

WEST BENGAL STATE ELECTRICITY DISTRIBUTION COMPANY LTD.

TECHNICAL SPECIFICATION OF 1000 KVA, 11/0.415KV or 0.433 KV WITH CABLE END BOX AT BOTH END OR WITH OUTDOOR TYPE BUSHING AT HV SIDE & CABLE BOX AT LV SIDE: 3-PHASE PLINTH MOUNTED BIS COMPLIED STACK CORE TYPE: ONAN COOLED: NON SEALED TYPE DISTRIBUTION TRANSFORMER

1.00 SCOPE:-

This specification covers design, manufacture, assembly, testing at manufacturer's works, supply & delivery of three phase 50HZ, 11/ 0.415KV or 0.433KV, Delta/Star, Vector Group Dyn11, two winding, oil immersed naturally Oil & Air cooled, Stack Core Type 1000 KVA Distribution Transformer non sealed type both with outdoor/Indoor type with/without cable End Box at both ends along with Off circuit Tap Switch on HV side for voltage variation of +5.0% to -7.50% or -10.00% in step of 2.5% (as per the requirement of NIT) as per details furnished hereafter.

2.00 APPLICABLE STANDARD:

2.01 The transformers covered by this specification shall, unless otherwise specified be built to confirm to the latest Indian Electricity Rules, wherever applicable and the requirements of the latest issues of IS: 1180(Part-I) of 2014 and IS: 2026, CBIP Standards and other ISS (All as per latest issues) some of which are as stated below-

Serial No	Item	IS Number
1.	Specification for Power Transformer	IS:2026
2	Outdoor Type oil immersed Distribution Transformers upto & including 2500 KVA, 33-KV specification	IS 1180(Part-1) of 2014
3.	Specification for Cold Rolled Grain Oriented Electrical Steel	IS:3024
4.	Specification for Copper wire rods	IS:12444
5.	Specification for Craft Paper	IS:9335
6.	Specification for Press Board	IS:1576
7.	Specification for Transformer/Mineral Oil	Conforming to IS:335 in accordance to WBSEDCL's latest Technical Specification of Transformer Oil before Tanking & IS 1866 (2014) after Tanking
8.	Specification for up to 1.0 KV voltage Bushing	For Porcelain Part-IS:3347(Part-I/Section-I) For Metal Part-IS:3347(Part-I/Section-II) and IS 7421 (1988), IS2099 (1986) & IS 9431
9.	Specification for 17.50 KV Bushing	For Porcelain Part-IS:8603 For Metal Part-IS:3347(Part-III/Section-II)
10.	Specification for Marking and Relative positions of terminals	IS:2026 (Part-I)
11.	Specification of Gaskets	Type-III as per IS:11149/Type-C as per IS:4253(Part-II)
12.	Specification for colours for ready mixed paints	IS 5
13.	Specification for ready mixed paint, brushing Zinc Chromate, priming	IS 104
14.	Testing for steel sheets and strips and magnetic circuits	IS 649
15.	Guide for loading of oil immersed Transformers	IS 2026 (2009) Part-7

16.	Specification for Mechanical testing of metals- Tensile Testing	IS 1608:2005
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02. In the event of a conflict between the above standard and the specification the later shall govern

2.02 Pre-qualifying requirements for BIS certified transformer manufacturer-

Serial No	Requirements	Documents required to be submitted
1.	BIS License	(i) For 1000 KVA (copper wound & CRGO Core) rating distribution transformers ,the bidding is open to those manufacturers only , who possesses valid ISI License/ Marketing rights as per BIS for offered ratings for energy efficiency level-2((as per amendment no. 4 of IS-1180 (Part-I):2014) as specified in IS:1180 (Part-I):2014. (ii) ISI marking- The transformer, as per Energy Efficiency Level-2 (as per amendment no. 4 of IS-1180 (Part-I):2014), must bear '<u>ISI</u>' <u>certification mark</u>. In this connection, a certified photocopy of the valid ISI license/marketing rights 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 photo copies of valid type & special test Reports for 'ISI' mark i.e. for obtaining manufacturing license from BIS authorities, losses as per Energy Efficiency Level-2 (as per amendment no. 4 of IS-1180 (Part-I):2014) specified in IS-1180(Part-1):2014, copper wound & CRGO Core -1000 KVA rating distribution transformer from the Govt. Standard test Laboratory/Govt. Approved Laboratory shall be submitted along with the tender. (ii) The type test certificates for all ratings shall not be more that 5 years old from the date of opening of the tender.

3.00 CLIMATIC CONDITION:

For the purpose of design following climatic conditions shall be considered:-

1. Elevation at mean sea level	: 1000M
2. Maximum ambient Air temperature (°C):	50 Deg.C
3. Maximum daily average ambient (°C)	: 40 Deg.C
4. Minimum Ambient air temperature (°C): (-)	5Deg.C
5. Relative humidity	: 100%
6. Pollution level	: Heavily polluted.
7. Maximum Wind Pressure	: 250kg/sq. mtr.
8. Annual average rainfall	: 3000mm
9. Average No. of thunderstorm day per annum:	100 Days

3.01 APPLICATION:

The equipment shall be installed on plinth for indoor/ outdoor use anywhere in West Bengal in the

Distribution system of WBSEDCL to effect power supply to the consumer.

4.00 **PRINCIPAL PARAMETERS:**

- 4.01 The transformers shall be suitable for outdoor & indoor installation as the case may be with three phase, 50 Hz, 11 KV system in which the neutral is effectively earthed and they should be suitable for service with fluctuations in supply voltage up to plus 12.5% to minus 12.5%.
- 4.02 The Transformer shall conform to the following specific parameters

