WEST BENGAL STATE ELECTRICITY DISTRIBUTION COMPANY LIMITED
TECHNICAL SPECIFICATION FOR 33/0.415 KV 100 KVA; 3 PHASE: ONAN COOLED ; OUTDOOR TYPE STATION SERVICE BIS LEVEL-II COMPLIED TRANSFORMER (STACK CORE & NON SEALED TYPE)

1. **SCOPE:**

1.1 This specification covers design, manufacture, assembly, testing at manufacturer's works, supply & delivery of Three Phase 50 HZ, 33/ 0.415 KV, Delta/Star, Vector Group Dyn11, two winding, outdoor type, oil immersed naturally Oil & Air cooled, having Off Load Tap Switch with voltage variation of +5.0% to -7.50% in step of 2.5% at HV side, Non sealed and Stack Core Type Station Service Transformer as per details furnished hereafter.

1.2 The transformers covered by this specification shall be complete in all respect. Any materials or accessories which may not here specially mentioned but which is usual and necessary for satisfactory and trouble free operation and maintenance of the transformer, shall be supplied without any extra charge.

2. **LOCATION:**
The transformers may be installed outdoor anywhere in West Bengal. The elevations of the sites above mean sea level shall not exceed 1000 meters.

3. **SYSTEM DETAILS:**
The 33 KV systems are non effectively earthed through grounding transformer & 0.415 KV systems are effectively earthed at the neutral points of the star connected secondary winding of the transformer.

4. **WEATHER CONDITIONS:**

01. The area is also subject to heavy monsoon rains, 80 to 90% of the annual precipitation being in the month of June to October.

Maximum temperature of air in shade	50°C
Minimum temperature of air	4°C
Maximum temperature of air in sun	60°C
Maximum Humidity	98%
Average number of thunderstorm day per annum	100
Number of months of tropical monsoon rainy condition per annum(June to October)	4.5
Average rainfall per annum	300cm
Maximum wind pressure	250kg/m²

02. For the purpose of this specification the maximum daily average ambient temperature shall be 40°C average over 24 hours period.

5. a) **STANDARDS:**

01. Transformers covered by this specification shall, unless otherwise specified be built to conform to the latest Indian Electricity Rules, whenever applicable and the requirements of latest issue of ISS: 1180(Part- I):2014 and ISS 2026, CBIP Standards and other ISS (all as per latest issues)

Serial No	Item	IS Number
1.	Specification for Power Transformer	IS:2026
2	Outdoor Type oil immersed Distribution Transformers up to & including 2500 KVA, 33-KVspecification	IS 1180(Part-1) of 2014
3.	Specification for Cold Rolled Grain Oriented Electrical Steel	IS:3024
4.	Specification for Aluminum wire rod	IS 5484
5.	Specification for Copper wire rod	IS:12444
6.	Specification for Craft Paper	IS:9335
7.	Specification for Press Board	IS:1576
8.	Specification for Transformer/Mineral Oil	IS:335
9.	Specification for Up to 1.1KV Bushing	For Porcelain Part-IS:3347(Part-I/Section-I) For Metal Part-IS:3347(Part-I/Section-II)
10.	Specification for Outdoor Bushing	For Porcelain Part-IS:3347(Part-I/Section-I) For Metal Part-IS:3347(Part-I/Section-II)
11.	Specification for Marking and Relative positions of terminals	IS:2026 (Part-I)
12.	Specification for Gaskets	Type-III as per IS:11149/Type-C as per IS:4253(Part-II)

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13.	Specification for Mechanical testing of metals- Tensile Testing	IS 1608:2005
14.	Specification for Terminal Connector for HV & LV	IS 5561
15.	Specification for colours for ready mixed paints	IS 5
16.	Specification for ready mixed paint, brushing Zinc Chromate, priming	IS 104
17.	Testing for steel sheets and strips and magnetic circuits	IS 649
18.	Guide for loading of oil immersed Transformers	IS 6600
19.	Specification for clamping arrangement of Bushing .	IS 1257

02. In the event of a conflict between the above standards and the specification the later shall govern.

b) Pre-qualifying requirements for BIS certified transformer manufacturer-

Serial No.	Requirements	Documents required to be submitted
1.	BIS License	(i) For 100 KVA (Copper wound) distribution transformer having voltage class of 33KV, the bidding is open to only those manufacturers who possesses valid ISI License/ Marketing rights 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 Notary attested photocopy of the valid ISI License /marking rights must be submitted 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 Reports for 'ISI' mark , losses as per Energy Efficiency Level-2 specified in IS-1180(Part-1):2014, copper wound – 100 KVA; 33/0.415 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 than 5 years old from the date of opening of the tender.

