing horns shall be provided on HV bushings.

20.7 Brazing of all inter connections, jumpers from winding to bushing shall have cross section larger than the winding conductor. All the Brazes shall be qualified as per ASME, section – IX.

20.8 The bushings shall be of reputed make supplied by those manufacturers who are having manufacturing and testing facilities for insulators.

20.9 The terminal arrangement shall not require a separate oil chamber not connected to oil in the main tank.

21 TERMINAL CONNECTORS:

21.1 The LV and HV bushing stems shall be provided with suitable terminal connectors as per IS 5082 so as to connect the jumper without disturbing the bushing stem. Connectors shall be with eye bolts so as to receive conductor for HV. Terminal connectors shall be type tested as per IS 5561.

22 LIGHTNING ARRESTORS:

22.1 9 kV, 5 kA metal oxide lightning arrestors of reputed make conforming to IS 3070 Part-III, one number per phase shall be provided.(To be mounted on pole or to be fitted under the HV bushing with GI earth strip 25x4 mm connected to the body of the transformer with necessary clamping arrangement as per requirement of purchaser.) Lightening arrestors with polymer insulators in conformance with relevant IEC can also be used. 1 clamp for LA shall also be provided for each HT bushing. Supply of LA is not included in DT supplier"s scope.

23 CABLE BOXES:

No cable box shall be provided in transformer below 200 kVA. Above 200kVA, Cable Boxes shall be provided on both HV & LV side.

23.1 In case HV/LV terminations are to be made through cables the transformer shall be fitted with suitable cable box on 11 kV side to terminate one 11kV/ 3 core aluminium conductor cable up to 240 sq. mm. (Size as per requirement).

The bidder shall ensure the arrangement of HT Cable box so as to prevent the ingress of moisture into the box due to rain water directly falling on the box. The cable box on HT side shall be of the split type with faces plain and machined and fitted with Neo-k-Tex or similar quality gasket and complete with brass wiping gland to be mounted on separate split type gland plate with nut-bolt arrangement and MS earthing clamp. The bushings of the cable box shall be fitted with nuts and stem to take the cable cores without bending them. The stem shall be of copper with copper nuts. The cross section of the connecting rods shall be stated and shall be adequate for carrying the rated currents. On the HV side the terminal rod shall have a diameter of not less than 12 mm. The material of connecting rod shall be copper. HT Cable support clamp should be provided to avoid tension due to cable weight.

23.2 The transformer shall be fitted with suitable LV cable box having non-magnetic material gland plate with appropriate sized single compression brass glands on LV side to terminate 1.1 kV/single core XLPE armoured cable (Size as per requirement).

24 TERMINAL MARKINGS:

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 small letter 2U, 2V, 2W. The neutral point terminal shall be indicated by the letter 2N. Neutral terminal is to be brought out and connected to local grounding terminal by an earthing strip.

26.1 The following standard fittings shall be provided :

i. Rating and terminal marking plates, non-detachable.
ii. Earthing terminals with lugs - 2 Nos.
iii. Lifting lugs for main tank and top cover
iv. Terminal connectors on the HV/LV bushings (For bare terminations only).
v. Thermometer pocket with cap - 1 No.
vi. Air release device (for non-sealed transformer)
vii. HV bushings - 3 Nos.

viii. LV bushings - 4 Nos.

ix. Pulling lugs

x. Stiffener

xi. Radiators - No. and length may be mentioned (as per heat dissipation calculations)/ corrugations.

xii. Arcing horns on HT side - 3 No . Only clamps for lightning arrestor shall be provided.

xiii. Prismatic oil level gauge.

xiv. Drain cum sampling valve.

xv. One filter valve on upper side of the transformer (For transformers above 200 kVA)

xvi. Oil filling hole having p. 1- ¼ „" thread with plug and drain plug on the conservator.

xvii. Silica gel breather (for non-sealed type transformer)

xviii. Base channel 75x40 mm for up to 100 kVA and 100 mmx50 mm above 100 kVA, 460 mm long with holes to make them suitable for fixing on a platform or plinth.

xix. 4 No. rollers for transformers of 200 kVA and above.

xx. Pressure relief device or explosion vent (above 200 kVA)

xxi. Oil level gauge

A. -5 °C and 90°C marking for non-sealed type Transformers

B.- 30°C marking for sealed type transformers

xxii. Nitrogen / air filling device/ pipe with welded cover Capable of reuse (for sealed type transformers)

xxiii. Inspection hole for transformers above 200 kVA

xxiii. Pressure gauge for sealed type transformers above 200 kVA.

xxiv. Buchholz relay for transformers above 1000 KVA.

27 FASTENERS:

27.1 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.

27.2 Bolts or studs shall not be less than 6 mm in diameter except when used for small wiring terminals.

27.3 All nuts and pins shall be adequately locked.

27.4 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 position.

27.5 All bolts/nuts/washers exposed to atmosphere should be as follows.

a) Size 12 mm or below – Stainless steel

b) Above 12 mm- steel with suitable finish like electro galvanized with passivation or hot dip galvanized.

27.6 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 and nuts are placed so that they are inaccessible by means of ordinary spanners, special spanners shall be provided.

27.7 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.

27.8 Taper washers shall be provided where necessary.

27.9 Protective washers of suitable material shall be provided front and back of the securing screws.

28 OVERLOAD CAPACITY:

28.1 The transformers shall be suitable for loading as per IS 6600.

29 TESTS:

29.1 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. The type test must have been conducted on a transformer of same design **during the last five years** at the time of bidding. The bidder shall furnish four sets of type test reports along with the offer. **In case, the offered transformer is not type tested, the bidder will conduct the type test as per the relevant standards including the additional type tests at his own cost in CPRI/ NABL accredited laboratory in the presence of employers representative(s) without any financial liability to employer in the event of order placed on him.**

29.2 Special tests other than type and routine tests, as agreed between purchaser and bidder shall also be carried out as per the relevant standards.

29.3 The requirements of site tests are also given in this clause.

29.4 The test certificates for all routine and type tests for the transformers and also for the bushings and transformer oil shall be submitted with the bid.

29.5 The procedure for testing shall be in accordance with IS1180 (Part-1) :2014 /2026 as the case may be except for temperature rise test.

29.6 Before dispatch each of the completely assembled transformers shall be subjected to the routine tests at the manufacturer"s works.

30 ROUTINE TESTS:

30.1 Ratio, polarity, phase sequence and vector group.

30.2 No Load current and losses at service voltage and normal frequency.

30.3 Load losses at rated current and normal frequency.

30.4 The test certificates for all routine and type tests for the transformers and also for the bushings and transformer oil shall be submitted after the receipt of order.

30.5 Impedance voltage test.

30.6 Resistance of windings at each tap, cold (at or near the test bed temperature).

30.7 Insulation resistance.

30.8 Induced over voltage withstand test.

30.9 Separate source voltage withstand test.

30.10 Neutral current measurement-The value of zero sequence current in the neutral of the star winding shall not be more than 2% of the full load current.