1.	System Voltage	12KV
2.	Rated Voltage HV	11KV
3.	Rated Voltage LV	0.415 KV or 0.433KV
4.	Phase	3 phase
5.	Frequency	50HZ subject to fluctuation of $\pm 3\%$
6.	Connection HV	Delta
7a.	Connection LV	Star (Neutral brought out)
7b.	LV Neutral Earthing	The Neutral point of the secondary (LV) winding shall be brought out in a separate insulated terminal and shall be solidly earthed.
8.	Vector Group	Dyn11
9.	Type of Core	High Grade CRGO material (Stack Core)
10.	Winding	HV & LV winding shall be wound from Double Paper Covered copper conductor for 1000 KVA
11.	Rating	1000 KVA
12.	Type of Cooling	ONAN
13.	Percentage Impedance at 75°C & 50Hz	5.0% $\pm$ 10% (IS tolerance)
14.	Maximum Temperature Rise over ambient	i) Top oil temp. rise measured by thermometer - "40°C" ii) Winding temp. rise measured by resistance method - "45 °C" Bids not meeting the above limits of temperature rise will be treated as non-responsive.
15.	Rated Short Circuit Level	500MVA for 2 seconds at 11KV
16.	Taps	Tapping shall be provided for on HV winding for voltage variation of +5.0% to -7.50% or -10.00% in step of 2.5% with Tap position no. 3 as Normal.
17.	Sound levels in decibel at rated voltage & frequency	751- 1000KVA -58db
18.	Type	Non-Sealed type

5.00 **LOSSES:**

Standard Losses at 75°C will be as follows:

The Total Loss at 50 % & 100% loading at rated voltage and frequency at 75°C shall not exceed the value as mentioned below.

NO POSITIVE TOLERANCE SHALL BE ALLOWED ON THE MAXIMUM ALLOWABLE TOTAL LOSSES AT 50% & 100% LOADING at column (4) & (5) mentioned below.

Sl. No.	Voltage Ratio	Rating in KVA	Max ^{III} Total Loss (NLL+ LL) at 75°C	% Imp. Voltage at 50 Hz & 75°C
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(1)	(2)	(3)	50%Loading (4)	100%Loading (5)	(6)
1.	11000/ 415V	1000	2620Watts	7000Watts	5.0% ± (IS Tol)

6.00 TERMINALS:

a) FOR CABLE END BOX AT BOTH ENDS:

HV & LV bushings shall be located on opposite side of the transformer, not on the Top Cover. The Height of the top of the H.V Bushing should be below the minimum oil level marking of the oil level gauge. **L.V bushing location should be well above the top yoke.**

Suitable size cable end box with Non-magnetic gland plate shall have to be provided at both HV & LV side of transformer. For 11 KV side, 3C X 95 sq. mm XLPE armoured cable and for L.V. side- 1.1 KV grade 3 runs of 4 x 1C, 630sq. mm XLPE armoured cable will be fitted. The bidder shall ensure the arrangement of cable boxes so as to prevent the ingress of moisture into the box due to rain water directly falling into the box. The cable boxes shall be of split type with faces plain and machined and fitted with NEO-K-Texor similar quality gasket and complete with brass wiping gland to be mounted on separate split type gland plate with nuts bolts 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 Brass 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 not less than 12 mm. The material of connecting rod shall be of copper.

HV & LV cable support clamp should be provided to avoid tension due to cable weight.

In addition to the terminal bushings at HV & LV Cable box, additional support bushing should be provided so that cables will be connected directly to the support bushing. Necessary copper dropper (busbar with sleeveings) should be provided as required. Current density of copper dropper shall not be more than 1.6A/mm²

The LV cable box shall have non-magnetic type gland plate with gland plate of appropriate size suitable for single compression brass glands on LV side to terminate 3 runs of 1.1 KV grade 4 x 1C 630sq. mm XLPE armoured cable. Sheet thickness of HV & LV cable boxes shall be 14 SWG minimum.

b) FOR HV SIDE BARE BUSHING AND LV SIDE WITH CABLE END BOX:

HV & LV bushings shall be located on opposite side of the transformer. HV bushing should located on tank top cover. Suitable turrets to be provided at tank top cover for fixing HV bushing. Turrets should have bolted cover and air release plug arrangement.

Suitable size cable end box with non-magnetic gland plate shall have to be provided at LV side of the transformer. For L.V. side - 1.1 KV grade 3 runs of 4 x 1C, 630sq. mm XLPE armoured cable will be fitted. The bidder shall ensure the arrangement of cable boxes so as to prevent the ingress of moisture into the box due to rain water directly falling into the box. The cable boxes shall be of split type with faces plain and machined and fitted with NEO-K-Texor similar quality gasket and complete with brass wiping gland to be mounted on separate split type gland plate with nuts bolts 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 Brass nuts. The cross section of the connecting rods shall be stated and shall be adequate for carrying the rated currents. The material of connecting rod shall be of copper.

LV cable support clamp should be provided to avoid tension due to cable weight. In addition to the terminal bushings at LV Cable box, additional support bushing should be provided so that cables will be connected directly to the support bushing. Necessary copper dropper (busbar with sleeveings) should be provided as required. Current density of copper dropper shall not be more than 1.6A/mm²

The LV cable box shall have non-magnetic type gland plate with gland plate of appropriate size suitable for single compression brass glands on LV side to terminate 3 runs of 1.1 KV grade 4 x 1C 630sq. mm XLPE armoured cable. Sheet thickness of LV cable boxes shall be 14 SWG minimum.

The electrical characteristic of bushings insulators shall be in accordance with the latest version of IS2099. Dimensions & type of bushing shall conform to IS: 8603, IS: 3347, IS: 7421 shall be as follows:

H.V. Bushing (11KV Side) : 17.5 KV class

L.V. Bushing (0.415KV or 0.433KV side): 1000 V Class

Neutral bushing at L.V. Side : Neutral of L.V. Winding shall be brought out through porcelain bushing similar to LV bushing for connection with earth terminal. Extra Neutral bushing of same rating shall also to be provided at cable end box.