However, the bidder submitting BIS level-II and Type Test certificates as specified in IS 1180(Part-1):2014 for Distribution Transformer of the ONAN type, CRGO core, Copper wound, non sealed Type having KVA rating above 100 KVA and up to & including 200 KVA and voltage class of 33KV, may also be technically acceptable provided, in that case, they will have to conduct all the Type & special tests as specified in IS: 1180 (Part-1):2014 for obtaining BIS level-II certificates including Lightning Impulse Test and Dynamic Short Circuit test after placement of Order maintaining the delivery schedule of the NIT. However, for techno-commercial eligibility of the bidder, the bidder needs to qualify the other qualifying requirement as per terms & conditions of the NIT. All the related costs for conducting such Type & special Tests shall have to be borne by the bidder. An undertaking in this regard is to be submitted along with the bid documents by the participating bidders who belong to this category.

c) The Transformer shall conform to the following specific parameters:

1	System Voltage	36 KV
2	Rated Voltage HV	33 KV
3	Rated Voltage LV	0.415 KV
4	Phase	3 phase
5	Frequency	50 HZ subject to fluctuation of +5%
6	Connection HV	Delta
7a	Connection LV	Star (Neutral brought out)

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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	CRGO material (Stack Core)
10	Winding	Both HV & LV winding shall be wound from Double paper Covered copper conductor.
11	Rating	100 KVA
12	Type of Cooling	ONAN
13	Percentage Impedance at 75°C	4.5% ± 10% IS tolerance
14	Maximum Temperature Rise over ambient	i) Top oil temp. Rise measured by thermometer - 35°C
		ii) Winding temp. Rise measured by resistance method – 40 °C
		Bids not meeting the above limits of temperature rise will be treated as non responsive.
15	Taps	Off Load Tap Switch is to be provided on H.V. winding for a voltage variation of +5.0% to -7.50% in step of 2.5% at HV side with its normal position at 3.
16	Rated Short apparent power of the stem at 33 KV as per IS 2026 (Part 5)	1000 MVA
17	Audible sound levels in decibel at rated voltage & frequency	i) Up to 50 KVA - 48db ii) 51 to 100 KVA – 51db iii) 101 to 300KVA – 55 db iv) 301 to 500KVA – 56db.
18	Type	Non-Sealed type

6. **RATING AND GENERAL DATA FOR DISTRIBUTION TRANSFORMER:**

01. Stack Core Type, Non sealed type, three phase, oil immersed step down two winding distribution transformer for outdoor installation with weather condition as stated above.
02. Rating: 100 KVA
03. Number of phase: Three
04. Frequency: Transformer shall be suitable for continuous operation at the rated output and also with voltage variation of ±10% of rated voltage and a frequency variation of ±3% from normal 50c/s without exceeding the specified temperature rise.
05. Type of cooling: ONAN
06. Voltage Ratio: 33/0.415 KV at normal tap
07. Vector group reference: Dyn11

7. **CONNECTIONS:**

The primary (HV) winding shall be connected in delta and secondary (LV) winding in star with vector group Dyn11.The neutral of the secondary (LV) winding shall be brought out to a separate insulated terminal.
The size (Cross section) of the neutral connection conductors and jumpers must be of same size as that of phase connecting conductors and jumpers which shall be properly supported and insulated.

8. **TEMPERATURE RISE:**

For winding 40°C (measured by resistance) and for top oil 35°C (measured by thermometer) as per cl. No 6.10.2 of IS: 1180 (Part-I): 2014 when tested in accordance with IS:2026 (Part-II).Temperature rise will be conducted corresponding to total loss(NLL at 50Hz+ Load loss at Lowest tap) at lowest tap position.

9. **SHORT CIRCUIT IMPEDANCE:**

4.50 % ± IS tolerance at 75°C, 50Hz.

10. **TERMINAL ARRANGEMENT:**

Bare on outdoor porcelain bushings suitable for heavily polluted area as per ISS/CBIP specification and other relevant specification shall be used. The top of the bushing shall be immersed in the oil when the oil level is at the minimum marking of the oil level gauge. The bushing rods should be locked in position so that twisting of leads is avoided during tightening of nuts of bushing rods.HT & LT studs are to be made of brass for terminal connections as per IS 1180 (Part-I) of 1989.

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33KV SIDE

The terminals shall be through outdoor type bushings conforming to IS:2099 and provided with Bi-metallic terminal connectors(rigid type) suitable for "Panther" ACSR conductor. Terminal connectors are to be supplied as per Technical specification of Clamps & connectors. The terminal connectors to be provided in the HV bushing stems shall conform to IS 5082 so as to connect the jumper without disturbing the bushing stem.