30.11 Oil samples (one sample per lot) to comply with IS 1866.

30.12 Measurement of no load losses and magnetizing current at rated frequency and 90%, 100% and 110% rated voltage.

30.13 Pressure and vacuum test for checking the deflection on one transformer of each type in every inspection.

31 TYPE TESTS TO BE CONDUCTED ON ONE UNIT:

In addition to the tests mentioned in clause 30 and 31 following tests shall be conducted:

31.1 Temperature rise test for determining the maximum temperature rise after continuous full load run. The ambient temperature and time of test should be stated in the test certificate.

31.2 Impulse voltage test: with chopped wave of IS 2026 part-III. BIL for 11 kV shall be 7 5 kV peak.

31.3 Short circuit withstand test: Thermal and dynamic ability.

31.4 Air Pressure Test: As per IS – 1180 (Part-1):2014.

31.5 Magnetic Balance Test.

31.6 Un-balanced current test: The value of unbalanced current indicated by the ammeter shall not be more than 2% of the full load current.

31.7 Noise-level measurement.

31.8 Measurement of zero-phase sequence impedance.

31.9 Measurement of Harmonics of no-load current.

31.10 Transformer tank shall be subjected to specified vacuum. The tank designed for vacuum shall be tested at an internal pressure of 0.35 kg per sq cm absolute (250 mm of Hg) for one hour. The permanent deflection of flat plates after the vacuum has been released shall not exceed the values specified below:

Horizontal length of flat plate (in mm)	**Permanent deflection (in mm)**
Upto and including 750	5.0
751 to 1250	6.5
1251 to 1750	8.0
1751 to 2000	9.0

31.11 Transformer tank together with its radiator and other fittings shall be subjected to pressure corresponding to twice the normal pressure or 0.35 kg / sq.cm whichever is lower, measured at the base of the tank and maintained for an hour. The permanent deflection of the flat plates after the excess pressure has been released, shall not exceed the figures for vacuum test.

31.12 Pressure relief device test: 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.

31.13 **Short Circuit Test and Impulse Voltage Withstand Tests**: The purchaser intends to procure transformers designed and successfully tested for short circuit and impulse test. In case the transformers proposed for supply against the order are not exactly as per the tested design, the supplier shall be required to carry out the short circuit test and impulse voltage withstand test at their own cost in the presence of the representative of the purchaser.

31.13.1 The supply shall be accepted only after such test is done successfully, as it confirms on successful withstand of short circuit and healthiness of the active parts thereafter on un-tanking after a short circuit test.

31.13.2 Apart from dynamic ability test, the transformers shall also be required to withstand thermal ability test or thermal withstand ability will have to be established by way of calculations.

31.13.3 It may also be noted that the purchaser reserves the right to conduct short circuit test and impulse voltage withstand test in accordance with the IS, afresh on each ordered rating at purchaser cost, even if the transformers of the same rating and similar design are already tested. This test shall be carried out on a transformer to be selected by the purchaser either at the manufacturer"s works when they are offered in a lot for supply or randomly from the supplies already made to purchaser"s stores. The findings and conclusions of these tests shall be binding on the supplier.

32 ACCEPTANCE TESTS:

32.1 **At least 10% transformers of the offered lot (minimum of one)** shall be subjected to the following routine/ acceptance test in presence of purchaser"s representative at the place of manufacture before dispatch without any extra charges. The testing shall be carried out in accordance with IS:1180 (Part-1): 2014 and IS:2026.

32.2 Checking of weights, dimensions, fitting and accessories, tank sheet thickness, oil quality, material, finish and workmanship as per GTP and contract drawings on one transformer of each type in every inspection.

32.3 Physical verification of core coil assembly and measurement of flux density of one unit of each rating, in every inspection with reference to short circuit test report.

32.4 Temperature rise test on one unit of the total ordered quantity.

33 TESTS AT SITE:

The purchaser will conduct the following test on receipt of transformers in their store. The utility shall arrange all equipment, tools & tackle and manpower for the testing. The bidder will depute his representative to witness the same. All such test shall be conducted by utility not later than 10 days from receipt of transformers.

i) Megger Test

ii) Ratio test

34 INSPECTION:

34.1 In respect of raw material such as core stampings, winding conductors, insulating paper and oil, supplier shall use materials manufactured/supplied by standard manufacturers and furnish the manufacturers" test certificate as well as the proof of purchase from these manufacturers (excise gate pass) for information of the purchaser. The bidder shall furnish following documents along with their offer in respect of the raw materials:

i. Invoice of supplier.
ii. Mill"s certificate.
iii. Packing list.
iv. Bill of landing.

v. Bill of entry certificate by custom.

Please refer to "**Check-list for Inspection of Prime quality CRGO for Transformers"** attached at Annexure-A. It is mandatory to follow the procedure given in this Annexure.

35 INSPECTION AND TESTING OF TRANSFORMER OIL:

35.1 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 as per IS: 335 , after taking out the sample from the manufactured transformers and tested in the presence of purchaser"s representative.

35.2 To ensure about the quality of transformers, the inspection shall be carried out by the purchaser"s representative at following two stages:-

35.2.1 Anytime during receipt of raw material and manufacture/ assembly whenever the purchaser desires.

35.2.2 At finished stage i.e. transformers are fully assembled and are ready for dispatch.

35.3 The stage inspection shall be carried out in accordance with **Annexure-II.**

35.4 After the main raw-material i.e. core and coil material and tanks are arranged and transformers are taken for production on shop floor and a few assembly have been completed, the firm shall intimate the purchaser in this regard, so that an officer for carrying out such inspection could be deputed, as far as possible within seven days from the date of intimation. During the stage inspection a few assembled core shall be dismantled to ensure that the laminations used are of good quality. Further, as and when the transformers are ready for despatch, an offer intimating about the readiness of transformers, for final inspection for carrying out tests as per relevant IS shall be sent by the firm along with Routine Test Certificates. The inspection shall normally be arranged by the purchaser at the earliest after receipt of offer for pre-delivery inspection. The proforma for pre delivery inspection of Distribution transformers is placed at **Annex- III**.

35.5 In case of any defect/defective workmanship observed at any stage by the purchaser"s Inspecting Officer, the same shall be pointed out to the firm in writing for taking remedial measures. Further processing should only be done after clearance from the Inspecting Officer/ purchaser.

35.6 All tests and inspection shall be carried out at the place of manufacture unless otherwise specifically agreed upon by the manufacturer and purchaser at the time of purchase. The manufacturer shall offer the Inspector representing the Purchaser all reasonable facilities, without charges, to satisfy him that the material is being supplied in accordance with this specification. This will include Stage Inspection during manufacturing stage as well as Active Part Inspection during Acceptance Tests.

35.7 The manufacturer shall provide all services to establish and maintain quality of workman ship in his works and that of his sub-contractors 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.

35.8 Purchaser shall have every right to appoint a third party inspection to carry out the inspection

process.

35.9 The purchaser has the right to have the test carried out at his own cost by an independent agency wherever there is a dispute regarding the quality supplied. Purchaser has right to test 1% of the supply selected either from the stores or field to check the quality of the product. In case of any deviation purchaser have every right to reject the entire lot or penalize the manufacturer, which may lead to blacklisting, among other things.