6.01 **INSULATION LEVEL:**

The Transformer shall be capable to withstand test voltage as specified below:

Nominal voltage	Highest System voltage	Rated Lightning impulse withstand voltage (In KV peak)	Rated short duration power frequency withstand voltage In KV(r.m.s)
11KV	12KV	75	28
415 V	-	-	3

Note: The wave shape of Impulse voltage should be chopped on tail

7.00 **Cores:**

- 7.01. The cores shall be of stack type only, constructed from low loss Silicon Steel cold rolled grain oriented with inter lamination resistance & rust inhibiting property having Carlite as Inter lamination insulation.
- 7.02. The maximum flux density in any part of the core and yoke at normal voltage & frequency shall be such that the flux density with +12.5% combined voltage and frequency variation from rated voltage & frequency does not exceed 1.9Tesla.
- 7.03. The No Load Current at rated voltage and frequency shall not exceed 2% of the full load current and at 112.5% combined variation of voltage & frequency the no load current shall not exceed 5% of full load current.
- 7.04. The assembled core shall be securely clamped with uniform pressure to minimize noise.
- 7.05. The M.S. Core clamping frame shall be provided with lifting eyes for Tanking & detanking and the core is to be electrically connected by tinned copper strip of adequate section to the top core-yoke frame for earthing through the tank at two different points to drain off electrostatic potential that may build up.
- 7.06. The supporting framework of the core shall be so designed, so as to avoid the presence of pocket which would prevent complete emptying of tank or cause trapping of air during filling.
- 7.07. Adequate provision shall be made to prevent movement of core and winding relative to the tank during transport and installation or while in service.
- 7.08. The core shall conform to: IS: 3024, Electrical sheet steel & IS: 649, Method of test steel sheet. Successful bidder will offer for core for inspection and/or approval by the purchaser during the manufacturing stage.
- 7.09. The manufacturers call notice in this regard should be accompanied with the following documents as proof towards the use of prime core material.
- 7.010. Invoice of the supplier 2) Mill's test certificate 3) Packing list 4) Bill of Landing 5) Bill of entry certificate to customs.
- 7.011. Core material shall be procured either from core manufacturer or through the accredited marketing organization of repute.
- 7.012. Transformer Sl. No. shall have to be punched on the top core-yoke frame.

8.00 **Winding:**

- 8.01. The Transformer shall be provided with requisite number of windings and shall be so designed to withstand the electromechanical stress exerted under short circuit conditions as per IS : 2026 (Part-5)
- 8.02. The winding shall be so designed to reduce to a minimum out of balance forces in the transformer.
- 8.03. The winding shall be so designed that all coil assemblies of identical voltage & KVA rating shall be interchangeable. Foil winding will not be acceptable.

04. The winding shall be assembled on the core centrally for magnetic balance & symmetrically for electrical balance. Ducts shall be provided for oil circulation and lowering hot spot temperature in the winding.
- 8.05. All insulating materials to be used in the transformer shall be of Class A insulation as specified in Indian Standards. The paper insulation shall be Epoxy Dotted Kraft Paper and shall be dry and free from puncture and other defects. Solid insulation shall be of best quality. Wooden support, if used, shall be well seasoned and compatible with hot transformer oil. The test certificate of the raw materials shall be made available by the Transformer manufacturer on request during Inspection & Testing.
- 8.06. The insulation of Transformer winding & connections shall be free from Insulating materials liable to soften, ooze out, shrink or collapse and shall be non-catalytic & chemically inactive to transformer oil during service.
- 8.07. The details Insulation covering for H.V & LV conductors shall be DPC (Double Paper Cover).
- 8.08. The number of HV coils per phase per limb for stack core shall be of any nos. but foil winding will not be acceptable.
- 8.09. The Inter-leaved Insulating paper between the layers of the winding, shall be Epoxy dotted Kraft Paper.
- 8.010. The clearance between the coils shall be adequate and well co -coordinated.
- 8.011. The stacks of windings shall receive adequate pre-shrinkage treatment before assembly.
- 8.012. HV/LV lead termination to the stud should be made either by method of brazing/soldering/bolted or the free end of the lead wire having considerable length should be bent to form a ring & the ring should be fixed to the bushing stud with suitable nut, bolt and washer. Crimping not allowed.
- 8.013. The neutral formation point inside the tank should be at a suitable location on the upper portion of the tank and not on the lower side so that it is easily accessible without lifting the core coil assembly.

8.014. WINDING AND CLEARANCE INSIDE THE TANK(For Stack type core)

CONSTRUCTION:

The winding shall be assembled on the core co-axially for magnetic balance and symmetrically for electrical balance. Liberal ducts shall be provide for oil circulation and lowering hot spot temperature in the winding. Spacers, wedges shall be robust & hard insulations are so fitted in the winding that they will neither move, nor permit any relative movement of any part of the winding during normal service and under a terminal short circuit, without causing mechanical injury to any insulation in the winding. Foil winding is not acceptable.

- i) The transformer shall have separate H.V. and L.V. windings made of electrical grade copper wires as specified conforming to relevant ISS
- ii) Number of HV coils per phase/limb shall be of any nos.
- iii) Minimum clearance between HV coils and/or sections should be 6.4mm, if not of single coil and at top/bottom, the minimum clearance should be 12 mm including 1.5 mm insulating ring.
- iv) Minimum inter phase clearance (HV to HV) with 3 mm phase barriers should be 10 mm up to voltage class of 12 KV.
- v) The minimum end clearance (HV to earth) should be 20mm up to voltage grade 12 KV.
- vi) End insulations at both ends shall include upto 360 KV grade:-
 - a) 3mm thick yoke insulation over winding of the phases.
 - b) 6mm ducts at the top and bottom for circulation of oil in the LV and HV windings.
- vii) The minimum radial clearance in the winding will be as follows:-
 - a) Between core & LV winding 3 mm minimum.
 - b) Between LV winding and HV winding 10mm minimum including 2.0 mm thick pressboard conforming IS:1576 cylinder where LV winding is 1100V grade and HV winding 12 KV grade.
- viii) LV cylinder preferably be made of corrugated insulating press board. Oil ducts need to be provided between core and LV winding.
- ix) Minimum clearance between tank wall and HV windings/live parts, where the HV winding is 12 KV grade, clearance: 25 mm no additional insulating barrier shall be used in between. The dimension in respect of ducts and clearance in the windings shall hold for the assembled windings and core prior to application of pressure for permanent shrinkage of

coils. The changes in dimensions in finished condition shall remain within 15% (Fifteen percent).

- x) The stack of winding shall receive adequate shrinkage treatment before final assembly. Adjustable devices shall be provided for taking up any possible shrinkage of coils in service. The coil clamping arrangement and finished dimensions of any coil duct shall be such as will not impede free-circulation of oil through the ducts.
- xi) All spacers, axial wedges/runners used in windings shall be made of pre-compressed pressboard -solid, conforming to B 3.1 of IEC 641-3-2. In case crossover coil winding of H.V. 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 desired spacers freely. Insulation shearing, cutting, milling and punching operations shall be carried out in such away, that there should not be any burr and climatic variations.