L.V. SIDE

Connections from transformer LV terminals to the respective LV switchgears shall be made through three phase 4 core cable. LT terminals of transformers shall be brought out through LV bushing mounted on side wall mounted bushing. The neutral terminals shall be brought out along with LV terminals through a separate bushing for connection to the respective switch gears neutral bus. Terminal connectors are to be supplied as per Technical specification of Clamps & connectors. The terminal connectors to be provided in the LV bushing stems shall conform to IS 5082 so as to connect the jumper without disturbing the bushing stem.

11. **LEADS:**

All leads of the windings, connections of the winding or their wires to one another to terminal bushing shall be properly insulated and covered with insulation sleeves. The soldering materials shall have higher melting temperature above 300°C and preferably above 400°C for better thermal endurance and material strength. The tenderer shall specifically mention the method and materials to be used by them for lead connection.

12. **CONDUCTOR MATERIAL:**

Electrical Grade Copper for both HV & LV winding of quality as per relevant ISS.

13. **TANK:**

I. Tank must be of plain surface of conventional type and Tank wall must be fabricated from tested quality of mild steel sheets of adequate thickness conforming to clause no. 15 of IS 1180(Part 1) of 2014 for plain conventional tank. Corrugated tank will not be accepted. It should be shaped so as to make welding to a minimum. All welding shall be done electrically and relieved from welding stresses. All wielding shall be absolutely oil tight and no bulging should occur during service. All seams shall be double welded for absolute oil tightness. The tank wall shall be formed by stiffener of structural steel for general rigidity and to dampen transformer noise. It shall also withstand partial vacuum pressure test as per clause no. 15.2 of IS 1180 (Part 1) of 2014. The manufacturer shall have to carry out this test during inspection if requested.

Tank design shall be such that the core and winding assembly can be tanked or de-tanked freely and easily.

The thickness of tank top & bottom wall shall be of minimum thickness of 6mm and that for side wall is 4 mm.

Horizontal & vertical Stiffer shall be continuously welded on the tank wall.

The manufacturer should carry out all welding operations as per relevant ASME standards and will submit a copy of the welding procedure and welder performance qualification certificates whenever asked during inspection.

The tank plate and the lifting lugs shall be of such strength that the complete transformer filled with oil can be lifted by means of a shackle.

Inside of the tank shall be painted with varnish/Hot oil resistant paint.

One suitable inspection hole with cover of adequate size should be provided on the tank cover so that the bushing ends and tap changer assembly may be easily accessible through that hole. The inspection cover should be placed on turret and should be provided with lifting handle and air release plug. All the fittings on the top cover should be placed on turret. An air release plug should also be provided at the top most point of the HV Bushing turrets so that any accumulated air bubble therein may be released through Air Release Plug.

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 levelgauge

II. The tank cover shall be bolted on to flanged rim of the tank with a weather proof, hot/cool oil resistant, resilient gasket in between for oil tightness. If the gaskets compressible, metallic strips shall be provided to prevent over compression of the gaskets. Bushing turrets, covers for pockets of thermometers and other devices shall be designed to prevent any ingress of rain water into the tank and the tank cover as a whole shall shed of all rain water. The tank cover should have downward bent edges on all sides so that the gasket under the top cover is protected from direct exposure to weather. All the welding of the tank and it's fittings shall be double welded and the welding shall only be done by a qualified welders.

The tank design shall be such that the core & winding assembly can be lifted freely.

The main tank body shall be capable of withstanding vacuum gauge pressure 250 mm of HG. For 10 min and subjected to air pressure of 80kpa for 30mins. The permanent deflection of flat plates, after pressure/vacuum has been released, shall not exceed the values givenbelow:

Length of plate	Deflection
Up to 750 mm.	5 mm.
751 to 1250 mm.	6.50 mm.

The transformer tank shall be of adequate strength to withstand +ve & -ve pressure that may build up inside the tank while the transformer in operation.

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Gasket used between top cover and tank flange shall be synthetic rubber or synthetic rubberised cork sheet resistant to hot oil and shall be provided with water tight compound between the tank flange and the gasket. Gaskets wherever used shall conform to Type III as per IS 11149/Type C as per IS 4253(Part2). 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 galvanised with passivation or hot dip galvanized. Nuts, bolts, flat washers, spring washers shall be suded and suitably spaced to press the tank cover.

III. Bushing turrets, access hole covers, pockets of thermometers shall be so designed to prevent any ingress or collection of water. Inspection cover is to be placed on a suitable turret and the OTI Thermometer pocket should be placed on a elevated base so that sleepage of rain water can not take place from the tank top surface. Another thermometer pocket as per relevant ISS properly wielded on tank top cover is also to be provided and it's location should be as near to the centre of the of the tank top cover as possible to measure the top oil temperature by external thermometer. The projected part of the thermometer pocket above the tank cover should have suitable threaded portion so that it can be covered with a metallic threaded cap.