36 **QUALITY ASSURANCE PLAN:**

36.1 The bidder shall invariably furnish following information along with his bid, failing which his bid shall be liable for rejection. Information shall be separately given for individual type of equipment offered.

36.2 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.

36.3 Information and copies of test certificates as above in respect of bought out accessories.

36.4 List of manufacturing facilities available.

36.5 Level of automation achieved and list of areas where manual processing exists.

36.6 List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspection.

36.7 List of testing equipment available with the bidder for final testing of equipment along with valid calibration reports. These shall be furnished with the bid. Manufacturer shall posses 0.1 accuracy class instruments for measurement of losses.

36.8 Quality Assurance Plan (QAP) withhold points for purchaser"s inspection.

36.9 The successful bidder shall within 30 days of placement of order, submit following information to the purchaser :

36.9.1 List of raw materials as well as bought out accessories and the names of sub-suppliers selected from those furnished along with offer.

36.9.2 Type test certificates of the raw materials and bought out accessories.

36.9.3 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.

36.9.4 ISI marking on the transformer is mandatory. As per Quality Control Order for Electrical Transformers- 2015, issued by Department of Heavy Industries, Government of India, the Standard / ISI marking on Distribution Transformers is mandatory and the product should be manufactured in compliance with IS 1180 Part-1: (2014).

37 DOCUMENTATION:

37.1 The bidder shall furnish along with the bid the dimensional drawings of the items offered indicating all the fittings.

37.2 Dimensional tolerances.

37.3 Weight of individual components and total weight.

37.4 An outline drawing front (both primary and secondary sides) and end-elevation and plan of the tank and terminal gear, wherein the principal dimensions shall be given.

37.5 Typical general arrangement drawings of the windings with the details of the insulation at each point and core construction of transformer.

37.6 Typical general arrangement drawing showing both primary and secondary sides and end-elevation and plan of the transformer.

38 PACKING AND FORWARDING:

38.1 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.

38.2 The marking on each package shall be as per the relevant IS.

39 GUARANTEE

39.1 The manufacturers of the transformer shall provide a guarantee of 60 months from the date of receipt of transformer at the stores of the Utility. In case the transformer fails within the guarantee period, the supplier will depute his representative within 15 days from date of intimation by utility for joint inspection. In case, the failure is due to the reasons attributed to supplier, the transformer will be replaced/repaired by the supplier within 2 months from date of joint inspection.

39.2 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.

39.3 In the event of the supplier"s inability to adhere to the aforesaid provisions, suitable penal action will be taken against the supplier which may inter alia include blacklisting of the firm for future business with the purchaser for a certain period.

40 SCHEDULES:

40.1 The bidder shall fill in the following schedule which will be part of the offer. If the schedule are not submitted duly filled in with the offer, the offer shall be liable for rejection.

Schedule-A : Guaranteed Technical Particulars

Schedule-B : Schedule of Deviations

41 DEVIATIONS :

41.1 The bidders are not allowed to deviate from the principal requirements of the Specifications. However, the bidder is required to submit with his bid in the relevant schedule a detailed list of all deviations without any ambiguity. In the absence of a deviation list in the deviation schedules, it is understood that such bid conforms to the bid specifications and no post-bid negotiations shall take place in this regard.

41.2 The discrepancies, if any, between the specification and the catalogues and / or literatures submitted as part of the offer by the bidders, shall not be considered and representations in this regard shall not be entertained.

41.3 If it is observed that there are deviations in the offer in guaranteed technical particulars other than those specified in the deviation schedules then such deviations shall be treated as deviations.

41.4 All the schedules shall be prepared by vendor and are to be enclosed with the bid.

42.0 **Addition/ Modification in Technical specification to suit WBSEDCL specific requirement**

The Addition / Modification in technical specification required to suit WBSEDCL specific requirement are noted in the **Annexure – specific requirements and Additional Accessories.** The Addition/ Modifications noted there are to be considered in the technical specification.

Annex-I

METHODOLOGY FOR COMPUTING TOTAL OWNING COST

TOC = IC + (A x**Wi) + (B** x**Wc) ; Losses in KW**		
Where,		
TOC	=	Total Owning Cost
IC	=	Initial cost including taxes of transformer as quoted by the manufacturer
A factor	=	Cost of no load losses in Rs/KW (A = 288239)
B factor	=	Cost of load losses in Rs/KW (B = 93678)
Wi	=	No load losses quoted by the manufacturer in KW
Wc	=	Load losses quoted by the manufacturer in KW

Note: No (+)ve tolerance shall be allowed at any point of time on the quoted losses after the award. In case, the losses during type testing, routine testing etc are found above the quoted losses, the award shall stand cancelled. In such a case, the CPG money shall also be forfeited.

Annexure-Paint

Painting-Transformer Main tank, pipes, Conservator Tank, Radiator etc.-

	Surface Preparation	primer coat	intermediate under coat	finish coat	total DFT	Colour shade
Main tank, pipes, conservator tank, etc. (External surfaces)	Blast cleaning Sa2½	Epoxy base Zinc primer 30-40 micron	Epoxy base Zinc primer 30-40 micron	Aliphatic Polyurethane (PU Paint) (min 50 micron	Min 110 micron	541 shade of IS:5
Main tank, pipes (above 80 NB), conservator tank, etc (Internal surfaces)	Blast cleaning Sa2½	Hot oil resistant, non-corrosive varnish or paint	--	--	Min 30 micron	Glossy white for paint
Radiator (External surfaces)	Chemical / blast cleaning (Sa2½)	Epoxy base zinc primer 30-40 micron	Epoxy base Zinc primer Min 30-40 micron	Aliphatic Polyurethane(PU Paint) (min)50 micron	Min 110 micron	541 shade of IS:5
Radiator and pipes up to 80 NB (Internal surfaces)	Chemical cleaning if required	Hot oil proof low viscosity varnish or hot oil resistant non corrosive paint	--	--	--	Glossy white for paint

Annexure – II

PROFORMA FOR STAGE INSPECTION OF DISTRIBUTION TRANSFORMERS

(A) GENERAL INFORMATION:

1. Name of firm : M/s.
2. Order No. and Date :
3. Rating-wise quantity offered :
4. Details of offer
   a) Rating
   b) Quantity
   c) Serial Numbers
5. Details of last stage inspected lot:
   a) Total quantity inspected
   b) Serial Numbers
   c) Date of stage inspection
   d) Quantity offered for final inspection of
      (a) above with date

(B) **Availability of material for offered quantity** :

Details to be filled in

(C) **Position of manufacturing stage of the offered quantity** :

a) Complete tanked assembly
b) Core and coil assembly ready
c) Core assembled
d) Coils ready for assembly
   (i) HV Coils
   (ii) LV Coils

Note: (i) A quantity of less than 100 Nos. shall not be entertained for stage inspection. If the awarded quantity is less than 100 Nos., then whole lot shall be offered in single lot.