8.15 BRACING OF WINDINGS:

- i) The windings and connections of all transformers shall be braced to withstand chocks which may occur during transport or due to switching/ short circuit and other transient conditions during service.
- ii) Coil clamping rings, if provided, shall be of steel or of suitable insulating material. Axially laminated material other than Bakelite paper shall not be used.

9.00 TANK:

- 9.01 Conventional plain tank shall be constructed. The Transformer tank and cover shall be fabricated from good commercial grade low Carbon Steel suitable for welding & of adequate thickness. The tank wall should be of thickness 5.0 mm. **Top and bottom plate should be of 6.0 mm thickness.** Tolerance as per IS: 1852 shall be applicable.
- 9.02 Tank design shall be such that core & winding assembly can be tanked or detanked easily and welding is minimum.
- 9.03 The under carriage of the tank shall be made of channel of suitable size & design.
- 9.04 The base of each tank shall be so designed that it shall be possible to move the complete transformer unit by skidding in any direction without injury when using plates or rails. Suitable Roller shall be provided in the base channel as per Drawing shown in Fig. 7 of IS 1180 (Part-1) of 2014.
- 9.05 Tank shall be designed to prevent retention of water. Tank cover shall be of adequate strength. It shall be bolted on the flanged rim of the tank with weather proof hot oil resistant Synthetic rubber or synthetic rubberized cork resistant to hot transformer oil conforming to Type III as per IS 11149/Type C as per IS 4253(Part2) of 5mm thickness and shall be provided with water tight compound between the tank flange and the gasket.
- 9.06 Horizontal Stiffer shall be provided continuously welded on the tank wall. Vertical stiffener of similar type shall also be provided. These Stiffeners shall be adequate in no. and size in order to maintain the mechanical strength of the Transformer during it's life span.
- 9.07 The thermometer pocket should be welded on tank top cover having threads on projected portion above top cover so that the pocket can be covered by a metallic cap having thread inside. The location of the thermometer pocket should be as near to the centre of the tank top cover as possible. In addition to the Thermometer pocket as stated two numbers thermometer pockets shall be provide for inserting the Oil Temperature sensor probe for OTI and WTI. The OTI and WTI thermometer pocket shall be placed on an elevated base so as to avoid ingress of moisture into the tank. The OTI and WTI shall be of Perfect Control/ Precimeasure/ Aditya Mechatronics make with 2 nos. contact (1 each for Alarm & Trip).
- 9.08 One inspection cover with Air release of plug shall have to be provided at the centre of the top cover of the tank. The size of the inspection cover shall be such that the Tap switch connecting leads can be viewed and checked through that inspection cover hole. The inspection cover shall be provided with lifting handle.
- 9.09 Lifting lugs are to be provided at the diagonally opposite corner sides of the tank body so that the finished transformer can be lifted by means of a shackle. The top cover for transformers shall also be provided with a lifting eye for lifting the tank top cover.
- 9.10 The tank shall be designed in such a way that the metallic part inside the H.V bushing shall remain immersed in oil when the oil level is at minimum oil level marking of oil level gauge

Tank cover and inspection cover should have 90° downward bent edges on all sides to protect the gasket under the top cover from direct exposure to weather. The tank cover should have slightly slanted towards HV side so that rain water could not accumulate on the tank cover.

The rating, Sl. No., P.O. No., year & month of manufacture, guaranteed for five years, property of WBSEDCL etc. Asset Codification no., Energy efficiency level of Level 2 (as per amendment no. 4 of IS-1180 (Part-I):2014) type, marking with standard mark as per clause no. IS 1180 (Part1) of 2014 & BIS marking shall be engraved/ Embossed distinctly on the tank body in addition to those provided in the name & rating plate. Adequate care shall be taken so that tank does not get damaged during such engraving. Alternatively a M.S Sheet of adequate thickness containing those data being engraved in the sheet may be welded at a suitable location of the tank body. Adequate care must be taken so that the main tank/Hot resistant paint inside the tank/Transformer oil do not suffer any damage during the process of welding.

Nuts & Bolts and washers are to be provided for outside use on tank cover & accessories shall 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.

- 9.11 Inside wall of the tank and the M.S. Channel shall be painted with varnish or with hot oil resistance paint. Stiffener shall be continuously welded on the tank wall.
- 9.12 All the welding of the tank & accessories must be double welded and all welding operations must be done by qualified welders.
- 9.13 Nuts, bolts, flat washers, spring washers as specified shall be used and suitable space to press the tank cover.
- 9.14 Pressure relief device (0.49 Kg/cm²) shall be provided of sufficient size for rapid release of any pressure that may be generated within the tank and which might result in damage to the equipment. The device shall operate at a static pressure of less than the hydraulic test pressure for the transformer tank. Means shall be provided to prevent ingress of rain water. It shall be mounted on the cover of the main tank and shall be designed to prevent gas accumulation. Spring loaded setting type Pressure relief valve having suitable opening port hole according to the capacity of the transformers should be provided. The pressure relief valve should have provision of visual indication for opening of the valve and also Contact/Micro Switch arrangement for alarm/tripping function. The alarm/trip contact of the Pressure relief device shall be brought by suitable PVC copper wire to the connectors provided in the Marshalling box.
- 9.15 Thermometer pocket as per relevant ISS should be provided on top cover for measurement of top oil temperature. The thermometer pocket should be welded on tank top cover having threads on projected portion of top cover so that the pocket can be covered by a metallic cap having thread inside.
- 9.16 The Inspection cover should be placed on turret so as to eliminate the seepage of rain water from the top cover of the tank.
- 9.17 Silica gel breathers are to be provided on transformers. A suitable metallic cover should be provided on the pipe on which the breather is provided at a location just above the breather so that it can protect rain water from falling directly onto the breather. Detachable Conservators are to be provided. The moisture absorption shall be indicated by a change in the colour of silica gel crystals which should be visible from a distance. The volume of the breather shall be suitable for 1Kg. The conservator shall be liberally dimensioned such that with the lowest ambient temperature and no load on the transformer, the oil level shall not recede too low with the highest ambient temperature & permissible overload on the transformer, the oil will not spill into the breather pipe or to the exterior to waste. The conservator shall be provided with oil level indicator of prismatic type with minimum, normal & maximum temperature markings and one magnetic oil level gauge with low oil level alarm contact shall have to be provided on the opposite side of the conservator on which plain oil level gauge is fitted. The alarm contact of the MOG shall be brought by suitable PVC copper wire to the connectors provided in the Marshalling box. The inside diameter of the pipe connecting the conservator to the main tank shall be within 20 to 50 mm and it should be projected into the conservator in such a way that its end is an approximately 20 mm above the bottom of the conservator.