IV. The rating, Sl. No., P.O No. , year & month of manufacture, guaranteed for five years , property of WBSEDCL, Asset Codification no., Energy efficiency level of Level2 type, marking with standard mark as per clause no. IS 1180 (Part1) of 2014 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.

V. Conservators along with silica gel breathers are to be provided in the transformers. 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 and with the highest ambient temperature and permissible over load on the transformer the oil will not spill into the breather pipe or to the exterior to waste. The capacity of the conservator tank shall be made keeping in view the total quantity of oil and it's contraction & expansion due to temperature rise.

The conservator shall be provided with oil level indicator of Prismatic type with minimum, normal & maximum temperature markings. 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 approximately 20 mm above the bottom of the conservator.

Conservators shall be provided Oil filling hole with threaded cover for absolute air tightness at the top of conservator and Air release plug at the bottom.

The conservator pipe hole fitted to the tank cover should be provided with a suitable slanted plate, required so that while pouring oil into the transformer through the conservator, oil does not fall directly on the winding. Care should be taken so that free oil flow is not impeded.

Explosion Vents for transformers shall also be welded on the cover. Air release plug should be provided at the top of the explosion vent.

Conservator tank shall be provided with plain oil gauge of prismatic type with maximum, normal Minimum oil level marking visible from the G.L.

Conservator tank shall be provided with dehydrating breathers. Drain Valve shall be provided on conservator. The moisture absorption shall be indicated by a change in the colour of Silica Gel crystals which should be visible from a distance. Volume of the breather shall be suitable for 500 gm. of Silica Gel conforming to IS:3401. A suitable metallic cover should be provided on the pipe on which breather is provided at a location just above the breather so that it can protect rain water from falling directly onto the breather.

One Bucholtz relay is to be provided at suitable location in the pipe connecting the conservator and main tank. The Bucholtz relay shall have two contacts for alarm and for tripping. The relay shall also comprise drain cock, air vent, and facility of testing with air injection/mechanical testing facility. One Shut off valve of suitable size is also to be provided in the pipe in between conservator and Buchholz relay.

VI. OTI pocket is to be provided.

VII. Marshalling box is to be provided for housing OTI. OTI shall be DIAL type Thermometer with mercury Contacts preferably of Precimeasure/Perfect control make. The OTI shall have two mercury contacts which can be set at 80° C & 85° C as Alarm & Trip contacts respectively. The Marshalling box shall have adequate connectors suitable for connection of control cables and wires from OTI.

VIII. PRESSURE TEST:

a) Type Test:

The tank shall be subjected to air pressure of 80Kpa above atmosphere for 30 minutes and vacuum of 250 mm. of mercury up to 200KVA & 500 mm. of mercury for rating above 200KVA for 30 minutes. The permanent deflection of flat plate after pressure has been released shall no exceed values given below:-

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Length Of Plate	Deflection for rating up to 200KVA
Up to 750mm	5 mm
751mm to 1250 mm	6.5 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 welded/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.

IX. **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.

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

14. **CORE:**

i. The magnetic core shall be built of low loss silicon steel, cold rolled grain oriented steel. The transformer shall be of stack core type.

ii. The materials used for insulating the sheets, shall have high inter-lamination resistance and rust inhibiting property. It shall not be deteriorated by ageing from hottest operating temperature and clamped pressure of the core and shall not disintegrate due to mechanical modes of core vibration. It shall not have the least tendency to absorb moisture or to react with the dissolved particles in the insulating oil thus accelerating sludge formation.

iii. The assembled core shall be securely clamped in the lines and in the uniform pressure so as to minimise the noise from the core.

iv. The core-clamping plate shall be provided with lifting eyes for the purposes of tanking and un-tanking the active parts of the transformer. The whole core shall be electrically connected by copper strip of adequate section to the core frame at two separate points for being eventually earthed through the tank to drain off electrostatic potential that may be built up.

v. Core base and top and bottom of yoke shall be supported with MS Channel of proper size and properly bolted together for stack type core.

vi. The supporting framework of the cores shall be so designed so as to avoid the presence of pockets which would prevent complete emptying of the tank through the drain vulve or cause trapping of air during filling.

vii. Adequate provision shall made to prevent movement of the core and winding relative to the tank during transport or installation or while in service.

viii. The cores shall conform to:

IS:3024 - Electrical Sheet Steel
IS:649 - Method of test steel sheet

ix. 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 1.9 Tesla.

The No Load Current at rated voltage and frequency shall not exceed 3% of the full load current and at 112.5% combined variation of voltage & frequency the no load current shall not exceed 6% of full load current.

x. Successful bidder will offer for core for inspection and/or approval by the purchase during the manufacturing stage. The manufacturer's call notice for the purpose should be accompanied with the following documents as proof towards the use of prime core materials:

(i) Invoice of supplier
(ii) Mill's Test certificate
(iii) Packing list
(iv) Bill of Landing
(v) Bill of entry certificate to customs.