(ii) The stage inspection shall be carried out in case :-

(a) At least 25% quantity offered has been tanked and

(b) core coil assembly of further at least 30% of the quantity offered has

been completed.

(iii) Quantity offered for stage inspection should be offered for final Inspection within 15 days from the date of issuance of clearance for stage inspection, otherwise stage inspection already cleared shall be liable for cancellation.

Sl. No	Particulars	As offered	As observed	Deviation and Remarks
(D)	**Inspection of Core**: (I) **Core Material** (1) Manufacturer"s Characteristic Certificate in respect of grade of lamination used. (Please			
	(2) Remarks regarding Rusting and smoothness of core.			
	(3) Whether laminations used for top and bottom yoke are in one piece.			
	(II) **Core Construction** :			
	(1) No. of Steps			
	(2) Dimension of Steps			

	Step No.	1	2	3	4	5	6	7	8	9	10	11	12
	As offered:												
	W mm												
	T mm												
	As found:												
	W mm												
	T mm												

	(3) Core Dia (mm)		
	(4) Total cross Section area of core		
	(5) Effective cross Sectional area of core		
	(6) Clamping arrangement		
	(i) Channel Size		
	(ii) Bolt size and No.		

	(iii) Tie Rods size and No.			
	(iv) **Painting**			
	(a) Channels			
	(b) Tie Rods			
	(c) Bolts			
	(7) Whether top yoke is cut for LV connection.			
	(8) If yes, at 7 above, whether Reinforcement is done.			
	(9) Size of Support Channels provided for Core base and bottom yoke (Single piece of channels are only acceptable) This will not be applicable for Amorphous core. For Amorphous core, core clamps with locking arrangement with tank base cover will be provided. This will not be applicable for Amorphous core. For Amorphous core, core clamps with locking arrangement			
	(10) Thickness of insulation provided between core base and support channel.			
	(11) core length (leg center to leg center)			
	(12) Window height			
	(13) Core height			
	(14) Core weight only (without channels etc.)			
(E)	**INSPECTION OF WINDING**			
	(I) Winding material			
	(1) Material used for			
	(a) HV winding			

	(b) LV winding			
	(2) Grade of material for			
	(a) HV winding			
	(b) LV winding			
	3) Test certificate of manufacturer (enclose copy) for winding material of:			
	(a) HV			
	(b) LV			
	(II) CONSTRUCTIONAL DETAILS (1) Size of Cross Sectional area of conductor for :			
	(a) HV winding			
	(b) LV winding			
	(2) Type of insulation for conductor of :			
	a) HV winding			
	(b) LV winding			
	i) Diameter of wire used for delta formation (mm)			
	ii) Diameter of coils in:			
	a) LV winding			
	i) Internal dia (mm)			
	ii) Outer dia (mm)			
	b) HV winding			
	i) Internal dia (mm)			
	ii) Outer dia (mm)			
	(5) Current Density of winding material used for :			

	(a) HV			
	(b) LV			
	(6) Whether neutral formation on top.			
	(7) HV Coils/ Phase			
	a) Number			
	b) Turns / coil			
	c) Total turns			
	(8) LV Coils/ Phase			
	a) Number			
	b) Turns / coil			
	c) Total turns			
	(9) Method of HV Coil Joints			
	(10) Total weight of coils of			
	a) LV winding (kg)			
	b) HV winding (kg)			
(F)	**INSULATION MATERIALS** :			
	(I) **MATERIAL** :			
	1) Craft paper			
	a) Make			
	b) Thickness (mm)			
	c) Test Certificate of manufacturer (enclose copy).			
	2) Press Board			
	a) Make			
	b) Thickness (mm)			

	c) Test Certificate of manufacturer (enclose copy).			
	3) Material used for top and bottom yoke and insulation			
	(II) **Type and thickness of material used** :			
	a) Between core and LV			
	b) Spacers			
	c) Inter layer			
	d) Between HV and LV winding			
	e) Between phases			
	f) End insulation			
(G)	**CLEARANCES** : (mm)			
	(I) **Related to core and windings**			
	1) LV to Core (Radial) 2) Between HV and LV			
	3) (i) Phase to phase between HV Conductor			

	(ii) Whether two Nos. Press Board each of minimum 1 mm thick provided to cover the tie rods.			
	4) Thickness of locking spacers between LV coils (mm)			
	5) Axial wedges between HV and LV coils / phase (Nos.)			
	6) No. of radial spacers per phase between HV coils			
	7) Size of duct between LV and HV winding (mm)			

	(II) **Between core - coil assembly and tank : (mm)**			
	1) Between winding and body:			
	a) Tank lengthwise			
	b) Tank Breadth wise			
	2) Clearance between top cover and top yoke upto 100 kVA and between top cover and top most live part of tap changing switch			
(H)	**TANK** : (I) **Constructional details** :			
	1) Rectangular shape			
	2) Thickness of side wall (mm)			
	3) Thickness of top and bottom plate (mm)			
	4) Provision of slopping top cover			
	5) Tank internal dimensions (mm)			
	a) Length			
	b) Breadth			
	c) Height			
	(i) On LV side			
	(ii) On LV side			
	(II) **General details** :			
	1) Inside painted by varnish/ oil corrosion resistant paint (please specify which type of coating done).			
	2) Gasket between top cover and tank i) Material			
	ii) Thickness (mm)			
	iii) Jointing over laps (mm)			
	3). Reinforcement of welded angle (specify size and No. of angle provided) on side walls of tank.			
	4) Provision of lifting lugs:			
	b) Whether lugs of 8 mm thick MS Plate provided			

Sl. N	Particulars	As offered	As observed	Deviation and Remarks
	b) Pressure of 0.8 kg/sq cm for 30 minutes.			
(I)	**RAIDATORS** :			
	1. Fin Radiators of 1.25 mm thick sheet			
	a) Dimension of each fin (LxBxT)			
	b) Fins per radiator			
	c) Total No. of radiators			
	2. Verification of manufacturer"s test certificate regarding Heat dissipation (excluding Top and Bottom) in w/sq m			
	3. Verification of position of radiator with respect to bushing.			
(J)	**CONSERVATOR** :			
	1. Dimensions (L x D) (in mm)			
	2. Volume (m^3)			
	3. Inside dia of Conservator tank pipe (mm)			
	4. Whether conservator outlet pipe is projected approx. 20 mm inside the conservator tank.			
	5. Whether arrangement made so that oil does not fall on the active parts.			
	6. Whether die cast metal oil level gauge indicator having three positions at (- 5 ^{o} C, 30 ^{o} C and 98 ^{o}C) is provided .			
	7. Whether drain plug and filling hole with cover is provided.			
	8. Inner side of the conservator Tank painted with-			
(K)	**BREATHER** :			

	1. Whether Die cast Aluminium body breather for silica gel provided.			
	2. Make			
	3. Capacity			
Sl. No **(L)**	Particulars **TERMINALS** :	As offered	As observed	Deviation and Remarks
	1. Material whether of Brass Rods/ Tinned Copper.			
	a) HV			
	b) LV			
	2. Size (dia in mm)			
	a) HV			
	b) LV			
	3. Method of Star connection formed on LV side of 6mm thick (Should use Al./Cu. Flat bolted/ brazed with crimped lugs on winding alternatively for 63 and 100 kVA ratings brazing is done covered with tubular sleeve duly crimped). - Please state dimensions of Al/			
	4. Method of Connection of LV winding to LV Bushing (end of winding should be crimped with lugs (Al/Cu) and bolted with bushing stud).			
	5. Method of Connection of HV winding to HV bushing (Copper joint should be done by using silver brazing alloy and for Aluminium, brazing rod or with tubular connector crimped at three spots).			
	6. Whether SRB Ptube/insulated paper used for formation of Delta on HV.			