Conservators of suitable dimension shall have to be provided. The conservator shall have Drain

valve. Filling hole with threaded air tight metallic cover shall be provided as usual. Conservator pipe shall be welded on the tap cover.

The pipe connecting the conservator and tank shall be provided with a gas actuated Buchholz relay with two contacts one for alarm and one for Trip. The alarm & Trip contacts of the Buchholz relay shall be brought by suitable PVC copper wire to the connectors provided in the Marshalling box. The Buchholz relay shall be of Atvus/Sukrut/Press n Force make.

A shut of valve of suitable dimension is to be provided in the pipe in the portion between conservator and Buchholz relay. Care should be taken so that oil flow is not impeded.

A WTI CT having rating 15VA, 1400/5A, Acc. Class: 1.0 or better, shall also be provided at LV side W-phase lead and secondary terminals of the WTI CT should be brought out at the top cover through Epoxy moulded terminals of rating 1KV/5A. A protective cover arrangement shall also be provided for these bushings. Connection of WTI CT secondary terminals shall be brought by suitable PVC copper wire to the connectors provided in the Marshalling box

9.18 COOLING ARRANGEMENT:

1. The transformer shall be suitable for loading of 100% continuous maximum rating with 'ONAN' cooling without exceeding the thermal limit at all tap positions.
2. The DTR shall be fitted with detachable type radiators. The radiator banks shall be provided with shut off valves and Air Release plug at the top of header of each bank. Drain plugs are also to be provided in each radiator banks. Lifting eyes shall also be provided at each radiator bank. Radiators are to be fixed in such a position so that circulation of oil and heat dissipation will be effective.
3. The radiator fins shall be made of CRCA steel sheet having a minimum wall thickness of 1.50 mm and a clean bright internal surface free from rust and scale. They shall be suitably branched to protect them from mechanical shocks normally met in transportation and damp the modes of vibration transmitted by the active part of the transformer in service.
5. The manufacture will have to provide information regarding wall surface area of tank and radiator cooling separately as part of the guaranteed technical particulars.

9.19 PRESSURE TEST:

a) Type Test:

The transformer shall be subjected to air pressure of 80kPa above atmosphere for 30 minutes and vaccum of 500 mm. of mercury for rating above 200KVA for 30 minutes. The permanent deflection of flat plate after pressure has been released shall not exceed values given below:-

<u>Length of Plate</u>	<u>Deflection</u>
Upto 750m	5.0 mm
751 to 1250 mm	6.5 mm
1251 to 1750 mm.	8.0 mm.
Above 1751 mm.	9.0 mm.

If required, the manufacturers should submit pressure test certificates for the transformer tanks at least for one Tank for each batch either conducted by their fabricators or by themselves. Transformer tanks should be double welded electrically as per the specification.

b) Routine Test:

The transformer tank with bolted cover shall be tested at a pressure of 35 kPa above atmosphere pressure maintained inside the tank for 10 mins. There should be no leakage in any part.

9.20 Oil Leakage Test:

The assembled transformer with all fittings including the bushing in position shall be tested at a pressure equivalent to twice the normal head measured at the base of the tank for 8 hr. There should be no leakage at any point.

9.21 The manufacturers should submit pressure test certificates for the transformer tanks at least for one batch either conducted by them or by their fabricators, for which order is placed with them and edges(both inside and outside) of the transformer tanks should be double welded electrically and scrupulously as per the specification.

9.22 TAP CHANGER/TAPPINGS:-

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

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 cannot 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.

9.23 BUSHINGS:

All bushings shall conform to the requirements of latest revision of IS 8603, IS: 3347, IEC 60137, IS 7421, IS 2099 and IS 9431 and other relevant standards. Bushings must be well processed, homogeneous and free from cavities and other flaws. Glazing must be uniform in colour and free from blisters, burns and other defects.

The bushing rods shall be made of Tinned Copper material having proper dimension for both HV and LV bushings with brass nuts.

The bushings shall be fixed to the transformer on side with straight pockets and in the same plain for one Voltage side and on the opposite side for the other voltage side. The tests as per IS 2099 and IS 7421 shall be conducted on the bushings. The Bushings can be of porcelain/epoxy material bushings conforming to relevant IEC can also be used. For 11KV, 17.5 KV class bushing and for 0.415KV or 0.433KV, 1.0 KV class bushing shall be used.

Dimensions of bushings of the voltage class shall conform to the standards specified. Lightning Impulse voltage of H.V. bushing shall be 25 KV.

Lightning Impulse voltage of H.V bushing shall be 95 KVp and short duration Power frequency voltage shall be 28 KV (RMS). The LV bushing shall have short duration Power frequency voltage shall be 3 KV (RMS). The Bushings shall be of reputed make. The Bushing manufacturer shall have credential of supply of Bushings and have testing facility for bushing.

The minimum phase to phase and phase to earth clearance in air in case of Cable End Box type bushing shall be as follows:

Voltage	Clearance	
	Phase to Phase	Phase to Earth
11 KV	130 mm	80 mm.
LV	45mm.	20 mm.

The minimum phase to phase and phase to earth clearance in air in case of outdoor type bushing shall be as follows:

Voltage	Clearance	
	Phase to Phase	Phase to Earth
11 KV	255 mm	140 mm.
LV	85mm.	40 mm.