Core materials shall be procured either from core manufacturer or through the accredited marketing organisation of repute.

15. **WINDING:**

i. The winding shall be made of paper insulated continuous and smooth electrolytic copper conductor & shall be provided with the requisite number of Coils and shall be designed to withstand the electromechanical stress exerted under short circuit conditions as per ISS:2026(Part 5). Foil winding will not be acceptable.

ii. Class "A" insulation shall be used. Paper insulation shall be dry and free from punctures and other defects. Solid insulation shall be of best quality. Wooden support, if used, shall be seasoned and compatible with transformer oil. The test certificates of the raw materials shall be made available by the transformer manufacturer on request

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during Inspection & Testing.

iii. The insulation level of the windings shall be as follows as per Part-III of IS:2026

Voltage	Impulse Voltage (KV Peak)	Short Duration Power frequency Voltage(KV)
415 V	-	3
33000 V	17 0	7 0

The wave shape of the impulse voltage should be chopped on tail

iv. The winding shall be so designed to reduce to a minimum the out of balance forces in the transformer (at all voltage rating). The insulation of both H.V & L.V winding shall be paper insulation. Epoxy dotted craft paper insulation shall be used.

v. The winding shall also be so designed such that all coil assemblies of identical voltage & KVA rating shall be Interchangeable and repairing of the winding can be made readily without special equipments. The minimum no. of coils of H.V. winding shall be 8(Eight).

vi. BRACING OF WINDINGS:

(1) The windings and connections of all transformers shall be braced to withstand shocks which may occur during transport or due to switching/short circuit and other transient conditions during service.

(2) Coil clamping rings, if provided , shall be of steel or of suitable insulating material. Axially laminated material other than bakelised paper shall not be used.

vii. WINDING AND CONSTRUCTION:

The winding shall be assembled on the core co-axially for magnetic balance and symmetrically for electrical balance. Liberal ducts shall be provided for oil circulation and lowering hot spot temperature in the winding. Spacers, wedges shall be robust & hard insulations are 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.

viii.

1. The stacks of windings shall receive adequate shrinkage treatment before final assembly. Adjustable devices shall be provided for taking up any possible shrinkage of coils in service.
2. The coil clamping arrangement and the finished dimensions of any oil duct shall be such as it will not impede free-circulation of oil through the ducts.
3. 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 H.V. coil 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 climational variations.

16. **BUSHINGS:**

All bushings shall conform to the requirements of latest revision of IS:3347 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 & and nuts shall be made of brass m material 12 mm diameter for both HT and LT bushings. The bushings shall be shall be fixed to the transformer on side with straight pockets and in the same plain or on the top cover top cover for transformers above 100 KVA. For transformers of 100 KVA and below the bushing can be mounted on pipes.

The tests as per IS 2099 and IS 7321 shall be conducted on the bushings.

The Bushings can be of porcelain/epoxy material. Polymer Insulator bushings conforming to relevant IEC can also be used.

For 33 KV, 36 KV class bushings shall be used and for 11KV, 17.5 KV class bushing and for 0.415 KV, 1.1 KV class bushing shall be used.

Dimensions of bushings of the voltage class shall conform to the standards specified . Arcing horns shall be provided on HV bushings.

Lightning Impulse voltage of H.V bushing shall be 170 KVP and short duration Power frequency voltage shall be 70 KV (RMS). The LV bushing shall have short duration Power frequency voltage shall be 3 KV (RMS).

The minimum creepage distance of 33KV bushings should be 900 mm.

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 outdoor type bushing shall be as follows:

Voltage	Clearance	
	Phase to Phase	Phase to Earth
33 KV	350 mm.	320 mm.

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Voltage	Clearance	
	Phase to Phase	Phase to Earth
11 KV	255 mm	140 mm.
LV	75 mm for DTR up to 25 KVA and 85 mm. beyond 25 KVA.	40 mm.

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
33 KV	350 mm.	220 mm.
11 KV	130 mm	80 mm.
LV	45 mm.	20 mm.

The Lightning Impulse Voltage level and Arcing Horn Gap shall be as follows:

Voltage	Lightning Impulse Voltage Level	Arcing Horn Gap
33 KV	170 KV_P	220 mm.
11 KV	95 KV_P	86 mm.
LV	NA	NA

17. **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 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 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.

18. **COOLING ARRANGEMENT:**

i. The transformer shall be suitable for loading of 100% continuous maximum rating with 'ONAN' cooling without exceeding the thermal limit at all tap positions.

ii. The transformer shall be fitted with round or elliptical cooling tubes bent and welded to tank or radiators consisting of a series of separate circular or elliptical tubes, or a pressed steel plate assembly formed into elliptical oil channels, wielded at their top and bottom to the tank.

iii. The round cooling tubes shall be made of mild steel (ERW) 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. The elliptical tubes or elliptical oil channels of pressed steel plate at least of 18 SWG (or 1.25mm thickness).

iv. The radiator on the upper side should be placed beneath the LV bushing pocket so that due to oil leakage from the gaskets of LV bushing oil level does not in any way go below the upper side of top radiator header and in the process effectiveness of the radiators for cooling is not lost.

v. The manufacture will have to provide information regarding wall surface area of tank radiator cooling tubes separately as part of the guaranteed technical particulars.

19. **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.
2. Steel surfaces shall be prepared by shot blast cleaning(IS 9954).

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3. Chipping, scraping, and steel wire brushing using manual or power driven tools can not remove firmly adherent mill-scales. This method shall only be used where blast cleaning is impractical.

iii. Protective coating:

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

iv. 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 synthetic enamel/polyurethane base paint. These paints can be either air drying or stoving.
c) All nuts and bolts used in the transformer for external fittings shall be painted with body paint.

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:

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 acontinuous 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. No.	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.
2. The painted surface shall pass the cross hatch adhesion test and impact test as acceptance test and salt spray test and hardness test as type test as per ASTM standard.

Note: The paint wok shall also come under the coverage of guarantee period of the equipment.

20. TEST & INSPECTION (AS PER IS: 1180 (PART-I):2014

All transformers shall be subjected to Routine test at the manufacturer's works. One transformer of each offered lot will be tested for Temperature rise test at lowest tap position.

The following tests are to be carried out:

01 ROUTINE TEST:

a. Measurement of winding resistance at all tap positions.
b. Measurement of Voltage Ratio, polarity and phase relationship at all tap positions.
c. % Impedance voltage measurement at 75°C & 50 Hz.
d. Measurement of No Load Loss at rated voltage & Frequency.
e. Measurement of Load losses at 75C at 100% Load and at 50% load at Normal Tap. Measurement of Load losses at lowest Tap at 100% Load for Temperature rise test.
f. Measurement of No load Current at 100% and 112.50% rated voltage and no load loss.
g. Measurement of Insulation resistance.
h. Induced over voltage withstand test.
i. Separate source voltage withstand test.
j. Temperature Rise Test is also to be conducted at lowest tap on one transformer for every lot offered for inspection as per test procedure described in cl. No. IS 21.3 (b) of IS:1180 (part-I):2014

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k. Unbalance current: The maximum value of unbalance current in transformer shall not exceed 2% of full load current as per CBIP for transformer.

l. Magnetising current at rated voltage & frequency & 112.5 % of rated voltage & frequency should not exceed the limit as per IS: 1180 (Part-I) 1989 Cl. 22.6.

m. Pressure Test: As per Clause no. 21.5 of IS 1180 (Part-1) 2014

n. Oil leakage Test: As per Clause no. 21.5 of IS 1180 (Part-1) 2014

Note: To facilitate testing, arrangement should be made for carrying out Heat Run tests for at least two transformers simultaneously.

02 TYPE TEST:

In addition to the routine tests, the following type tests, are to be carried out at CPRI/ NABL Accredited third party Laboratory or any other Govt. recognized Test House. Transformers for such tests are to be manufactured as per relevant technical specification and approved drawing and should be offered for preliminary testing like routine and temperature rise test at lowest tap position prior to type tests, by WBSEDCL's testing wing. After successful completion of preliminary tests, transformers may be sent for type tests. After successful completion of Type tests the transformer will be sealed by WBSEDCL Testing Wing.

a) Dynamic short circuit withstand test to be conducted as per cl. No. 21.3(c) of IS 1180(Part-I):2014.

b) Impulse voltage withstand test to be conducted as per cl. No 21.3 (a) of IS 1180 (part-I):2014., The wave shape of the Impulse voltage waveshape should be chopped on tail.

All the related costs & arrangements for conducting such tests are to be borne by the manufacturer. The Type tested transformer duly sealed by representative of DTD, WBSEDCL, may have to be retained at the works of the manufacturer at the discretion of WBSEDCL for comparison until completion of the final lot of transformer against the instant P.O.

03. The manufacturer have to submit thermal calculation of short circuit withstand ability for 2 seconds and 3 seconds.

04. Performance under external short circuit condition and limit of temperature rise - All the transformers shall be capable of withstanding, without damage, the thermal and mechanical effects of a short circuit at the terminals of any of windings for 2 seconds.

The temperature in the winding after 2 secs, of over current must not exceed 200°C for Al and 250°C for Cu windings.

The transformer so tested shall not exhibit more than 2 percent variation in percentage after the short circuit test from the original measured value before testing according to clause 16.11.5.4 of IS:2026 (Part-5).

05 INSPECTION:

Inspection & Testing of the equipment/materials shall be subjected to routine & other acceptance test as per provisions in the relevant I.S. 1180(Part-1) of 2014.

WBSEDCL reserves the right to send its Engineers if so, desired to witness manufacturing process and to reject either raw materials or finished products found to be not complying with requirement of the specification and also shall have the right to select any / all equipment from the lot offered for tests.

The manufacturer shall give at least fifteen (15) days advance notice regarding readiness of such Inspection and testing and shall submit the sets of work test certificates of the materials/equipment offered for Inspection and testing indicating probable date of Inspection and testing.

The supplier shall arrange all possible facilities for such Inspection and testing at any time during the course of manufacturing, free of cost.

The transformer may be staged inspected at the factory of the manufacturer. The manufacturer shall intimate in advance in writing to the purchaser about the stages of manufacture & subsequent readiness of the transformers to enable the purchaser to carry out **stage inspection** & final inspection and testing of the finished transformers.

The stage inspection will be carried out at the discretion of the purchaser during the process of manufacturing of the transformers. The manufacturer need not stop the process of production because of the programme of stage inspection of the Purchaser.

The stage inspection will be carried out at the discretion of the purchaser during the process of manufacturing of the transformers. The manufacturer need not stop the process of production because of stage inspection of the Purchaser.

While offer for final inspection among other points the following point should invariably be taken care of:

i) Name plates should be welded/riveted on the tanks of the transformer.

ii) The bolts connecting top cover of the transformer with the tank at the two opposite corners are to be provided with holes at their lower portions which would go beyond nuts so that the transformers may be sealed by inserting sealing wire in these holes.

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06 Test Certificates:-

06.01 Seven Copies of Test Certificates i.r.o offered transformers are to be furnished to WBSEDCL for acceptance before issuance of instruction for dispatch of the equipment

21. **CONTACT DRAWINGS:**

i) The General outline drawing giving details of dimensions of fittings should be submitted for each type of transformer indicating there on physical centre line & position of centre of gravity.
ii) Cross sectional drawing showing various parts including core coil assembly.
iii) Sketches for rating plate, Net weight of core & winding, tank, oil, total weight, PO no, property column & guaranteed loss figures.
iv) The drawing of the property plate mentioning the items to be provided.
v) Drawing for Marshalling Box along with the wiring diagram.

22. Guaranteed technical Particulars of equipment offered as per Schedule-A should be submitted by the tenderers. Performance guaranteed shall be based on Guaranteed Technical Particulars (G.T.P.).

23. **OVER LOAD CAPACITY:**

Each transformer shall be capable of carrying sustained overload as stated is IS: 6600.

24. **OVER FLUXING:**

Over fluxing in the core shall be limited to 10% so that the flux density in the core does not exceed 1.9 Tesla (19000 line/sq. cm.).

The maximum flux density in any part of the core under such condition shall not exceed 19000 lines/sq. cm. On the basis of M4, M5 & M6 grades as per IS: 601 Part-2 :1973 (Specification for sheet and for magnetic circuits of electrical apparatus oriented steel).

25. **TRANSFORMER OIL:**

A. The oil shall be specified in IS: 335-1980 and it shall free from moisture and have uniform quality throughout.
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 will have to submit the complete test report as collected from the oil manufacturer, whenever asked, failing which the transformer will not be accepted.
G. The manufacturer will have the facility of the following test at their works:
   1. Breakdown Voltage
   2. Acidity test
   3. Moisture content test
   4. Resistivity test at 27°C and at 90°C

Note: The manufacturer of the will have to submit the works test certificates of the above test of the sample of oil used in the transformer.

26. **INTERNAL EARTHING ARRANGEMENT:**

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

27. Anything not covered by this specification will be as per relevant ISS/ IEC Specifications.

28. **MOUNTING ARRANGAMENT:**

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.

29. **RATING & DIAGRAM PLATE:**

29.01 A rating plate bearing the data specified in the relevant clauses of IS 1180 (Part 1) of 2014 which shall include connection diagram, Vector group, Voltage LV & HV, LV & HV current, percentage Impedance, Loss figure,. Makers name, serial no., Voltages at different Tap positions along with HV winding showing the tappings etc. are to be provided along with the transformer.

29.02 The total weight of finished transformer along with the untanking weight of core & winding is to be mentioned.

29.03 Guaranteed maximum temp rise in oil & winding should be mentioned.

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29.04 Guaranteed Load loss at 100% load and at 50% load (Both at 75°C) is to be mentioned. It should be mentioned that the loss figures of the DTR corresponds to Efficiency Leve2 of IS 1180 (Part 1) of 2014.

29.05 The Guaranteed values of Temperature rise of top oil & winding are to be mentioned.

29.06 "Property of WBSEDCL" is also to be mentioned.

29.07 The transformer shall also be marked with standard mark as per clause no. 13.4 of IS 1180 (Part 1) of 2014.

30. **MAXIMUM ALLOWABLE LOSS VALUES AND % IMPEDANCE:**

KV A 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.

31. **Guaranteed Technical Particulars:-**
Tenders shall be furnished with guaranteed technical particulars of equipment offered as per Schedule. Performance guarantee shall be based on guaranteed technical particulars.

32. **Performance Certificate as pre-requisites:-**
Copies of performance certificates of similar equipment supplied to various organization shall have to be furnished in triplicate along with the tender.

33. **Credentials as pre-requisites:-**
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).

34. **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 100 KVA; 33/0.415 KV transformer from the Govt. standard test Laboratories/Govt. approved laboratories/NABL accredited third party laboratory shall be submitted along with the tender for all Type & Special tests mentioned in relevant clause of IS 1180 (Part 1) of 2014.

The bidder should submit **Test Report** of 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 their offer having identical rating and type as that of the tendered item as **pre-requisites mentioned in GCC**, failing which their offer may not be technically accepted.

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

35. **Deviations:-**
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.

36. **Validity Period:-**

36.01 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.

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

37. **STORE TESTING:**
Store testing of supplied DTR at WBSEDCL/vendor store may be done at the discretion of WBSEDCL.

38. **FITTINGS:-**
The following fittings shall be provided with the Transformers.

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.

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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, Normal & Max 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
xi) Explosion Vent placed on tank top cover with Air release plug.
xii) Air release plug & lifting handle on the top of Inspection cover, Bushing turrets.
xiii) Inspection Cover placed on Turret on top cover with Air Release plug & lifting handle.
xiv) 1 no. Bouchholtz Relay on conservator pipe.
xv) Dial Type Thermometer for OTI preferably of Precimeasure or Perfect Control make
xvi) Marshalling Box for accommodating OTI and terminalconnector.
xvii) Pocket for placing OTI probe on top cover. The pocket should be placed on an elevated base from top cover
xviii) Thermometer pocket with suitable cap as near to the centre of the top cover aspossible.
xix) Shut off valve at suitable location in between Bouchholz Relay and the conservator
xx) Air Release Plug on Top of HV bushing Turret.
xxi) Lifting Lugs spaced suitably on top of tank top cover.
xxii) One thermometer pocket on tank top cover placed as near to the centre of of core yoke as possible with suitable threaded cap in addition to the pocket for OTI
xxiii) Oil level gauge in the conservator as specified.
xxiv) Dehydrating Breather as specified to be fitted in the breather pipe of conservator.
xxv) Terminal connectors at HV & LV terminals as specified
xxvi) Lifting handle for tank top cover

39. **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 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. **Month/ Year ofManufacturing:**
6. **Guaranteed for 5 Years**
7. **Property of : WBSEDCL**
8. **Energy Efficiency Level2 as per IS 1180 (Part-1) of 2014:**
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 min 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.**

40. **TESTING EQUIPMENTS:-**

i) **KV Meter for 33 KV system**
ii) **Volt Meter (0-1000V)**
iii) **Mili-Ammeter 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) **Test set for measuring Breakdown voltage of transformer oil.**
xvi) **Test kit for measurement of acidity of transformer oil.**
xvii) **Test Set for measurement of Moisture content of transformer oil.**

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xviii) Test Set for measurement of resistivity at 27°C and at 90°C.

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 ANS WHEN REQUIRED.

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SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS

SCHEDULE-A

(As per clause no.22 of the Specification)

(To be furnished and signed by the tenderer)

Item Size :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)	::	

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	(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	No load loss in watt at rated frequency & voltage	::	
16	Load loss in Watt at 75 Deg C. At rated output and frequency at 100% loading & at 50% loading in watt	::	
17	Total Loss at 50 Hz & 75°C at 100% Loading in Watt	::	
18	Total Loss at 50 Hz & 75°C 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	Impedance 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	::	

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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 a) 125% load after running with 50% load with steady temp rise. (hrs.) b) 125% 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	::	

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	(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	:::	

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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) Un-tanking weight	::				
	(vi) Oil required for the transformer	::				
	(vii) Total weight with Core, Winding, oil and fittings	::				
41	Details of Tank	::				
	(i) Type of tank	::				

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	(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		
46	Whether they have facility for painting and test in line with the technical specification		
47	**Marking : whether agreeable to** **a) 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.**		
48.	**List of testing equipments available in the testing lab. of manufacturer in line with Cl. No. 40. 00**		

Signature :
Name :
Designation :
Company Seal :

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