	7. Whether Empire sleeves used on the portion of HV winding joining to HV bushing.			
	8. Whether neutral formation is covered with cotton tape			
	Whether arrangement for studs for fitting of HV Bushing are in diamond shape (so			
	4. Position of mounting of LV bushings.			
	5. Bushing Clearance: (mm)			
	a) LV to Earth			
	b) HV to Earth			
	c) Between LV Bushings			
	d) Between HV Bushings			
(N)	**TANK BASE CHANNEL / ROLLERS** :			
	1. Size of channel (mm)			
	2. Whether channels welded across the length			
	3. Size and type of roller (mm)			
(O)	**OIL** :			
	1. Name of supplier			
	2. Break down voltage of oil: (kV)			
	i) Filled in tanked transformer			
	ii) In storage tank (to be tested by Inspecting			
	3. Supplier"s test certificate(enclose copy)			
(P)	**ENGRAVING** :			
	1. Engraving / punching Sl. No. and name of firm on top channel / clamp or on separate plate which is firmly welded to the top channel/			
	i) On bottom of clamping channel of core-coil assembly.			
	ii) Engraving of Sl. No. and name of firm on side wall and top cover of tank along with date			
(Q)	i) MS plate of size 125x125 mm welded on width side of stiffner			
	ii) Following details engraved (as per			
	(a) Serial Number			
	(b) Name of firm			
	(c) Order No. and Date			
	(d) Rating			
	(e) Name of Inspecting Officer			
	(f) Designation			
	(g) Date of dispatch			

(R)	**NAME PLATE DETAILS** :			
	Whether Name Plate is as per approved drawing			
(S)	**Colour of Transformer**			
	1. Tank body colour shall be as per Annexure-Paint which is attached herewith			
	2. Conservator colour shall be as per Annexure-Paint which is attached herewith .			
(T)	**CHECKING OF TESTING FACILITIES**:			
	(Calibration certificate also to be checked for			
	TESTS :			
	1. No Load Current			
	2. No Load Loss			
	3. % Impedance			
	4. Load Losses			
	5. Insulation Resistance Test			
	6. Vector Group Test (phase relationship)			
	7. Ratio and Polarity test relationship			
	8. Transformer Oil Test (Break Down Voltage)			
	9. Magnetic Balance			
	10. Measurement of winding resistance (HV and LV both)			
	11. Induced over voltage withstand test (Double voltage and Double frequency)			
	12. Separate source power frequency withstand test at 28 kV for HV and 3 kV for LV (one minute).			
	13. Air pressure/ Oil leakage Test			
	14. Vacuum test			
	15. Unbalanced current test			
	16. Temperature rise (Heat Run) test.			
(U)	We have specifically checked the following and found the same as per G.T.P./deviations observed as mentioned against each:			
	i) Rustlessness of CRGO laminations used			
	ii) Core steps			
	iii) Core area			
	iv) Core weight			
	v) Winding cross sectional area			
	a) LV			
	b) HV			
	vi) Weight of windings			
	vii) Clearance between winding and wall of			
	a) Length-wise			
	b) Breadth-wise			
	viii) Clearance between top of yoke/ top most live part of tap changer to tank cover.			
	ix) Details of Neutral formation			
	x) Connections to bushings:			

	xxiii) LV			
	xxiv) HV			
	a Slope of tank top			
	b Position of mounting of bushings			

Annexure - A

Check-list for Inspection of Prime quality CRGO for Transformers

During inspection of PRIME CRGO, the following points needs to be checked by the Transformer manufacturer. Utilitity"s inspector shall verify all these points during inspection:-

ii) **In case PRIME CRGO cutting is at works of Transformer Manufacturer:**

Review of documents:

Purchase Order (unpriced) to PRIME CRGO supplier/Authorised Agency
Manufacturer"s test certificate

Invoice of the Supplier

Packing List

Bill of Lading

Bill of Entry Certificate by Customs Deptt.

Reconciliation Statement as per format below
Certificate of Origin
BIS Certification

Format for Reconciliation/Traceability records

Packing List No./date /Quantity of PRIME CRGO received

Name of Manufacturer

Manufacturer test certificate No./date

	Serial No.	Details of package/job	Drawing Reference	Quantity Involved	Cumulative Quantity Consumed	Balance stock
.1						

Inspection of PRIME CRGO Coils:

PRIME CRGO-Manufacturer"s Identification Slip on PRIME CRGO Coils

Visual Inspection of PRIME CRGO Coils offered as per packing list (for verification of coil details as per Test certificate & healthiness of packaging).

Unique numbering inside of each sample of PRIME CRGO coil and verification of records to be maintained in the register for consumption of CRGO coil.

ISI logo sticker on packed mother coil and ISI logo in Material TC.

2.2. During inspection of PRIME CRGO, surveillance testing of sample shall be carried out for Stacking Factor, Permeability, Specific watt loss at 1.5 Tesla and/or 1.7 Tesla depending on the grade of PRIME CRGO and aging test etc. applicable as per relevant IS/ IEC standard, Tech. Spec., MQP and Transformer manufacturer plant standard.

Inspection Clearance Report would be issued after this inspection

3 Inspection of PRIME CRGO laminations: Transformer manufacturer will maintain records for traceability of laminations to prime CRGO coils and burr/bow on laminations shall be measured. Utility can review these records on surveillance basis.

4. Inspection at the time of core building:

Visual Inspection of PRIME CRGO laminations. In case of suspected mix-up/ rusting/decoloration, samples may be taken for testing on surveillance basis for tests mentioned in A.2.2 above.

Above tests shall be witnessed by Utility. In case testing facilities are not available at Manufacturer"s work, the sample(s) sealed by Utility to be sent to approved labs for testing.

Inspection Clearance Report would be issued after this inspection

(ii) In case PRIME CRGO cutting is at Sub-vendor of Transformer Manufacturer:

Review of documents:

Purchase Order (unpriced) to PRIME CRGO supplier/ Authorised Agency

Purchase Order (unpriced) to Core Cutter

Manufacturer test certificate

Invoice of the Supplier

Packing List

Bill of Lading

Bill of Entry Certificate by Customs Deptt.

Reconciliation Statement as per format below
Certificate of origin
BIS Certification

Format for Traceability records as below:-

Packing List No./date /Quantity of PRIME CRGO received
Name of Manufacturer
Manufacturer test certificate No./date

Serial No.	Name of Customer	Details of package/job	Drawing Reference	Quantity Involved	Cumulative Quantity Consumed	Balance stock	Dispatch Details

.1 Inspection of PRIME CRGO Coils:

PRIME CRGO-Manufacturer"s Identification Slip on PRIME CRGO Coils

Visual Inspection of PRIME CRGO Coils offered as per packing list (for verification of coil details as per Test certificate & healthiness of packaging).