10.00 PAINTINGS:

10.01 SURFACE PREPERATION&PAINTING:

i) GENERAL

1. All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brass marks or other defects.
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 recommendation. However, where ever airless spray is not possible, conventional

- spray be used.
- ii) 1. 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.
3. Steel surfaces shall be prepared by shot blast cleaning (IS 9954).
4. Chipping, scraping, and steel wire brushing using manual or power driven tools cannot remove firmly adherent mill-scales. This methods shall only be used where blast cleaning is impractical.
- iii) Protective coating:
1. As soon as all items have been cleaned and within four hours of subsequent drying, they shall be given suitable anti-corrosion protection.
- iv) 1. Following are the types of paint which may be suitably used for the items to be to be painted at shop and supply of matching paint to site.
a) Hot oil resistant (Proof) or varnish paint for inner surface.
b) For external surfaces one coat of thermo setting powder paint or one coat of epoxy primer followed by two coats of polyurethane base paint. These paints can be either air drying or stoving.
- v) Painting Procedure:
1. All prepared steel surfaces should be painted 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.
2. Where the quality of films impaired by excess film thickness (Wrinkle, mud cracking or general softness) the supplier shall remove the unsatisfactory paint coating and apply another coating. As a general rule, the dry film thickness should not exceed the specified minimum dry film thickness by more than 25%.
- vi) Damaged paintwork:
1. 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.
- vii) Dry Film thickness:
1. To the maximum extent practicable the coats shall be applied as a continuous film of uniform Thickness and free from pours. Overspray, skips, runs, sags, and drips should be avoided. The different coats may or may not be of same colour.
2. Each coat of paint shall be allowed to harden before the next is applied as per manufacturer's recommendation.
3. Particular attention must be paid to full film thickness at the edges.
4. The requirement for dry film thickness (DFT) of paint and the materials to be used shall be as given below:

Sl. N	Paint Type		Area to be painted	No of coats	Total dry film thickness, min(Microns)
1	Thermosetting Power Paint		Inside	01	30
			Outside	01	60
2	Liquid Paint	a. Epoxy(Primer)	Outside	01	30
		b. Polyurethane(finish coat)	Outside	02	25 each
		c. Hot oil resistant paint/Varnish	Inside	01	35/10

- viii) Test for painted surface:
1. The painted surface shall be tested for paint thickness and cross hatch adhesion test for Category 4B according to ASTM: D-3359: 2010 as acceptance test.
2. The painted surface shall pass Impact Test according to ASTM D-2794:2004 (Weight-1Kg, Height-50cm), Salt Spray Test according to ASTM: B117:2019, Duration-100 Hrs and Scratch Hardness test (Grade-2H, 1Kg Pressure) as per ASTM: A194/IS 101 (Part-5, Sec-I): 1988 RS 2014 as type / special test.

Note: The paint wok shall also come under the coverage of guarantee period of the equipment. The shade of colour of the transformer shall be Dark Admiralty Gray as per IS 5.

- 2 Before painting or filling with oil, all un-galvanized parts shall be completely cleaned & free from rust, scale & grease and all external surface on casting shall be filled by metal deposition. The interior of all transformer tank & internal structural steel work shall be thoroughly cleaned of all scale & rust by sand blasting or other approved method. This surface shall be printed with hot oil resisting varnish or paint.

11.00

EARTHING TERMINALS:

Two earthing terminals with lugs capable of carrying the full amount of lower voltage, short circuit current of transformer continuously for a period of 5 Sec. on the tank body at suitable locations shall be provided.

12.00 RATING & DIAGRAM PLATE:

- 12.01 A rating plate bearing the data specified in the relevant clauses of IS 1180 (Part 1) of 2014 including connection diagram, Tap positions on HV sides mentioning the voltages at different tap positions Vector group, Voltage LV & HV, LV & HV current, percentage Impedance, Loss figure, Makers name, serial no etc. are to be provided along with the transformer. BIS logo for BIS level 2 CRGO core copper winding is to be marked. Material of Rating & Diagram plate shall be of stainless steel with thickness 20SWG minimum.
- 12.02 The total weight of finished transformer along with the untanking weight of core & winding is to be mentioned.
- 12.03 Guaranteed maximum temp rise in oil & winding should be mentioned.
- 12.04 It should be mentioned that the loss figures of the DTR corresponds to Efficiency Level 2 of IS 1180 (Part 1) of 2014.
- 12.05 The Guaranteed values of Temperature rise of top oil & winding are to be mentioned.
- 12.06 "Property of WBSEDCL" is also to be mentioned.

13.00 MOUNTING ARRANGEMENT:

The Mounting arrangement shall be as per clause no. 14 of IS 1180 (Part 1) of IS 2014 or latest amendment thereof. The 1000 KVA; 11/0.415KV or 0.433KV transformer may also be placed on concrete base without any tolerance. The base of each tank shall be so designed that it shall be possible to move the complete transformer unit by skidding in any direction without injury when using plates or rails. Suitable Roller shall be provided in the base channel as per Drawing shown in Fig. 7 of IS1180 (Part-1) of 2014.

13.00(a) Marshalling Box:

A sheet steel weather proof box having louvers and hinged door having glass windows to see the OTI and WTI from the outside shall be provided on the side opposite to which rating plate is provided. The box shall have sufficient space to accommodate the OTI, WTI and terminal box for control cable termination. The Marshalling box shall be provided with adequate terminal boxes for MOG Alarm contacts, OTI Alarm & Trip contacts, WTI Alarm & Trip contacts, Buchholz Alarm & Trip contact, Pressure relief trip contact and A.C cable terminations. Current rating of all the contacts shall be 5A. 1.1Kv, 2.5sq. mm., 48 strands, Copper cables shall be used for wiring inside the Marshalling Box. Moreover the box shall accommodate cubicle lamp, Space Heater, Thermostat and removable cable gland plate. The door shall contain door switch. 20% extra terminal blocks to be provided as extra.

4.00 DUTY UNDER FAULT CONDITION:

- 14.01 It is to be assumed that abnormal voltage will be maintained on one side of the transformer when there is a short circuit between phases or to earth on the other side.
- 14.02 The transformer maybe directly connected to an underground or overhead line and may be switched into and out of service together with or without its associated incoming/ outgoing line.
- 14.03 The thermal ability to withstand short circuit shall be three seconds without injury for 3 phase dead short circuit at the terminals. The related calculation is to be submitted.
- 14.04 **Over Load Capacity:**
Each transformer shall be capable of carrying sustained overload as stated in IS 2026 (2009) Part-7.

15.00 FITTINGS:-

- 15.01 The following fittings shall be provided with the Transformers.

- i) Name, rating & terminal marking plates.
- ii) Two nos. earthing terminals with lugs at suitable locations of tank base channel.
- iii) Four nos. Lifting Lugs.
- iv) Four nos. Lifting eye on top cover.
- v) Plinth mounting arrangement.
- vi) Silica Gel breather.
- vi) Cable End Boxes for both HV & LV terminals with suitable Cable Gland Plates or HV Bushings at Tank top cover for HV terminals and Cable end box with suitable gland plates at LV Side for LV terminals as per requirement.
- vii) H.V. Bushing for cable termination.
- viii) L.V. Bushing for phases & neutrals with extra neutral bushing.
- ix) Off load Tap Changer
- x) One no. oil level gauge of prismatic type with Minimum, Normal & Maximum Temperature Markings at suitable location of the conservator.
- xi) Magnetic oil level gauge as specified.
- xii) Detachable Conservator with oil filling hole at the centre of top of conservator with threaded cover and Drain plug at the bottom.
- xiii) Flange mounted Drain cum Sampling Valve [Wheel type 1 1/4"]
- xiv) Flange mounted Filter Valve [Wheel type 1 1/4"]
- xv) Inspection cover placed on turret at the centre of tank top cover with Air release plug and lifting handle shall be provided on the top of the inspection cover.
- xvi) Plain thermometer pocket shall have threaded metallic cover placed as near to the centre of the tank top cover as possible.
- xvii) Oil Temperature indicator with Alarm & Trip contacts.
- xviii) Winding Temperature indicator with Alarm & Trip contacts.
- xix) Double Float Buchholz Relay with Alarm & Trip contact.
- xx) Detachable radiators with shut off valves both at top & bottom of each radiator header of Radiator banks and air release plug at top and drain plug at the bottom.
- xxi) Marshalling Box with Accessories as stated.
- xxii) Pressure relief device with trip contact
- xxiii) Jacking Pad 4 nos

xxiv) Property Plate

xxv) Shut off Valve between Conservator and Buchholz Relay.

16.00 Lifting and Haulage facilities:

- 16.01 Each transformer tank shall be provided with lifting lugs suitable for lifting of transformer complete with oil. Suitable holes shall be provided in the base channel of the transformer tank for fixing in the D.P. Structure above ground level of height 4.5 meter approx.

17.00 Insulating Oil:

TRANSFORMER OIL:

- A. The oil shall be as specified in IS:335-2018 or it's latest amendment and it shall be free from moisture and have uniform quality throughout. After receiving of Transformer at store, the oil sample will be taken from any transformer on random basis and tested at site as per IS: 1866-2017.
- B. Use of recycled oil is not acceptable.
- C. Oil shall be filtered and tested for breakdown voltage (BDV) and moisture content before filling.
- D. The oil shall be filled under vacuum.
- E. The design of the materials and processes used in the manufacture of transformer, shall be such as to reduce to a minimum the risk of development of acidity in the oil.
- F. The transformer oil is to be procured from reputed manufacturer only. During inspection of transformer the manufacturer may have to submit the complete test report as collected from the oil manufacturer, whenever asked, failing which the transformer may not be accepted.

18.00 Internal Earthing Arrangement:-

All metal parts of the transformer with the exception of the individual core lamination, core bolts and associated clamping plates shall be maintained at same fixed potential & core should be earthed at two points.

ROUTINE & TYPE TEST AND OTHER DETAILS

19.00 Testing & Inspection: -

19.01 Routine Test:

Each and every offered transformers offered shall be subjected to routine tests and one transformer out of each offered lot shall also be subjected to Temperature Rise Test at lowest tap position at the manufactures works.

The following tests are to be carried out:

- a) Measurement of winding resistance at all Tap position
- b) Ratio at all tap positions, polarity and phase relationship
- c) % Impedances voltage at 75°C and at 50 Hz
- d) Load losses at 50% & at 100% loading at 75°C and load loss at 100% loading at lowest tap position for Temperature Rise Test.
- e) No load loss and no load current at rated voltage.
- f) Insulation resistance.
- g) Induced overvoltage withstand.
- h) Separate source voltage withstand
- i) Magnetizing current at rated voltage & frequency & at 112.5% of rated voltage & frequency should not exceed the limit as per IS: 1180 (Part-I)2014 Cl. 7.9.2

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- 19.02 Type test:-

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24.01 Copies of performance certificates of similar equipment supplied to various organization shall have to be furnished in triplicate along with the tender.

25.00 Credentials as pre-requisites:-

25.01 Tenderer shall furnish document along with bid, in support of supply, delivery at consignee stores (e.g copy of P.O., SRV, Challan etc) of identical type & rating transformer and also higher capacity with same voltage Ratio and type, to the Govt. & Power Utility, indicating thereon names of the Organization, quantity ordered, quantity supplied along with the tender. Credentials for Purchase orders shall be within last 3(three) financial years from the date of opening of bid (If opening date extended, the 1st mentioned date for opening, shall be considered for submission of credential).

26.00 Type Test & special test Report as pre-requisites:-

The certified copies of valid type test reports for ISI clauses as per Energy Efficiency Level-2 specified in IS: 1180(Part-I):2014, copper wound CRGO Core type 1000 KVA rating distribution transformer from the Govt standard test Laboratories/Govt. approved laboratories/NABL accredited third party laboratory shall be submitted along with the tender.

The type test certificates for all ratings shall not be more than 5 years old from the date opening of the tender.

26.01 The bidder should submit **Type Test Report** of Dynamic Short circuit Test and Lightning Impulse voltage test **report Etc. for the rating they are offering** along with drawing conducted from **CPRI, NABL accredited laboratory of third party/ Govt. approved laboratories** carried out **within Five years** along with the offer having similar rating and type as that of the tendered item as **credential mentioned in ITB**, failing which the offer may not be technically accepted.

27.00 Deviations:-

27.01 All deviations from the specification, shall be recorded in the 'Deviation Sheet' with reference to respective clauses of the specification by drawing specification for the same. Unless deviations are recorded in the deviation sheet and submitted with the offer, it will be taken for granted that the offer is made in conformity with specification.

28.00 Validity Period:-

28.01 Validity period of the offer shall be reckoned from the next date of opening of tender provided it is technically & commercially complete one. Otherwise, it will be counted from the date of receipt of complete information.

28.02 Anything not covering by this specification, will be as per relevant CEA/ REC specification & ISS/CBIP manual.

29.00 Testing After Delivery:-

The materials (including Transformer oil) delivered to consignee stores will be subjected to re-inspection/ re-testing in presence of authorized representative of suppliers for which due notice in advance will be furnished by the C.E. (DTD) / C.E. (P&CD)/ Addl. C.E. (DTD)/ In charge of Zonal Testing Unit. In case of absence of vendor's representative, WBSEDCL shall test unilaterally and the result shall be binding on vendor.