Unique numbering inside of each sample of PRIME CRGO coil and verification of records to be maintained in the register for consumption of CRGO coil.

ISI logo sticker on packed mother coil and ISI logo in Material TC.

2.2. During inspection of PRIME CRGO, surveillance testing of sample shall be carried out for Stacking Factor, Permeability, Specific watt loss at 1.5 Tesla and/or 1.7 Tesla, thickness depending on the grade of PRIME CRGO and aging test etc. applicable as per relevant IS/ IEC standard, Tech. Spec., MQP and Transformer manufacturer plant standard.

Inspection Clearance Report would be issued after this inspection

3 Inspection of PRIME CRGO laminations**:**

Transformer manufacturer representative will inspect laminations and issue their internal Inspection Clearance Report. Inspection will comprise of review of traceability to prime CRGO coils, visual Inspection of PRIME CRGO laminations and record of burr/bow. After clearance given by transformer manufacturer, Utility will issue an Inspection Clearance Report after record review. If so desired by Utility, their representative may also join transformer manufacturer representative during this inspection.

Inspection Clearance Report would be issued after this inspection vii)
Inspection at the time of core building:

Visual Inspection of PRIME CRGO laminations. In case of suspected mix-up/rusting/decoloration, samples may be taken for testing on surveillance basis for tests mentioned in B.2.2.

Inspection Clearance Report would be issued after this inspection NOTE :-

a) Transformer Manufacturer to ensure that PRIME CRGO is procured from POWERGRID approved vendors and CRGO manufacturer should have valid BIS Certificate for respective offered Grade.

14.2 Transformer Manufacturer should also involve themselves for ensuring the quality of CRGO laminations at their Core Cutter"s works. They should visit the works of their Core cutter and carry out necessary checks.

b) General

If a surveillance sample is drawn and sent to TPL (if testing facility not available with the manufacturer), the Transformer manufacturer can continue manufacturing at their own risk and cost pending TPL test report on PRIME CRGO sample drawn. Decision for acceptance of PRIME CRGO shall be based upon report of the sample drawn.

These checks shall be read in-conjunction with approved Quality Plan, specification as a whole and conditions of contract.

Sampling Plan (PRIME CRGO)

33 / 11 kV	-1st transformer and subsequently at random 10% of Transformers (min. 1) offered for inspection.
DTs and other ratings	-1st transformer and subsequently at random 2% of Transformers (min. 1) offered for inspection.

NOTE:-

One sample for each lot of CRGO shall be drawn on surveillance basis.

CRGO has to be procured only from POWERGRID approved vendors. List of such vendors is available at the following website. Since the list is dynamic in nature, the site may be checked from time to time to see the list of approved vendors. http://apps.powergridindia.com/ims/ComponentList/Power-former%20upto%20420%20kV-CM%20List.pdf

Annexure – specific requirements and Additional Accessories

The Bidders are requested to follow the following Addition/ Modification in Technical specification to suit WBSEDCL specific requirement

1. Pre-qualifying requirements for bidders as BIS certified transformer manufacturer-

Serial No	Requirements	Documernts required to be submitted
1	BIS License	(i) For 100 KVA (Copper wound & CRGO Core) 33/0.4150KV rating distribution transformers ,the bidding is open to those manufactuerers only , who possesses valid ISI License/ Marketing rights as per BIS for offered ratings for energy efficiency level-II as specified in IS:1180 (Part-I):2014. (ii) **ISI marking-** The transformer, as per Energy Efficiency Level-2 specified in IS-1180(Part-1):2014, must bear 'ISI' certification mark.In this connection, a certified photocopy of the valid ISI License /marking rights for the offered rating of transformer must be submitted either along with the tender. (iii) In absence of ISI marking License, the offer shall be liable for rejection.
2	Type test report for tendered rating of transformers.	(i) The certified copies of valid type test & special test Reports for 'ISI' mark i.e for obtaining manufacturing license from BIS authorities, losses as per Energy Efficiency Level-2 specified in IS-1180(Part-1):2014, copper wound & CRGO Core – 100 KVA; 33/0.41500 KV rating distribution transformer from the Govt. Standard test Laboratory/Govt. Approved Laboratory shall be submitted along with the tender for all Type Tests as mentioned in the IS: 1180(Part-1) of 2014. (ii) The type test certificates for all ratings shall not be more that 5 years old from the date of opening of the tender.

2. **Clause no. 5.1(i) sl. no. 3**: Rated LV voltage shall be 415V -240 V in place of 433V-250V.
3. **Clause no. 6.1.2.1**: Regarding Core construction: T

   The core shall be only of conventional Stack type CRGO of specified grade as mentioned. The wound type CRGO or Amorphous core material will not be accepted.
4. **Clause no. 7.1.1**: Regarding winding material and it's insulation on HV and LV sides:

   The HV & LV winding shall be double paper covered Electrolytic copper conductor only. Aluminum conductor or super enamel insulation for both HV & LV winding will not be acceptable.
5. **Clause no. 8**, Regarding Tap Switch:

   Off circuit Tap Switch is to be provided on HV side as per following specification:

The OFF load tap changing shall be effected by an external 3 phase gang operated tap changing switch. The operating shaft shall be brought out of the tank and provided with hand wheel so that it can be operated at standing height from plinth level and be easily accessible. The tap position should correspond to the voltage variation of (+)5% to (-) 7½% in step of 2.5% at HV side with its normal position at 3.

A visual tap position indicator shall be provided near the operating handle and provision shall be made to pad lock the handle in each tap position. The locking arrangement shall be such that pad lock can not be inserted unless required contacts corresponding to the tap positions are correctly connected with full contact pressure.

All contacts of the tapping shall be silver plated and held in position under strong contact pressure.

Taps shall be provided on high voltage windings. At each tap positions, rated output shall be available within allowable range of voltage variations. The tap position marking should increase in clockwise direction and there should be a stopper in between maximum position i.e. 1 and minimum position i.e. 6.The tap position marking should be such that they are easily visible and permanent.

6. **Clause no. 11**: Regarding Losses: The maximum loss figures shall not exceed the following tolerance limit.

MAXIMUM ALLOWABLE LOSS VALUES AND % IMPEDANCE:

KVA Ratting	Voltage Ratio(KV)	Percentage Impedance	Total Loss at 50% Loading in Watts	Total Loss at 100% Loading In Watts
100	33/0.415	4.50± (IS Tol)	475.00	1650.00

Note: The Total loss figures at 50 Hz and at 75°C at 50% & 100% loading as noted above shall not exceed 7.50% as per clause no. 6.8.1.3 of IS 1180(Part-1) of 2014.

The above loss figures inclusive of noted tolerance limit are the maximum values. Bidders quoting with loss figures higher than these values will be treated as non-responsive. Financial evaluation will based on Landed price and not on total owning cost of the transformer i.e. loss capitalisation for financial evaluation will not be applicable.

7. Clause no. 26.1 regarding accessories:

The following fittings & accessories are to be provided in the transformer if these are not included in the clause:

i) Name , rating & terminal marking plates
ii) Two nos. earthing terminals on the tank body with lugs at suitable location with marking of earthing.
iii) Two nos. lifting Lugs at two diagonally opposite corners of the tank.
iv) Pole / plinth mounting arrangement.
v) Silica gel breather.
vi) H.V. Bushing with arcing horn.
vii) L.V. Bushing for phases & neutrals.
viii) One no. oil level gauge of prismatic type with Min^{m} , Normal & Max^{m} Temperature Markings on the conservator.
ix) Conservator with drain plug and oil filling hole with threaded cover.
x) Top & Bottom Filter Valve of proper size(1 ¼" REC Type)
xi) Explosion Vent placed on tank top cover with Air release plug.
Xii) Inspection Cover placed on Turret on top cover with Air Release plug & lifting handle.
Xiii) 1 no. Bouchholz Relay on conservator pipe.
Xiv) Dial Type Thermometer for OTI preferably of Precimeasure or Perfiect Control make
Xv) Marshalling Box for accommodating OTI and terminal connector.
Xvi) Pocket for placing OTI probe on top cover. The pocket should be placed on an elevated base on top cover
Xvii) Thermometer pocket with suitable cap as near to the centre of the top cover as possible in addition to OTI pocket.
Xviii) shutt of valve at suitable location in between Bouchholz Relay and the conservator
Xix) Air Release Plug on Top of HV bushing Turret.
Xx) Liftng Lugs spaced suitably on top of tank top cover.
Xxi) Dehydrating Breather as specified to be fitted in the breather pipe of conservator.

Xxii) Terminal connectors at HV & LV terminals as specified

8. **ASSET CODIFICATION NO:-**

Asset codification no. (10 digit alpha numeric numbers) as allotted by the purchaser for each transformer of the ordered quantity shall be communicated to the supplier after

placement of order. Necessary Engrave/Embossing (cold punch) shall be done on the main tank with 28 no font size and DTR name and diagram plate with font size not less than that used for marking KVA rating of the DTR.

If cold punch on the tank is not possible then separate property plate(details marking of the plate shall be submitted with the transformer drawing for approval) shall be welded to the tank with the following details:-

1. Ratings :
2. Manufacturer's Sl.No. :
3. Manufacturer's Name :
4. P.O. No. :
5. M o n t h / Year of Manufacturing:
6. Guaranteed for 5 Years
7. Property of : WBSEDCL
8. Energy Efficiency Level2 as per IS 1180 (Part-1) of 2014 & Logo as per BIS Level2 for CRGO Cu winding for 33 KV.
9. Asset Code Number : (10 digit alpha numeric numbers as allotted by the purchaser) Again the following points shall have to be noted
   a) Front Size of letter shall be 28 i.e. 7 mm x 5.5 mm
   b) Letters shall be distinctly engraved by cold Punch
   c) Plate size shall be minm 125mm X 170mm and shall be electrical run Welded be throughout its perimeter
   d) Material of Plate shall be Mild Steel and not less than 3mm thick.
   e) Plate shall be welded on the transformer tank at visible position and height.

9 Clause no. 32 for Acceptance Test:

100% inspection & testing of the offered transformers will be conducted at manufacturer's premises as acceptance test. Temperature rise test will be conducted on one transformer of each offered lot.

10 Clause no. 14 for Temperature Rise:

Temperature rise limits shall correspond to the total loss values of the transformer corresponding to lowest Tap position (Rated No Load Loss at 50 Hz + Load Loss at Lowest Tap position corresponding to Rated KVA). Temperature rise test will be conducted on one transformer of each offered lot.

11. Mouunting arrangement:

The Mounting arrangement shall be as per clause no. 14 of IS 1180 (Part 1) of IS2014 or latest amendment thereof. The transformer may also be placed on elevated concrete base. However the centre to centre distance of holes of the base channels to be used for fixing in pole structure shall be 415 mm without any tolerance

12 The transformer shall be of non sealed type

12. The bidder shall have the following testing equipments:

i) KV Meter for 33 KV system
ii) Volt Meter (0-1000V)
iii) Miliammeter for leakage current(0-100ma)
iv) Power Analyzer of reputed Make(Should display 3-Ph current, voltage, watt and ∑ 3-Φ Power).
v) Meggar – 2.5 KV
vi) Thermometer (Preferably Digital): 0-100°C
vii) TTR Meter
viii) Winding Resistance Measurement (Preferably ELTEL or reputed make)
ix) Digital Multimeter to measure magnetizing current & core balance of 11 KV system.
x) Clamp on Ammeter(0-300A)
xi) Instrument for measuring the thickness of different layers of painting.

xii) Instrument/Equipments required for testing of painting as per IS 1180 (Part 1) of 2014.

xiii) Equipment for pressure test as per Clause no. 21.5 of IS 1180 (Part-1) 2014

xiv) Equipment for Oil leakage test as per Clause no. 21.5 of IS 1180 (Part-1) 2014

xv) Instrument for measurement of Dry paint thickness.

xvi) 4(Four) nos Ambient pots as per relevant ISS for measurement of ambient temperature during Temperature Rise Test.

xvii) Oil Testing arrangements

ALL THE ABOVE TESTING EQUIPMENTS SHALL BE AVAILABLE IN THE TESTING LAB AND SHOULD BE CALIBRATED FROM NABL ACCRIDIATED LABORATORY

COPY OF CALIBRATION CERTIFICATES AS PER GCC CLAUSE NO.8 SHALL BE AVAILABLE WITH THE BIDDER AS ANd WHEN REQUIRED.

13.The following GTP is to be filled by the participating bidder and to be submitted along with the bid documents:

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS

(To be furnished and signed by the tenderer)

Item details :100 KVA; 33/0.415 KV Stn Service DTR

Sl.No.	Particulars		
1	Name of the manufacturer	::	
2	Country of origin	::	
2(a)	Whether the manufacturer has the BIS certification for manufacturing the item offered? If yes, Energy efficiency level for which BIS certification is submitted?	:: ::	
2(b)	Whether the manufacturer has uploaded Type, Special & other test reports required for BIS certification for manufacturing the item offered?		
3	Applicable standard	::	
4	Maximum continuous rating in KVA	::	
5	No load voltage ratio (In KV/KV)	::	
6	Rated frequency (in HZ)	::	
7	Number of phases	::	
8	Type of Cooling	::	
9	Connections		
	(i) H.V. Winding		
	(ii) L.V. Winding		
10	Vector Symbol		
11	(i) Temperature also under normal operation condition above ambient temperature	::	

	(a) Top oil (in Deg.C.)	::	
	(b) Winding (in Deg.C)	::	
	(ii) Maximum hot spot temperature of winding (in Deg.C)	::	
12	Magnetising current referred to H.V. at rated frequency	::	
	(a) At 90% rated voltage (in Amps)	::	
	(b) At 100% rated voltage (in Amps)	::	
	(c) At 112.5% rated voltage (in Amps)	::	
13	Power factor of magnetising current at 100% rated voltage & frequency	::	
14	No load current at rated voltage and rated frequency (in Amps)	::	
15	Declared No load loss in watt at rated frequency & voltage(For the purpose of record)	::	
16	Declared Load loss in Watt at 75 Deg C. At rated output and frequency at 100% loading & at 50% loading in watt (For the purpose of record)	::	
17	Total Loss at 50 Hz & 75C at 100% Loading in Watt		
18	Total Loss at at 50 Hz & 75C at 50% Loading in Watt		
19	Percentage Regulation at full load at 75 Deg.C.	::	
	(a) At unity power factor	::	
	(b) At 0.8 power factor lagging	::	
20	Efficiencies at 75 Deg.C. (in percentage)	::	
	(a) At full load	::	
	(i) At unity power factor	::	
	(b) At ¾ full load	::	
	(i) At unity power factor	::	
	(ii) At 0.8 power factor lagging	::	
	(c) At ½ full load		
	(i) At Unity power factor		
	(ii) At 0.8 Power factor lagging		

21	Impedence voltage on rated kVA base at rated current and frequency at 75 Deg.C (in percentage)	::	
22	(a)Resistance voltage at rated current and frequency at 75 Deg.C (in percentage)	::	
	(b) Reactance voltage at rated current and frequency at 75 Deg.C (in percentage)	::	
23	Resistance at H.V. base at 75 Deg.C (d) HV (between lines) (ohms) b) LV (between lines) (ohms)	::	
24	Reactance at H.V. base at 50 c/s	::	
25	Withstand time without injury for three phase dead short circuit at terminal (in seconds):	::	
26	Short time current rating for short circuit with duration	::	
	(a) H.V. Winding (in K Amps)	::	
	(b) L.V. Winding (in K Amps)	::	
	(c) Duration in seconds)	::	
27	Permissible over loading with time at max amb temp (d) 125%load after running with 50% load with steady temp rise. (hrs.) b) 120% load after running with 100% load with steady temp rise. (hrs.)	::	
28	Core :		
	(i) Type :		
	(ii) At 112.5% rated voltage at 50 HZ (in line/sq cm)		
	(iii) Thickness of Stampings (in mm)	::	
	(iv) Type of Insulation between core lamination	::	
	(v) Approximate area of Cross Section of Core and yoke (in sq.mm)	::	
	(vi) Material of Core clamping plate	::	
	(vii) Thickness of Core clamping plate (in mm)	::	
	(viii) Insulation of Core clamping plate	::	

	(ix) Describe location/Method of Core grounding	::	
29	Terminal Arrangement	::	
	(i) high voltage	::	
	(ii) low Voltage	::	
30	Positive Sequence Impedance between HV & LV winding on rated KVA base at rated current and frequency at 75 Deg.C. Winding temperature (in percent).	::	
31	Zero Sequence Impedance at reference temperature of 75 Deg.C (in percent)	::	
32	Details of windings :	::	
	(i) Type of Winding :	::	
	a) High Voltage ;	::	
	b) Low Voltage	::	
	(ii) Material of the winding conductor	::	
	(a) High Voltage :	::	
	(b) Low Voltage :	::	
	(iii) Current density of winding at rated KVA	::	
	(a) High Voltage (Amp per sq.cm)	::	
	(b) Low voltage (Amps per Sq.cm)	::	
	(iv) Insulating material used for	::	
	(a) High Voltage Winding	::	
	(b) Low Voltage Winding	::	
	(v) Insulating material used between	::	
	(a) High voltage and low voltage winding	::	
	(b) Low Voltage winding and Core	::	

33	Insulation withstand Test Voltages	::	
	(d) Lightning Impulse withstand test voltage (KV Peak)	::	
	(ii) Power frequency withstand test voltage (in KV rms for 1 mtn)	::	
	(d) Induced over voltage withstand test voltage (in KV rms)	::	
34	Current in the winding at rated KVA	::	
	(I) Low voltage (in Amps)	::	
	(ii) High Voltage (in Amps)	::	
35	Voltage per turn (KV per turn)	::	
36	Ampere turn	::	

37	Number of turns	::	
	(i) Low Voltage	::	
	(ii) High Voltage	::	
	(iii)No. of Tap positions, range of Voltage variation & Normal tap position	:::	
38	Bushing	::	High Voltage Low Voltage
	(i) Make	::	
	(ii) Type	::	
	(iii) Applicable standard	::	
	(iv) Insulation withstand test voltage	::	
	(d) Lightning Impulse withstand test voltage (1.2 x 50 micro seconds (in KV Peak)	::	
	(b) Power frequency withstand test voltage (in KV for 1 min)	::	

	(v) Creepage distance in air	::				
	(i) Total (in mm)	::				
	(ii) Protected (in mm)	::				
	(vi) Minimum height of the bushing					
39	Minimum clearance (in mm)	::				
	Between live conductive parts and live conductive parts to earthed structure		In Oil		In Air	
			Between Phases	Phase to Ground	Between Phases	Phase to Ground
	(i) H.V.	::				
	(ii) L.V.	::				
40	Approximate weight of Transformer (in Kgs)	::				
	(i) Core with clamping	::				
	(ii) Coil with Insulation	::				
	(iii) Core and winding	::				
	(iv) Tank and fitting with accessories	::				

	(v) Untanking weight	::	
	(vi) Oil required for the transformer	::	
	(vii) Total weight with Core, Winding, oil and fittings	::	
41	Details of Tank	::	
	(i) Type of tank	::	
	(ii) Approximate thickness of Sheet (in mm)	::	
	(a) Sides	::	
	(b) Bottom	::	
	(c) Cover	::	
	(iii) Vacuum withstand capacity	::	
	(iv) Dimension of base channel (in mm x mm)	::	
42	Oil quality	::	
	(i) Applicable standard	::	

	(ii) Total quality of oil (in litres)	::	
43	Approximate overall Dimensions (in mm)	::	
	(a) Length	::	
	(b) Breadth	::	
	(c) Height	::	
	(d) Minimum height of bottom most portion bushing from bottom of base channel	::	
44	Minimum clearance height for lifting tank cover (in mm)	::	
45	Whether they have facility for Air pressure test and oil leakage test in line with the technical specification		
47.	Whether the transformer is non sealed & Stack core type?		
48.	Whether the tank is of plain tank construction?		
49.	Whether agreeable to provide all the accessories as per technical specification of the NIT?		
50.	Whether they have facility for painting and test in line with the technical specification?		
51.	Tank type & shape(Plain/Corrugated & Rectangular/Elliptical etc.)		
52.	Insulation of HV & LV winding(DPC/SE)		
53.	**Marking : whether agreeable to** **a) Transformer Rating and Diagram plate along with Asset codification number shall be welded on the tr. Body.**		
54.	**List of testing equipments available in the testing lab. of manufacturer in line with Cl. No. 40 . 00**		

Signature :
Name :
Designation :
Company Seal :