30.00 Asset Codification no.-

Asset codification no. for 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, 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

1. Ratings:
2. Manufacturer's Sl. No. :
3. Manufacturer's Name:
4. P.O. No. :
5. Month / 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 Core Cu winding.

9. Asset Code Number: (10 digit alpha numeric numbers as allotted by the Purchaser) Again the following points shall have to be noted
- Front Size of letter shall be 28 i.e. 7 mm x 5.5 mm
 - Letters shall be distinctly engraved by cold Punch
 - Plate size shall be minimum 125mm X 170mm and shall be electrical run Welded be throughout its perimeter
 - Material of Plate shall be Mild Steel and not less than 3mm thick.
 - Plate shall be welded on the transformer tank at visible position and height.

31.00 Testing Equipment's:-

- i. KV Meter (0 -30 KV) for 11 KV system.
- ii. Volt Meter (0 -1000 V) .
- iii. Milli-ammeter for leakage current (0 -100ma) .
- iv. Power Analyzer of reputed make (should display 3 - phase current , voltage , watt and Σ 3- $\emptyset$ Power
- v. Insulation Tester - 2.5 KV
- vi. Thermometer(preferably Digital) 0 -100⁰C
- vii. TTR Meter
- viii. Winding Resistance measurement (reputed make)
- ix. Digital Multimeter
- x. Clamp-on ammeter(0 -300 A)
- 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. 4(Four) nos. ambient pots as per relevant ISS for measurement of ambient temperature during Temperature rise Tests.
- xvi. Instrument for measurement of Dry Paint thickness.
- xvii. Oil Test - Moisture content, BDV, Acidity.

ALL THE ABOVE TESTING EQUIPMENTS SHALL BE AVAILABLE IN THE TESTING LAB AND SHOULD BE CALIBRATED FROM NABL ACCREDITED LABORATORY. COPY OF CALIBRATED CERTIFICATES AS PER CLAUSE NO. 8 SHALL BE AVAILABLE WITH THE BIDDERAS AND WHEN REQUIRED.

Note: To facilitate testing, arrangement should be made for carrying out Heat run test of two Transformers simultaneously.

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- Y 19/08/26
- Z 19/08/26

WEST BENGAL STATE ELECTRICITY DISTRIBUTION CO. LTD

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS

SCHEDULE-A

(To be furnished and signed by the tenderer for each category of Transformer)

Sl. No.	PARTICULARS		GTP TO BE FILLED BY THE BIDDER FOR EACH OFFERED RATING
1	Name of the manufacturer & Factory address	::	
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	Tapings		
	(a) Range		
	(b) Number of steps		
	(c) Variation of voltage in each step (in KV)		

(xi) Whether the proof of use of prime core material is enclosed.

30 Terminal Arrangement:

(i) high voltage

(ii) low Voltage

31 Positive Sequence Impedance between HV&LV winding on rated KVA base at rated current and frequency at 75°C. Winding temperature (in percent).

32 Zero Sequence Impedance at reference temperature of 75°C (in percent)

33 Details of windings :

b) Type of Winding :

(ii) Joints in the windings soldering / brazing but in any case crimping is not allowed

a) High Voltage;

b) No. of Tap positions and it's range mentioning the normal Tap position

c) Low Voltage

(ii) Material of the winding conductor

(a) High Voltage:

(b) Low Voltage:

(iii) Conductor Area

(a) High voltage(in sq.mm)

(b) Low Voltage(in sq.mm)

(iv) Current density of winding at rated KVA

(a) High Voltage(Amp persq.cm)

(b) Low voltage(Amps per Sq.cm)

(v) Insulating material used for

(a) High Voltage Winding

(b) Low Voltage Winding

(vi) Insulating material used between

(a) High voltage and low voltage winding

(b) Low Voltage winding and Core

34 Insulation withstand Test Voltages

(i) Lightning Impulse withstand test voltage (KV Peak)

(ii) Power frequency withstand test voltage (in KVrms for 1 min)

	(iv) Tank and fitting with accessories	::	
	(v) Untanking weight	::	
	(vi) Oil required for the transformer	::	
	(vii) Total weight with Core, Winding, oil and fittings	::	
42	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)	::	
43	Thickness of Cable end Box		
		HV Side	::
		LV Side	::
44	Radiator Details		
	i) Number of Radiator Bank		
	ii) Number of tubes/fins in each radiator Bank		
	iii) Thickness of tubes/fins (in mm)		
	iv) Overall dimensions (in mm)		
	a) Length		
	b) Breadth		
	c) Height		
	v) Type of mounting		
	i) Vacuum withstand capability		
45	Gas And Oil Actuated Relay		
	i) Make		
	ii) Type		
	iii) Number of float contacts		
46	Type of Pressure relief device and pressure at which it operates		
47	WTI CT Ratio, Burden and Accuracy Class	::	
48	Temperature Indicators		OTI WTI
	i) Make		
	ii) Type		
	iii) Permissible setting ranges for alarm and trip		
	iv) Number of contacts		

v)	Current rating of each contact			
49	Oil quality	::		
	(i) Applicable standard	::		
	(ii) Total quality of oil(in litres)	::		
50	Approximate overall Dimensions(in mm)	::		
	(a) Length	::		
	(b) Breadth	::		
	(c) Height	::		
51	Paint Details:	::	Internal	External
	i) Type			
	ii) Colour			
	iii) Thickness			
	(d) Minimum height of bottom most portion bushing from bottom of base channel	::		
52	Minimum clearance height for lifting tank cover(in mm)	::		
53	Whether Type Test Report, Credential, Performance Certificate submitted as Pre-requisites as mentioned in respective clauses			
54	Marking : whether agreeable to b) Punching of transformer Sl. No. on the Top yoke. b) Transformer Rating and Diagram plate along with Asset codification number shall be welded on the tr. Body.			
55	Whether they have facility for painting and test in line with the technical specification at their works			
56	Whether they have facility for carrying out Tank Pressure & Oil leakage test in line with the technical specification at their works			
57	List of testing equipment's available in the testing lab. Of manufacturer in line with CI.No.31.00			

Signature:
Name:
Designation:
Company Seal: