WEST BENGAL STATE ELECTRICITY DISTRIBUTION COMPANY LIMITED.

PROCUREMENT OF 1000, 800,630, 315 & 100KVA, 11/0.415KV, OIL TYPE DTR. FOR THE USE AT BULK CONSUMER PREMISES FOR INDOOR INSTALLATION WITH CABLE CONNECTION AT BOTH HV & LV END.

1) **Mandates in respect of submission of Bids:-**

a) **This is a composite procurement for some particular job. The intending bidders shall have to quote each & every item supported by all relevant documents as per tender specification.**

However placement of order to the qualified bidders shall be made in accordance with vendor rating and existing purchase policy of WBSEDCL.

2) Mandates of Technical pre-requisites, to be submitted along with bid documents-

Sl. no	11/0.415KV DTr size	Type test Report	Supply credential
1	100KVA to 315KVA	The bidder should submit Type Test Report of Short circuit Test and Lightning Impulse voltage test along with drawing from CPRI, NABL/Govt. approved laboratories carried out within Five years from the date of NIT publication, 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. Type Test for only 315KVA may be considered as pre-requisites for both 100KVA or 315 KVA DTR, at the discretion of tendering authority of WBSEDCL.	Tenderer shall furnish document along with bid, in support of supply, delivery at consignee stores(e.g copy of PO,SRV, Challan etc), of identical type & rating transformer, to the Govt. & Power Utility, indicating thereon names of the Organization, quantity ordered, quantity supplied along with the tender. Credentials for Purchase orders of similar rating and higher rating shall be within last 3(three) financial years from the date of from the date of NIT publication.
2.	630 KVA to 1000 KVA	For the transformers, not usually used/procured in WBSEDCL system, Type Test Report **of** Short circuit Test and Lightning Impulse voltage test along with drawing for oil type transformers of identical rating of any of the 630, 800 and 1000 KVA DTr., may be submitted along with drawing from CPRI, NABL/Govt. approved laboratories carried out within five years from the date of NIT publication. The same may be accepted as pre-requisites as per GCC in respect of submission of Type test report of 630 to 1000KVA DTr, at the discretion of tendering authority of WBSEDCL. This is applicable for 630KVA & above rating DTr.	Tenderer shall furnish document along with bid, in support of supply, delivery at consignee stores(e.g copy of PO,SRV, Challan etc), of identical type & rating transformer. If not available, higher capacity Dtr with same voltage Ratio and type, supplied to the Govt. & Power Utility, indicating thereon names of the Organization, quantity ordered, quantity supplied along with the tender. Credentials for Purchase orders of similar rating and higher rating shall be within last 3(three) financial years from the date of from the date of NIT publication.

TECHNICAL SPECIFICATION FOR OILTYPE ONAN DISTRIBUTION TRANSFORMERS .

PART-A- 1000KVA, 800KVA,630KVA & 315 KVA COPPER WOUND OIL TYPE DIST.TR.

PART-B- 160KVA,100KVA,63KVA,25KVA&16 KVA ALUMINIUM WOUND OIL TYPE DIST.TR.

PART-C- ROUTINE & TYPE TEST AND OTHER COMMON DETAILS FOR 16-160 KVA AND 315 - 1000KVA DISTRIBUTION TRANSFORMER.

PART-A

1.	SCOPE : This specification covers design, manufacture, testing and supply of **11/0.415KV, 630KVA, 800KVA,1000KVA &315 KVA** with cable termination arrangement Indoor installation and 11/0.433KV 315KVA outdoor type, ONAN Distribution Transformers as per details furnished.
2.	LOCATION : The transformers may be installed outdoor/Indoor anywhere in West Bengal. The elevations of the sites above mean sea level shall not exceed 1000 metres.
3.	SYSTEM DETAILS : The 11 kV & 415V/433KV systems are effectively earthed at the neutral points of the star connected windings of the transformers.
4.	WEATHER CONDITIONS : 1. Elevation at mean sea level : 1000M 2. Maximum ambient Air temperature (°C) : 50 3. Maximum daily average ambient (°C) : 40 4. Minimum Ambient air temperature (°C) : (-)5 Deg C 5. Relative humidity : 100% 6. Pollution level : Heavily polluted. 7. Maximum Wind Pressure : 250 kg/sq.mtr. 8. Annual average rain fall : 3000 mm 9. Average No. of thunder storm day per annum: 100 10. Number of thunder storm day per annum : 100
5.	STANDARDS : 01. Transformers covered by this specification shall, unless otherwise specified be built to conform to the latest Indian Electricity Rules, wherever applicable and the requirements of latest issue of ISS:1180 and ISS 2026, CBIP Standards and other ISS(all as per latest issues) 02. In the event of a conflict between the above standard and the specification the latter shall govern.
6.	RATING AND GENERAL DATA FOR DISTRIBUTION TRANSFORMERS : 01. Core Type, three phase oil immersed step down two winding distribution transformers for outdoor installation with weather condition as stated above. 02. Number of phase : three 03. Frequency: Transformer shall be suitable for continuous operation with a frequency variation of ±3% from normal 50 c/s without exceeding the specified temperature rise. 04. Type of cooling : ONAN 05. Vector group reference : Dyn.11, unless otherwise stated.
7.	CONNECTIONS : The primary (HV) winding shall be connected in delta and the secondary (L.V) winding in star with vector group Dyn,11.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 the phase connecting conductors and jumpers which shall be properly supported and insulated.

8.	TEMPERATURE RISE : **For winding 40^{0}C** (measured by resistance) and **for top oil 35^{0}C** (measured by thermometer) when tested in accordance with clause 4.0 of I.S.2026-1977 (latest) Pt-II. Temperature Rise Test for Transformers will be conducted at the lowest tap position corresponding to losses at that tap.
9.	Percentage Impedance and Loss Figures : As per Annexure –"A"
10.	TERMINAL ARRANGEMENT : **i) 315 KVA, 11/0.433KV Outdoor Type Transformers-** Bare on outdoor porcelain bushings with arcing horn for outdoor type transformers as per ISS/CBIP specification and other relevant specification. The inner end of the bushing shall be completely immersed in the oil. The bushings rods should be locked in position so that twisting of leads is avoided during tightening of nuts of bushing rods. H.T. & L.T. studs are to be made of brass for terminal connections as per IS 1180 (Part-I) of 1989. **ii)315KVA11/0.415KV Indoor type transformers-** 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, 3Cx95 sq.mm XLPE cable and for LT side of 315 KVA Tr.- 1.1 KV grade 2 x 3½C 300 Sq.mm XLPE/PVC cable. **iii) 630 KVA and 800KVA 11/0.415KV Indoor & Outdoor Type Transformers but with cable termination arrangement at both end.** For 11 KV side, 3Cx 95 sq.mm XLPE cable & For LT side of 630KVA&800KVA Tr.- 1.1 KV grade 2x1c 630 Sq.mm XLPE cable per phase & 1x1c 630 Sq.mm XLPE cable for LT neutral connection. **OR** 3 x 3½C 300 Sq.mm XLPE cable may be used. **iv) 1000KVA 11/0.415KV Indoor & Outdoor Type Transformers but with cable termination arrangement at both end.** For 11 KV side, 3Cx 95 sq.mm XLPE cable & For LT side of 1000KVA Tr.- 1.1 KV grade 3x1c 630 Sq.mm XLPE cable per phase & 2x1c 630 Sq.mm XLPE cable for LT neutral connection. **OR** 4 x 3½C 300 Sq.mm XLPE cable may be used. And iv) The above terminal arrangement may change during detailed engineering while approval of drawing.
11.	TAP CHANGING SWITCH Tapping- + 5% to - 7.5% in steps of 2.5%.Provision shall be made for locking the tapping switch handle in position. Suitable aluminium anodized plate shall be fixed for tap-changing switch to know the position no of tap. OFF Circuit tap changing switch should be provided on HV side. Switch position no.1 shall correspond to the maximum plus tapping. The tap position no. should be in increasing order in clock-wise direction. The tap markings should be of engraved in nature. Provision shall be made for locking the tap switch handle at each position. The locking arrangement shall be such that padlock cannot be inserted unless required contacts corresponding to the tap position are correctly connected with full contact pressure. Mechanical back stopper should be provided at the limiting tap positions. The tap changing shall be affected by an external three phase gang operated switch. The operating shaft shall be easily accessible. The tap-changer switches used in the transformer shall be of robust design. The stationery brass contact shall be so rigidly fixed to maintain rigidity and co-axiality with operation shaft throughout its life. The operating handle shall not have appreciable play if any position of tap without disturbing the engagement of moving and fixed established by turning the handle in staple. The supplier may be required to give the results of electrical and mechanical tests including endurance tests carried out to ensure its life with reference to any relevant ISS or any other acceptable standard in the transformer with sectional drawings showing the size, arrangement and functioning of the contacts of the tap switch, if required. The sample of the tap switch used for different sizes of transformers and voltage grades shall have to be approved before using them in transformer if called for.
12.	LEADS : All leads of the windings, connection of the windings or their wires to one another to terminal bushing or to a tap changer shall be properly insulated and covered with insulation sleeves. The soldering materials shall have higher melting temperature above 300 ^{0} C and preferably above 400 ^{0} C for better thermal endurance and mechanical strength. The tenderer shall specifically mention the method and materials to be used by them for lead connection. **HV lead termination to the stud should be made either by method of brazing or the free end of the lead wire having considerable length should be bent to form a ring and the ring should be fixed to the bushing stud with suitable nut, bolt and washer.**

13. 01	Tank : Tank wall must be fabricated from quality mild steel sheets of thickness 4 mm. Top and bottom plate of the tank must be of 5 mm thick. It should be shaped so as to make welding to a minimum. All welding shall be done electrically and relieved of welding stresses. Seams shall be double welded where practicable and found necessary by the manufacturer/ fabricator for proper oil tightness. The tank wall shall be provided with stiffner of structural steel for general rigidity and to dampen transformer noise. It shall also withstand partial vacuum as per latest CBIP manual against standard atmospheric pressure. Maximum tolerance on the negative side of the steel sheets shall be 0.35 mm as per cl.8.2.2 of IS-1052- 1995 (Specification for Rolling and cutting tolerances for hot rolled steel products). Tank design shall be such that the core and winding assembly can be tanked or de-tanked freely and easily. Inside wall of the tank and the M.S. Core Channel shall be painted with varnish or with hot oil resistance paint. Stiffner shall be continuously welded on the tank wall. 02. The tank cover shall be bolted on to flanged rim of the tank with a weather proof, hot/cold oil resistant, resilient gasket in between for oil tightness. If the gasket is compressible, metallic straps may be provided to prevent over compression of the gasket. Access and inspection hole blanked with oil tight gasket and sealed cover plate shall be provided for working on the connection of the leads of winding, the bottom terminals of bushing and off load tap switch. Bushing turrets, cover of access hole, covers for pockets of thermometers and other devices shall be designed to prevent any ingress of rain water. The tank cover as a whole shall shed of all rain water. The tank cover should have downward 90° bent edges on all sides so that the gasket under the top cover is protected from direct exposure to weather. Gasket used between top cover and tank flange shall be of rubberized cork sheet of 5 mm thick and shall be provided with water tight compound between the tank flange and the gasket. G.I. nuts, bolts, flat washers, spring washers shall be used and suitably spaced to press the tank cover. The Sl. No., P.O. No, Year of manufacture & property of WBSEDCL etc. shall be engraved 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. The conservator shall be liberally dimensioned such that with the lowest temperature and no load on the transformer the oil level shall not reach the lowest level and with the highest ambient temperature and 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 with level marking as per ISS. The inside diameter of the pipe connecting the conservator to the main tank shall be within 20 to 50 mm and it shall be projected into the conservator so that its and is approx. 20 mm above the bottom of the conservator. Conservator shall be provided with drain plugs. Filing hold with cover shall be provided as usual. Conservator pipe shall be welded on the top cover. Explosion vents shall be welded on the top cover. Air release plug should be provided in the explosion vent. Detachable type conservator and explosion vent will also be acceptable. The conservator pipe hole fitted to tank cover should be provided with a suitable slanted plate, 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 03. PRESSURE TEST : The tank shall be fixed with a dummy cover with all fittings including bushings in position and shall be subject to air pressure of 35 Kpa above atmosphere for 30 minutes. The permanent deflection of flat plate after pressure has been released shall not exceed the values given below :- Length of plate — Deflection Upto 750 mm — 5 mm 751 to 1250 mm & — 6 mm for other sizes — As per CBIP manual If required, the manufacturers should submit pressure test certificate for the transformers tanks at least for one tank for each batch either conducted by their fabricators or themselves. Transformer tanks should be double welded electrically as per the specification.

14. CORE :

1. The magnetic core shall be built of low loss Silicon steel, cold rolled grain oriented steel. Core shall be of stack type.
2. 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. Quality of core should not dis-integrate due to mechanical modes of core vibration nor to have the least tendency to absorb moisture or to react with the dissolved particles in the insulting oil thus accelerating sludge formation.
3. The assembled core shall be securely clamped in the lines and in the uniform pressure so as to minimise the noise from the core.
4. The core-clamping frame shall be provided with lifting eyes for the purposes of tanking and untanking of the live part of the transformers. 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.

   Core top and bottom of yoke shall be supported with M.S. Channel of proper size and properly bolted together for stack type core. For wound type cores suitable M.S. clamping device should be used to hold together core laminations firmly to prevent vibration or noise.
5. The supporting framework of the cores shall be so designed so as to avoid the presence of pockets that would otherwise prevent complete emptying of tank through the drain valve or cause trapping of air during filling.
6. Adequate provision shall be made to prevent movement of the core and winding relative to the tank during transport and installation or while in service.
7. The cores shall conform to :
   IS : 3024 - 1965 Electrical sheet steel &
   IS : 649 - 1083 method of test steel sheet.
8. Successful bidder will offer for core for inspection and/or approval by the purchaser during the manufacturing stage.

   The manufacturer's call notice in this regard should be accompanied with the following documents as proof towards the use of prime core material:

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

   Core material shall be procured either from core manufacturer or through their accredited marketing organization of repute.

15. WINDING :

HV & LV winding shall be wound from Super Enamel covered/ Double Paper covered copper conductor/foil winding for rating 315KVA and above.
Transformer shall be provided with the requisite number of windings and shall be designed to withstand the electromechanical stress exerted under short circuit conditions as per ISS:2026 – 1977.
Class 'A' insulation shall be used. Paper insulation shall be dry and uniform and free from punctures and other defects. Solid insulation shall be of best quality. Wooden supports, 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.

01. 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)
433/415V	-	3
11000	95	28

02. The winding shall be so designed to reduce to a minimum the out of balance forces in the transformer at all voltage ratings.
The winding shall also be designed such that all coil assembles of identical voltage rating shall be interchangeable and repairing of the winding can be

	made readily without special equipments. **03.** All joints in the winding should be made by Brazing. But in no case crimping is allowed.
16.	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 bakelite paper shall not be used.
17.	WINDING AND CLEARANCE INSIDE THE TANK(For Stack type core)<u>CONSTRUCTION</u>: 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 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, with out causing mechanical injury to any insulation in the windings. i) The transformer shall have separate H.V. and L.V. windings made of electrical grade hard drawn Copper Wires as specified conforming to relevant I.S.S. of latest edition. ii) HV and LV winding shall be wound from Double paper covered copper conductor/foil winding. Qualities of DPC insulation are to be ensured. iii) a) No. of HV coils per phase/limb for stack type core shall not be less than 8 nos for voltage ratio of 11/0.433KV or 11/.415KV transformer. b) For HV winding of 630 KVA and above, continuous disc construction may be used.
	iv) Minimum clearance between H.V. Coils/or sections should be 6.4mm and at top/bottom, the minimum clearance should be 12mm including 1.5mm insulating ring. v) Minimum inter phase clearance (HV to HV) with 3mm phase barriers should be 10mm up to voltage class of 12 KV. vi) The minimum end clearance (HV to earth) should be 20mm up to voltage grade 12KV. vii) End insulation at both ends shall include up to 36 KV grade:- a) 3 mm thick yoke insulation over windings of the phases. b) 6 mm ducts at the top and bottom for circulation of oil in the LV and HV windings. viii) The minimum radial clearance in the windings will be as follows:- a) Between core and L.V. winding 3mm. b) Between L.V. winding and H.V. winding 10mm including 2.0mm thick Press Board cylinder, where L.V. windings is 1100 V grade and H.V. winding 12 KV grade. ix) L.V. cylinder preferably be made of corrugated insulating press board. Oil ducts need to be provided between core and L.V.winding. x) Minimum clearance between tank wall and H.V. windings/live parts. a) Where the H.V. winding is 12KV grade, clearance: 25mm No. additional insulating barrier shall be used in between. The dimension in respect of ducts and clearance in 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). xi) 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. The coil clamping arrangement and the finished dimensions of any oil duct shall be such as will not impede free-circulation of oil through the ducts.
18.	**<u>Conformation to IS standards relating of conductors and insulation.</u>** The following Indian standards specification shall govern the quality of conductor, covering insulation such as enamel, paper and insulating barrels.

	1) IS:7404(Pt.I & II)1974:Paper covered copper conductor(round & rectangle). 2) IS: 1397-1967: Kraft paper 3) IS: 335-1983 : New insulating oil. 4) IS: 1576-1967 IEC: {B-2.1, B-3.1 &B -4.3 } Solid Press Board for electrical purposes.
19.	Bushing for outdoor use: The bushings shall conform to IS: 2000-1968(latest): Bushing for Alternating voltage above 1000 Volts and IS 7421-1974(latest) for bushing upto and including voltage up to 1000 volts. The dimensions of bushings of the following voltage classes shall conform to Indian Standard mentioned against them.

Voltage Class	Indian Standards	
Upto 1KV Bushings	For porcelain parts IS: 3347/Part-I	For Metal Part IS: 3347/Part-I(Sec-2)(1979)
12/17.5KV bushings	IS:3347/Part-III (Sec-I)(1972)	IS:3347/Part-III (Sec-2)(1982)

The Height of the HV bushings relative to the oil level gauge should be such that the top of the HV bushings are immersed in the oil when the oil level of the oil level gauge is at minimum position.

The clearances in air between live and conductive parts and live conductive part to earthed structures shall be as follows:

Nominal System	Test Voltage	Clearances		
Voltage KV	Inpulse KVP	Phase to Phase (mm)	Phase to Earth(mm)	Arcing Horn gap(mm)
0.433/.415	-	85 without cable end box	40 without cable end box	-
		45 with cable end box	20 with cable end box	
11	95	255- without cable end box	140 - without cable end box	86/85 Refer Fig-26 in IS: 3347(Part-III/Sec-2)-1982
		130- with cable end box	80 - with cable end box	

20. COOLING ARRANGEMENT:

1. The transformer shall be suitable for loading of 100% continuous maximum rating with "ONAN" cooling without exceeding the thermal limit.
2. 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 eliptical tubes, or a pressed steel plate assembly formed into elipital oil channels, welded at their top and bottom to the tank.
3. The round cooling tubes shall be made of mild steel(ERW) having a minimum wall thickless 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 to 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).
4. The manufacturer will have to provide information regarding wall surface area of tank radiator cooling tubes separately as part of the guaranteed technical particulars.

21. PAINTING:

1. The surface to be painted shall be completely cleaned & made free from all rust, scale or foreign adhering matter on grease. The cleaning & de-rusting can be done by sand blasting or other approved method.
2. All steel surface in contact with insulating oil as far as accessible shall be painted with heat resistant, oil insoluble, insulating varnish or paint.

3. All steel surface exposed to weather, shall be given a primary coat of Zinc chromate and two coats of dark admiral gray paints. (IS 104 & IS 2932) **OR** Powder coating painting as specified by **CEA**

4. All paints shall be carefully selected to withstand tropical heat and extremities of weather. The paint shall not scale off or winkle or be removed by abrasion due to normal handling.

5. All nuts and bolts used in the transformer for external fittings shall be galvanized or zinc passivity and painted with body paint.

22. **Over Fluxing:** Over fluxing in the core shall be limited to 12.5% so that the flux density in the core does not exceed 1.9. Tesla (19000 lines/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 BS 601: Part-2: 1973 (Specification for sheet and for magnetic circuits of electrical apparatus oriented Steel)

23. Transformer Oil:
The oil shall be as specified in iS:335-1980 and it shall be free from moisture and have uniform quality throughout.

24. a) The outdoor apparatus including bushing insulators shall be designed so as to avoid pocket in which water can collect.

b) All mechanism shall be so as to prevent sticking of "dew" to avoid rust and corrosion.

c) All apparatus shall be designed to minimise the risk or accidental short circuit caused by animals, birds or vermin.

25. 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 att two points.

26. Anything not covered by this specification will be as per relevant I.S.S./REC Specificiation.

27.	**Fittings:-** The following fittings shall be provided with the transformers	
	i) Name, Rating & Terminal Marking Plates	xi) Filter Valve wheel/screw type- with ¾" & 1¼" for 315 and 630& above KVA respectively
	ii) Earthing Terminals with lug – 2 nos	xii) Explosion vent with air release plug (315KVA)
	iii) Lifting Lugs – 2 nos.	xiii) Explosion vent (double diaphram) with pressure equalizer connection(630 KVA and above).
	iv) Thermometer pocket with cap	xiv)OTI with mercury(A&T) contact(630KVA& above)
	v) Silicagel type breather	xv) Buccholz relay with (A&T) contact(630KVA&above)
	vi) H.V. bushings with arcing horns	xvi)Isolating valve betn.conservator& Buccholz relay (630KVA& above)
	vii) L.V.bushing for phases & Neutral	xvii) Marshalling box for OTI & all accessories connection termination.
	viii) Conservator with Oil gauge (315KVA)	xviii) 4 nos roller for Transformers of 160KVAand above.
	ix) Conservator with Oil gauge and MOG (630 KVA &above)	xix) Platform mounting arrangement- Base channel 75x40mm for up to 100KVA and 100x50mm above 100KVA, 460 mm long with holes to make them suitable for fixing on a platform or plinth.
	x) Steel drain-cum-sampling valve- wheel/screw type- P- ¾" & 1¼" for 315KVA and630 & above KVA rating	

	respectively.	

28. **Cable Boxes**

28.1 In case HV/LV terminations are to b e made through cables the transformer shall be fitted with suitable box on 11 KV side to terminate one 11 KV, 3 core Aluminium conductor cable up to 240 sq. mm. (Size as per requirement). The bidder shall ensure the arrangement of HT Cable box so as to prevent the ingress of moisture into the box due to rain water directly falling on the box. The cable box on HT side shall be of the split type with faces plain and machined and fitted with Neo-k-Tex or similar quality gasket and complete with brass wiping gland to be mounted on separate split type gland plate with nut-bolt arrangement and MS earthing clamp. The bushings of the cable box shall be fitted with nuts and stem to take the cable cores without bending them. The stem shall be of copper with copper nuts. The cross section of the connecting rods shall be stated and shall be adequate of carrying the rated currents. On the HV side the terminal rod shall have a diameter of not less than 12 mm. The material of connecting rod shall be copper. HT Cable support clamp should be provided to avoid tension due to cable weight.

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

Annexure-A

TRANSFORMER LOSS FIGURES :

DTR KVA Rating	Voltage Ratio	Maxm.allowable NO load loss (In Watts)	Maxm. allowable Load loss at100% loading at 75° C (In Watts)	Maxm. TOTAL LOSS(NLL+LL) at100% loading at 75°C (In Watts)	%Impedance (± 10% variation as per ISS)
315 KVA	11/0.433 KV(O/D) & 11/0.415KV (I/D)	800	3600	3630	5%
630 KVA	11/0.415 KV O/D & I/D	1200	6500	6640	5%
800 KVA	11/0.415 KV O/D &I/D	1400	7500	8000	5%
1000KVA	11/0.415 KV O/D &I/D	1600	9300	9800	5%
Maximum Limit of **No load loss** and **Load Loss** figures as mentioned above are without any positive tolerance					

PART-B

(TECHNICAL SPECIFICATION OF 16KVA to 160 KVA : 3 PHASE DISTRIBUTION TRANSFORMER)

1.00 *SCOPE:-*

01. This specification covers design, manufacture, assembly, testing, at manufacturer's works, supply & delivery of three phase 50 HZ, 11/0.433 KV, Delta/Star Vector Group Dyn11, two winding, outdoor type, oil immersed naturally air cool Distribution Transformer as per details furnished hereafter.

2.00 APPLICABLE STANDARD :

2.01 The offered equipment including all accessories shall conform to latest versions of ISS:2099, 1180 and ISS:2026, CBIP Standard & other ISS. In the event of a conflict between the above standard and the specification, the latter shall govern.

3.00 CLIMATIC CONDITION :

3.01 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
3. Maximum daily average ambient (°C)	: 40
4. Minimum Ambient air temperature (°C)	: (-)5 Deg C
5. Relative humidity	: 100%
6. Pollution level	: Heavily polluted.
7. Maximum Wind Pressure	: 250 kg/sq.mtr.
8. Annual average rain fall	: 3000mm
9. Average No. of thunder storm day per annum:	100
10. Number of thunder storm day per annum	: 100

3.01 APPLICATION :

The equipment shall be Installed on double pole structure. In outdoor location any where 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 installation with three phase, 50Hz, 11KV system in which the neutral is effectively earthed and they should be suitable for service with fluctuations in supply voltage upto plus 12.5% to minus 12.5%.

4.02 The Transformer shall conform to the following specific parameters

1.	System Voltage	12 KV
2.	Rated Voltage HV	11 KV
3.	Rated Voltage LV	0.415/0.433KV
4.	Phase	3 phase
5.	Frequency	50 HZ 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	CRGO material CRGO wound/stack core type up to 63KVA & only stack core type for 100& 160KVA Dtr.
10.	Winding	HV & LV winding shall be wound from Super Enamel Covered/Double Paper Covered aluminium /copper conductor/foil up to **63KVA.** For **100& 160 KVA**, Double Paper Covered aluminium /copper conductor/foil.
11.	Rating	16, 25, 63,100 &160 KVA
12.	Type of Cooling	ONAN
13.	**Percentage Impedance at 75°C**	**4.5% ± IS tolerance up to 100KVA and 5%± IS tolerance for 160KVA**
14.	Maximum Temperature Rise over ambient of 40°C	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.	Rated Short Circuit Level	13.1 KA for 3 Second at 11 KV
16.	Taps	No tapping shall be provided for transformers upto 160KVA rating, until and unless specified.
17.	Audible sound levels in decibel at rated voltage & frequency	i) Upto 50 KVA – 48 ii) 51 – 100 KVA – 51 iii)101 – 300 - 55

5.00 Losses

Standard Losses at 75°c will be as follows :

The bidder shall guarantee individually the NO Load Loss and Full Load Loss within the Maximum allowable Value as specified below, but the Total Loss at 100% load condition at rated and frequency at 75 °C shall not exceed the value as mentioned below. Capitalization of Transformer losses shall be evaluated as per CEA/REC guideline with the guaranteed value of declared losses of a particular type transformer. NO POSITIVE TOLERANCE SHALL BE ALLOWED ON THE MAXIMUM TOTAL LOSSES AT 100% LOADING at column (4) mentioned below.

Sl.no. (1)	Voltage Ratio (2)	Rating in KVA (3)	Maxm Total Loss at 100% Loading (NLL +LL) (4)	Maximum Allowable No load loss **(Core-Loss)** (NLL) (5)	Maximum Allowable Full Load losses **(Copper-Loss)** (LL) (6)
1.	11000/433V	16	480 Watts	80 Watts	475 Watts
2.	11000/433V	25	695 Watts	100 Watts	685 Watts
3.	11000/433V	63	1250 Watts	180 Watts	1235 Watts
4.	11000/433V	100	1800 Watts	260 Watts	1760 Watts
5.	11000/415 KV	160	2200 watts	425 Watts	2100 Watts

CAPITALISED COST OF NO LOAD LOSS AND FULL LOAD LOSS PER KILOWATT HAVE BEEN MENTIONED AGAINST CLAUSE- No. 28 OF THIS SPECIFICATION.

Maxm. Limit of **No load loss** and **Load Loss** figures as mentioned above are without any positive tolerance .

6.00 a) TERMINALS- Outdoor Bushing Type:

Transformer shall be provided with bushing insulators on both H.V. & L.V. Sides. HV & LV bushings shall be located on opposite side of the transformer, not on the Top Cover. Height of the top of the Bushing should be below the minimum oil level marking of the oil level gauge in case of transformer with conservator (i.e 63,100 &160 KVA)

The electrical characteristic of bushings insulators shall be in accordance with the latest version of IS 2099. Dimensions & type of bushing shall conform to IS: 3347 & shall be as follows :

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

LV bushing (0.433 KV side) : 1100V 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.

b) TERMINAL ARRANGEMENT FOR CABLE END BOX
For supply to Bulk Consumer – 100KVA & 160 KVA transformers for Indoor / Outdoor Installation - **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, 3Cx95 sq.mm XLPE cable and for LT side of 160 KVA Tr.-1.1 KV grade 1 x 3½C 300 Sq.mm XLPE/PVC cable. Cable Box details shall be as per PART-A of this specification.

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)
11 KV	12 KV	95	28
433 V	-	-	3

7.00 Cores

7.01 The cores shall be stack/wound type, as per clause 4.02(9), constructed from low loss Silicon Steel cold rolled grain oriented with inter lamination resistance & rust inhibiting property.

7.02 The maximum flux density in any part of the core & Yoke at rated frequencies shall not exceed 1.6 Tesla at normal voltage & 1.9 Tesla under over voltage condition.i.e 12.5% over voltage

7.03 The assembled core shall be securely clamped with uniform pressure to minimize noise.

7.04 The M.S. Core clamping frame shall be provided with lifting holes for Tanking & detanking and the core is to be electrically connected by tinned copper strip of adequate section to the core frame for earthing through the tank at two different points to drain off electrostatic potential that may built up.

7.05 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.

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

7.07 The core shall conform to:

IS:3024-1965, Electrical sheet steel & IS:649-1983, Method of test steel sheet .

Successful bidder will offer for core for inspection and / or approval by the purchaser during the manufacturing stage.

7.08 The manufacturers call notice in this regard should be accompanied with the following documents as proof towards the use of prime core material.

1.In voice of the supplier

2.Mill's test certificate

3.Packing list

4.Bill of Ladding

5.Bill of entry certificate to customs.

Core material shall be procured either from core manufacturer or through their accredited marketing organization of repute.

7.09 Transformer Sl. No. shall have to be punched on the 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 electro mechanical stress exerted under short circuit conditions as per ISS;2026-1977

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 rating shall be interchangeable.

8.04 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 dry and free form 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 of Insulation covering for LV. & HV conductors shall be DPC (Double Paper Cover) and DPC/SE (Super Enamel Medium) upto 63 KVA and DPC for both HV &LV in respect of 100 & 160 KVA.

8.08 The number of HV coils per phase per limb for stack core shall be minimum four nos up to 63 KVA and Six nos for 100& 160KVA and that for wound core may be one number. For 160 KVA DTr only stack core is allowed.

8.09 The Interleaved Insulating paper between the layers of the winding, shall be Kraft Paper.

8.10 The clearance between the coils shall be adequate and well co-coordinated. Recommended minm. Clearance are as follows:-

Minimum clearance between H.V. Coils/or sections should be 6.4mm and at top/bottom, the minimum clearance should be 12mm including 1.5mm insulating ring.

a) Minimum inter phase clearance (HV to HV) with 3mm phase barriers should be 10mm up to voltage class of 12 KV.

b) The minimum end clearance (HV to earth) should be 20mm up to voltage grade 12KV.

c) End insulation at both ends shall include up to 36 KV grade:-
   1) 3 mm thick yoke insulation over windings of the phases.
   2) 6 mm ducts at the top and bottom for circulation of oil in the LV and HV windings.

d) The minimum radial clearance in the windings will be as follows:-
   1) Between core and L.V. winding 3mm.
   2) Between L.V. winding and H.V. winding 10mm including 2.0mm thick Press Board cylinder, where L.V. windings is 1100 V grade and H.V. winding 12 KV grade.

e) L.V. cylinder preferably be made of corrugated insulating press board. Oil ducts need to be provided between core and L.V.winding.

f) Minimum clearance between tank wall and H.V. windings/live parts.

g) Where the H.V. winding is 12KV grade, clearance: 25mm No. additional insulating barrier shall be used in between.

8.11 The stacks of windings shall receive adequate pre shrinkage treatment before assembly. No tapping are to be provided on the winding.

8.12 **Lead:** HV lead termination to the stud should be made either by method of brazing or the free end of the lead wire having considerable length should be bent to form a ring and the ring should be fixed to the bushing stud with suitable nut, bolt and washer.

8.13 **Joints**: All joints in the winding should be made by Brazing/Soldering. **But in no case crimping is allowed.**

9.00 **TANK :**

9.01 Conventional 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 3.15mm. Top and bottom plate should be of 5.0 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.

9.03 The main tank body shall be capable of withstanding vacuum gauge pressure 68 KN per sq.m (500 mm of HG)

9.04 The under carriage of the tank shall be made of channel of suitable slze & design.

9.05 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.

9.06 Tank shall be designed to prevent retention of water. Tank cover shall be of adequate strength. It shall be bolted on to flanged rim of the tank with weather proof hot oil resistant resilient gasket of 5 mm thickness. Tank cover should have 90° downward bent edges on all sides to protect the gasket under the top cover from direct exposure to weather.

The rating, sl.no, P.O No, year of manufacture & property of WBSEDCL etc. and Asset Codification no. 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.

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

9.07 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.

9.08 The tank cover shall be bolted on to flanged rim of the tank with a weather proof, hot,/cold oil resistance, resilient gasket in between for oil tightness. If the gasket is compressible, metallic strips shall be provided to prevent over compression of the gasket. 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 downward90 degree bent edges on all sides so that the gasket under the top cover is protected from direct exposure to weather.
Gasket used between top cover and tank flange shall be of neoprene **rubberized** cork sheet of 5 mm thick and shall be provided with water tight compound between the tank flange and the gasket.

9.09 G.I. nuts, bolts, flat washers, spring washers shall be used and suitably space to press the tank cover. The Sl. No., P.O. No, Year of manufacture & property of WBSEDCL etc. shall be engraved 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. Following minimum clearance between top yoke and tank cover are to be maintained.

9.10 a) 16&25 KVA Transformer

Oil level from top cover shall not be less than25 mm and height of oil level from top yoke or top of core shall not be less than 50 mm (at cold condition).

b) 63/100/160 KVA (without tap changer) : Transformer (the clearance between top yoke or top of core and tank cover) shall not be less than 125 mm.

9.11 Silicagel breathers are to be provided on transformers of all ratings, Conservators are to be provided on transformers of ratings 63 KVA,100 and 160 KVA. 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 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 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 not be provided with drain plug for transformer of 63KVA,100KVA and 160KVA ratings. Filling hole with cover shall be provided as usual. Conservator pipe for 63 KVA,100KVA and 160 KVA transformers shall be welded on the top cover. The conservator pipe hole fitted to the tank cover should be provided with a suitable slanted plate, if 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 100/160 KVA transformers shall also be welded on the cover. Air release plug should be provided in the explosion vent, and in tank cover to release any entrapped air.

PRESSURE TEST :

9.12 The tank shall be fixed with a dummy cover with all fittings including bushings in position and shall be subject to air pressure of 35 Kpa above atmosphere for 30 minutes. The permanent deflection of flat plate after pressure has been released shall not exceed the values given below :-

Length of plate	Deflection
Upto 750 mm	5.0 mm
751 to 1250 mm	6.0 mm
1251 to 1750mm	8.0mm

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

9.14 The manufacturers 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.

10.00 **PAINTINGS :**

10.01 Before painting or filling with oil, all un galvanized parts shall be completely cleaned & free from rust, scale & grease and all external surface on castings shall be filled by metal deposition.

10.02 The interior of all transformer tank and Internal structural steel work shall be thoroughly cleaned of all scale & rust by sand blasting or other approved method. This surface shall be painted with hot oil resisting varnish or paint.

10.03 Except for nuts, bolts and washers, all external surfaces shall receive adequate nos. of coating of weather resisting paint.

All steel surfaces exposed to weather, shall be given a primary coat of Zinc chromate and at least two coat of final paint.i.e dark admiral gray paints. (IS 104 & IS: 2932) **OR** Powder Coating Painting as Specified by **CEA.**

All nuts & bolts used in the transformer for external fillings shall be galvanized or zinc passivity and painted with body paints.

11.00 EARTHING TERMINALS :

Two earthing terminals capable of carrying the full amount of lower voltage, short circuit current of transformer continuously for a period of 5 Sec. shall be provided at the base channel.

12.00 RATING & DIAGRAM PLATE :

12.01 A rating plate bearing the data specified in the relevant clauses of IS:2026 including connection diagram ,Vector Group, Voltages LV & HV,LV & HV current ,Percentage Impedance ,loss figure, makers name , serial no. are to be provided along with the transformer.

12.02 The weight of core & winding is to be mentioned.

12.03 Guaranteed maximum Temp rise in oil & winding should be mentioned.

12.04 No-load & load loss (at 75^{o}c) is to be mentioned.

13.00 DUTY UNDER FAULT CONDITION :

13.01 It is to be assumed that normal 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.

13.02 The transformer may be 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.

13.03 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.

13.04 Over Load Capacity :
Each transformer shall be capable of carrying sustained overload as stated in ISS.

14.00 FITTINGS:-

14.01 The following fittings shall be provided with the Transformers.

i) Name, rating & terminal marking plates

ii) Two nos. earthing terminals

iii) Two lifting Lugs

iv) Pole mounting arrangement

v) Silica gel breather

vi) H.V. Bushing with arcing horn

vii) L.V. Bushing for phases & neutrals.

viii) Two nos. oil filling hole with cover for only 16KVA but for other rating one no. oil filling hole with cover.

ix) One oil level guage with Min ,Normal & Max Temperature Markings.

x) Conservator (for 63,100 &160KVA)

xi) Drain Valve (for25, 63,100 &160KVA) [Rec type with ¾" plug]

xii) Filter Valve (for 63,100 &160KVA) [wheel/screwed valve- ¾" size]

xiii) Explosion Vent (for 100& 160KVA)

15.00 Lifting and Haulage facilities

15.01 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.

16.00 Insulating Oil

16.01 The transformer shall be supplied filled with oil maintaining the minimum oil level as mentioned in clause 9.10. The insulating oil shall conform to the requirement of IS:335.

16.02 **Use of re-cycled oil is not acceptable.**

The specific resistance of the oil shall not be less than 2.5×10^{12} ohm-cm at 27 ^{o}C when tested at IS6103.

16.03 Oil shall be filtered and tested for BDV and moisture content before filling. The Oil shall be filled under Vacuum.

16.04 The design and all materials and processes used in the manufacture of the transformer, shall be such as to reduce a minimum the risk of the development of acidity in the oil.

17.00 Internal Earthing Arrangement:-

17.01 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.

PART-C

ROUTINE & TYPE TEST AND OTHER COMMON DETAILS FOR 16-160 KVA AND 315 - 1000KVA DISTRIBUTION TRANSFORMER

1.00 Test & Inspection:-

1.01 Routine Test :

All transformers shall be subjected to routine tests at the manufactures works. The following tests are to be carried out :

a) Measurement of winding resistance.

b) Ratio, polarity and phase relationship

c) Impedances voltage

d) Load losses

e) No load loss and no load current.

f) Insulation resistance.

g) Induced over voltage withstand.

h) Separate source voltage withstand.

i) Characteristic requirement of oil sample will be as per IS:1866-1983 amended upto 1987.

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

k)**16KVA to 160KVA - Magnetizing 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 up to 100 KVA and magnetizing current at rated voltage & frequency & 112.5% of rated voltage in respect of 160 KVA DTR should not exceed 2.25% & 4.5% respectively of full load current.**

l) **315KVA and above- Magnetizing current at rated voltage & frequency & 112.5% of rated voltage i.r.o 315KVA, 630 KVA and above shall not exceed 2 & 4% respectively.**

1.02 **Type Tests:-**

In addition to the routine tests, the following type tests are to be made by the manufacturer, who does not have type tests report witnessed by WBSEDCL and prototype sample of identically designed transformers.

a)Dynamic short circuit withstand test to be conducted as per cl.16.11 & 16.11.4.4.of IS:2026 (Part-I) 1977.

b) Impulse voltage withstand test to be conducted as per cl.13 of relevant IS.

c) Temperature rise test – is **mandatory** and will be conducted on one transformer for every lot offered for inspection**. [**The temperature rise test for transformers having tap-changers shall be done at lowest tap at appropriate current related to the said tap position with losses fed corresponding to minimum voltage tapping. This is as per amendment no. 2, 19 & 4 to

IS- 2026 , (part-2) – 1977 **]**

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

d) Pressure test - Pressure test on tank as mentioned in the clause at 9.12 (Part-B) and clause13.03 (Part-A) of this specification WBSEDCL's testing wing may witness the said test, at the shop, if required.

1.03 The manufacture will have to submit thermal calculation of short circuit withstand ability for 2 seconds and 3 seconds.

1.04 Performance under external short Circuit condition and limit of temperature rise.

1.05 All 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 secs. The temperature in the windings after 2 secs. of over current must not exceed 200^0C for Al and $250\ ^0$C for Cu windings.

1.06 After the above tests, the transformer shall be subjected to all or a part of the routine test. The criteria for evaluation of test results shall be the same as that for the test to determine the dynamic ability to withstand short circuit in accordance with ISS 2026.

1.07 WBSEDCL may also make a testing arrangement for carrying out short circuit tests with duration not exceeding 2 secs. For distribution transformer upto 100 kVA in a NABL/Govt approved Laboratory. The transformer subjected to such test shall be examined for temperature rise within specified limit for any damage or displacement of any parts within the transformer.

1.08 Variation % reactance
The transformer so tested shall not exhibit more than 2 percent variation in percentage reactance for stack core and 4% for wound core after the short circuit test form the original measured value before testing according to clause 16.11.5.4 of IS 2026 (Part-I), 1977,however wound core is accepted upto 100KVA DTR, beyond that stack core is applicable

1.09 The selection of transformer for such test shall be carried out at the discretion of the Company from any lot of transformers of same capacities offered for inspection and testing before delivery.

1.10 **If records of type tests carried out in presence of WBSEDCL;s Representative, along with proto type sample of a particular transformer with identical design with essential details, is representative of the one being purchased, are produced, the purchaser may accept these as evidence of actual test.**

1.11 **The bidder should submit** Type Test Report **of Short circuit Test and Lightning Impulse voltage test along with drawing from** CPRI, NABL**/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.**

1.12 **However, if it is found that the bidder has submitted Tests Report of identical rating but not conducted on identical design of equipment/material as per specification of WBSEDCL, may be accepted for technical qualification, but after placement of order, the manufacturer has to arrange for Dynamic Short Circuit & Impulse tests at CPRI, NABL/Govt. approved Laboratories on a sample chosen at random during routine test by our representative, as per WBSEDCL's design in presence of the Engineers of WBSEDCL before mass production is undertaken.**

However routine test and temperature rise test shall be done on a sample/ samples chosen (at random upto 100KVA DTr but for higher KVA rating DTR, 100% routine tests shall have to be done) during routine test of transformer in presence of Engineers of WBSEDCL. Routine Test and Temperature rise test shall have to be carried out at the premises of the manufacturer/supplier before aforesaid Type test.

All charges for carrying out such tests, have to be borne by the manufacturer.

2.00 Inspection & Testing:-

2.01 Inspection & Testing as already mentioned the equipment shall be subjected to routine & other acceptance test as per provisions in the relevant I.S.

2.02 WBSEDCL reserves the right to send its Engineers if so, desires 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 equipments from the lot offered for tests.

2.03 The manufacturer shall give at least fifteen (10) 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.

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

2.05 **The transformer may be stage 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 him to carry out** stage inspection **& final inspection and testing of the finished transformers.**

2.06 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 programme of stage inspection of the Purchaser.**

2.07 **While offer for final inspection the following point should invariably be taken care of.**

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

ii) The bolts connecting the top cover of the transformer with the tank at the two opposite comers 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.

3.00 Test Certificates:-

Seven Copies of Test Certificates as mentioned above are to be furnished to WBSEDCL for acceptance before issuance of instruction for dispatch of the equipment.

4.00 Drawings & Manuals :-

4.01 The following drawings and manuals shall be furnished in triplicate along with tender.

i) General Arrangement outline drawing with plan, elevation and end view showing various dimension of transformer and its vital equipment including height of the bottom most portion of bushing from the bottom of base channel and also indicating thereon physical center line & position of center of gravity.

ii)Cross sectional drawing showing various parts, including Core- coil assembly.

iii) Sketches for rating plate, complete list of fittings, Net weight of core, winding, tank, oil, total weight, fixing arrangement of transformer in structures.

4.02 The following drawings in six sets shall be submitted for approval within15 (fifteen) days from the date of placement of L.O.I./Order.

1. As stated in clause 4.01 above
2. Cross sectional details with Plan, Elevation, End view showing all internal clearance.
3. Drawing of Name & rating plates.

5.00 Guaranteed Technical Particulars:-

Tenders shall be furnished with guaranteed technical particulars of equipment offered as per Schedule-A. Performance guarantee shall be based on guaranteed technical particulars.

6.00 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.

7.00 Credentials as pre-requisites:-

Tenderer shall furnish document along with bid, in support of supply, delivery at consignee stores(e.g copy of PO,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 from the date of NIT publication

8.00 Type Test Report as pre-requisites

i) The bidder should submit Type Test Report **of Short circuit Test and Lightning Impulse voltage test along with drawing from** CPRI, NABL**/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. This is applicable for 16 to 315KVA DTr.**

ii) For the transformers, not usually used/procured in WBSEDCL system, Type Test Report **of transformers with higher rating but same type and with same voltage ratio shall be submitted along with drawing from** CPRI, NABL**/Govt. approved laboratories carried out within five years from the date of NIT publication. The same may be accepted as pre-requisites at the discretion tendering authority of WBSEDCL. This is applicable for 630KVA & above rating DTr.**

iii) In addition to the routine tests, Type tests are to be arranged by the manufacturer, who does not have type tests report from CPRI/NABL accredited Lab witnessed by WBSEDCL and also prototype sample of identically designed transformers.

9.00 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.

10.00 Validity Period :-

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

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

11.00 <u>Capitalisation of Losses :-</u>

11.01 Bidder shall state the transformer losses viz. a) Iron loss b) Copper loss separately. Transformer losses will be taken into account during bid evaluation. The losses at rated load, rated voltage & frequency shall be guaranteed.

i) Capitalised value of iron loss (No load loss) per KW= Rs.3,19,218 /-

ii) Capitalised value of copper loss (Load loss) per KW=Rs.95,754 /-

If any losses after Routine Tests are found beyond guaranteed value declared inthe bid offered, penalty will be imposed for the excess loss over the corresponding guaranteed value by applying the above stated values. For fraction of a KW, penalty shall be applied pro-rata, but no bonus will be applied on vice-versa. The result of routine test on the sample selected from a lot would be applied to the specific lot. **No changes in guaranteed figures will be allowed after bid opening.**

29.00 **Store Testing** :-

The materials/equipment delivered to consignee stores will be subjected to inspection/ testing in presence of your authorized representative for which due notice in advance will be furnished by the CE/Addl. C.E. (DTD). If any discrepancy/dispute in quality arises in any sample selected from a lot, the supplier shall have to replace that specific lot at the Supplier's cost and WBSEDCL reserves the right to take any penal action whatsoever without any further reference. For higher loss values obtained during above tests, 'Capitalisation of losses' Clause of this specification will be applicable on you .

Loss values whichever is higher as obtained during factory test and store test, shall be considered for LOSS CAPITILASATION.
However for 160KVA and above rating transformers, covered by 100% quantity checking by routine test, store testing shall have to be done at the discretion of CE/Addl.CE testing if necessary.

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 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. **Year of Manufacturing:**
6. **Property of : WBSEDCL**
7. **Asset Code Number : (10 digit alpha numeric numbers as allotted by the purchaser)**

Again the following points shall have to be noted

a) **Front Size of letter shall be 28 i.e. 7 mm x 5.5 mm**
b) **Letters shall be distinctly engraved by cold Punch**
c) **Plate size shall be minm 125mm X 170mm and shall be electrical run Welded be throughout its perimeter**
d) **Material of Plate shall be Mild Steel and not less than 3mm thick.**
e) **Plate shall be welded on the transformer tank at visible position and height.**

31. **TESTING EQUIPMENTS**

i) KV Meter (0- 30KV) for 11KV system
ii) Volt Meter (0- 1000V)
iii) Milliammeter for leakage current (0 -100ma)
iv) Power Analyzer of reputed Make(should display 3-Ph current, voltage,watt and∑3ΦPower
v) Megger – 2.5KV
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 11KV system.
x) Clamp on Ammeter (0- 300A)
xi) Current transformer having ratio 25-50-100/5A or 25/5A, 50/5A & 100/5A with suitable accuracy and burden.

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 CLAUSENO. 8 SHALL BE AVAILABLE WITH THE BIDDER AS AND WHEN REQUIRED.

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ANNEXURE-A

SCHEDULE OF ACCESSORIES REQUIRED FOR TRANSFORMERS CAPACITY IN KVA (UPTO 11 KV VOLTAGE CLASS)

Sl.No	Item	16KVA	25 KVA	63 KVA	100KVA	160KVA	315KVA	630KVA and above
1.	Terminal Plate & Terminal Marking Plate. Nos.	1	1	1	1	1	1	1
2.	a) Steel drain-cum-sampling valve P-3/4" thread (as per REC spec) – Nos.	1	1	1	1	1	-	-
	b)) Steel drain-cum-sampling valve – wheel/screw type-P-3/4"	-	-	-	-	-	1	-
	c) Steel drain-cum-sampling valve – wheel/screw type-P-1¼"	-	-	-	-	-	-	1 no
3.	Earthing Terminal –nos.	2	2	2	2	2	2	2
4.	Lifting Lugs – nos.	2	2	2	2	2	2	2
5.	Platform mounting arrangement	yes	yes	yes	yes	yes	yes	yes
	Silicagel type breather	1	1	1	1	1	1	1
7.	H.V. bushings with arcing horns- if otherwise not mentioned	3	3	3	3	3	3	3
8.	L.V.bushing for phases & Neutral- if otherwise not mentioned	Reqd.	Reqd.	Reqd.	Reqd.	Reqd.	Reqd.	Reqd.
9.	Oil filling holes with plug/cap	2	1	-	-	-	1	1
10.	Filter Valve (wheel/screw type)	-	-	1	1	1	1	1
11.	Thermometer packet nos.	-	-	1	1	1	1	1
12.	Air release plug on top cover nos.	-	-	1	1	1	1 (on inspection cover)	1 (on inspection cover)
13.	Conservator with filling hole with cover and drain plug & oil gauge nos	-	-	-	-	-	1	1
14.	Conservator with filing hole with cover and oil gauge nos.	-	-	1	1	-	-	-
15.	Off circuit taping switch with marking: nos.	-	-	-	-	-	1	1
16.	Cast Iron roller (Plain) nos.	-	-	-	-	4	4	4
17.	Oil gauge nos.	1	1	-	-	-	-	-
18.	Diaram plate nos.	reqd	reqd	reqd	reqd	reqd	reqd	reqd
19.	Explosion vent with air release plug no.	-	-	-	1	1	1	-
20.	Explosion vent with double diaphragm & port hole window & air equalizer	-	-	-	-	-	-	1
21.	Inspection cover nos.	-	-	-	-	1	1	1
22.	OTI with Mercury Contacts(A&T)	-	-	-	-	-	-	1 set
23.	MOG with Low Oil Level Ann. contact	-	-	-	-	-	-	1 set
24.	Buccholz relay with Ann & Trip contact	-	-	-	-	-	-	1 set
25.	Isolation Valve betn. Conservator & Buccholz relay no	-	-	-	-	-	-	1
26.	Marshalling Box no.	-	-	-	-	-	-	1
27.	Auxiliary Supply	30V DC±10% and 230VAC ±10%, 1-phase, 4-wire,50 c/s						
28.	Bushing Clearance :	This should be as per ISSSpecification. The angle of inclination of the H.V. bushings should not exceed 33^0 with the vertical axis.						
29.	Tank:	Tank should be as per /ISS./CBIP standard for conventional type. For 315 KVA & above rating Dtr, tank wall must be from tested mild steel of thickness 4.00 mm and Top & bottom plate of the tank must be of 5 mm thick. For 16 to 160KVA Dtr,the thickness of tank wall shall be 3.15mm & Top & bottom plate thickness shall be 5mm.						
30.	Winding Maaterials:	Copper – above 300 KVA Rating. For Dtr. below 300KVA, Aluminium or Copper may be used, but no special preference shall be given on conductor material. Similar materials for both L.V. & H.V. windings should be chosen.						
31.	Cable end box (to be provided for indoor type 100 KVA Tr. &160KVA and above rating Tr. if mentioned specifically, in that case the voltage ratio shall be 11/0.415KV)							

Note : The location of thermometer pocket (without tap changer) should be directly above 11 KV windings and as near to the top of the yoke as possible and at the centre of top cover.Thermometer pocket (with Tap Changer & inspection cover) should be placed as near to centre of top cover as possible. The length of the thermometer pocket inside the tank should be as per relevant I.S.

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	::	
2	Country of origin	::	
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 operating condition above ambient temperature	::	
	(a) Top oil (in Deg.C.)	::	
	(b) Winding (in Deg.C)	::	
	(ii) Maximum hot spot temperature of winding (in Deg.C)	::	
12	Magnetising current referred to H.V. at rated frequency	::	
	(a) At 90% rated voltage (in Amps)	::	
	(b) At 100% rated voltage (in Amps)	::	
	(c) At 112.5% rated voltage (in Amps)	::	
	(d) At 110% rated voltage (in Amps) for 315 &630 KVA DTr.		
13	Power factor of magnetizing current at 100% rated voltage & frequency	::	
14	No load current at rated voltage and rated frequency (in Amps)	::	
15	Maxm.No load loss in watt at rated frequency & voltage	::	
16	Maxm.Load loss in Watt at 75 Deg C. at rated output and frequency	::	
17	Total Loss (including NLL & FLL) at 100% loading & rated condition		
18	Percentage Regulation at full load at 75 Deg.C.	::	

Sl.No.	PARTICULARS		GTP TO BE FILLED BY THE BIDDER FOR EACH OFFERED RATING
	(a) At unity power factor	::	
	(b) At 0.8 power factor lagging	::	
19	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		
19	Impedence voltage on rated kVA base at rated current and frequency at 75 Deg.C (in percentage)	::	
20	(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)	::	
21	a) Resistance at H.V. base at 75 Deg.C (ohms) b) HV (between lines) (ohms) c) LV (between lines) (ohms)	::	
22	Reactance at H.V. base at 50 c/s	::	
23	Withstand time without injury for three phase dead short circuit at terminal (in seconds):	::	
24	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)	::	
25	Permissible over loading with time at max amb temp a) 125% load after running with 50% load with steady temp rise. (hrs.) b) 120% load after running with 100% load with steady temp rise. (hrs.)	::	
26	Core :		
(i)	Material Type :		
(ii)	Whether stack core/wound core Type		

Sl.No.	PARTICULARS		GTP TO BE FILLED BY THE BIDDER FOR EACH OFFERED RATING
(iii)	Flux density of Core and yoke :		
	(a) At rated voltage at 50 HZ (in line/sq cm)	::	
	(b) At 112.5% rated voltage at 50 HZ (in line/sq cm)		
(iv)	Thickness of Stampings (in mm)	::	
(v)	Type of Insulation between core lamination	::	
(vi)	Approximate area of Cross Section of Core and yoke (in sq.mm)	::	
(vii)	Material of Core clamping plate	::	
(viii)	Thickness of Core clamping plate (in mm)	::	
(ix)	Insulation of Core clamping plate	::	
(x)	Describe location/Method of Core grounding	::	
(xi)	Please specify the use of primary core material in the offered transformer		
(xii)	Whether the proof of use of prime core material is enclosed.		
27	Terminal Arrangement	::	
	(i) high voltage	::	
	(ii) low Voltage	::	
28	Positive Sequence Impedance between HV & LV winding on rated KVA base at rated current and frequency at 75 Deg.C. Winding temperature (in percent).	::	
29	Zero Sequence Impedance at reference temperature of 75 Deg.C (in percent)	::	
30	Details of windings :	::	
	(i) Type of Winding :	::	
	a) High Voltage ;	::	
	b) Low Voltage	::	
	(ii) Material of the winding conductor	::	
	(a) High Voltage :	::	
	(b) Low Voltage :	::	
	(iii) 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 per sq.cm)	::	

Sl.No.	PARTICULARS		GTP TO BE FILLED BY THE BIDDER FOR EACH OFFERED RATING
	(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	::	
	vii) Type of joints in the winding		
31	Insulation withstand Test Voltages	::	
	(i) Lightning Impulse withstand test voltage (KV Peak)	::	
	(ii) Power frequency withstand test voltage (in KV rms for 1 mtn)	::	
	(iii) Induced over voltage withstand test voltage (in KV rms)	::	
32	Current in the winding at rated KVA	::	
	(I) Low voltage (in Amps)	::	
	(ii) High Voltage (in Amps)	::	
33	Voltage per turn (KV per turn)	::	
34	Ampere turn	::	
35	Number of turns	::	
	(i) Low Voltage	::	
	(ii) High Voltage	::	
36	Bushing	::	High Voltage Low Voltage
	(i) Make	::	
	(ii) Type	::	
	(iii) Applicable standard	::	
	(iv) Insulation withstand test voltage	::	
	(a) 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)	::	
	i) Dry	::	
	ii) Wet	::	
	(v) Creepage distance in air	::	

Sl.No.	PARTICULARS		GTP TO BE FILLED BY THE BIDDER FOR EACH OFFERED RATING			
	(i) Total (in mm)	::				
	(ii) Protected (in mm)	::				
	(vi) Minimum height of the bushing					
37	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.	::				
38	Approximate weight of Transformer (in Kgs)	::				
	(i) Core with clamping	::				
	(ii) Coil with Insulation	::				
	(iii) Core and winding	::				
	(iv) Tank and fitting with accessories	::				
	(v) Untanking weight	::				
	(vi) Oil required for the transformer	::				
	(vii) Total weight with Core, Winding, oil and fittings	::				
39	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)	::				
40	Oil quality	::				
	(i) Applicable standard	::				
	(ii) Total quality of oil (in litres)	::				
41	Approximate overall Dimensions (in mm)	::				
	(a) Length	::				

Sl.No.	PARTICULARS		GTP TO BE FILLED BY THE BIDDER FOR EACH OFFERED RATING
	(b) Breadth	::	
	(c) Height	::	
	(d) Minimum height of bottom most portion bushing from bottom of base channel	::	
42	Minimum clearance height for lifting tank cover (in mm)	::	
43	Whether Type Test Report, Credential, Performance Certificate has been submitted as Pre-requisites as mentioned in the respective clauses of Technical Specification.		
44	Marking: whether agreeable to a) Punching of transformer sl. No. on the yoke. b) Transformer Rating and Diagram plate along with Asset codification number shall be welded on the tr. Body.		
45	Painting: Type of Painting of all steel surface.		
46.	Whether the following Testing equipments available in the Testing Lab of Manufacturer a) KV Meter (0- 30KV) for 11KV system b) Volt Meter (0- 1000V) c) Milliammeter for leakage current (0 -100ma) d) Power Analyzer of reputed Make(should display 3Φ current, 3Φ voltage, 3Φ watt and∑3ΦPower e) Megger – 2.5KV f) Thermometer (preferably Digital)-0 -100°C g) TTR Meter h) Winding Resistance measurement (Preferably ELTEL or reputed make) i) Digital Multimeter to measure magnetizing current & core balance of 11KV system. j) Clamp on Ammeter (0- 300A) k) CT having ratio-25-50-100/5A or separate 3 nos CT- Accuracy class and burden shall be mentioned. l) Whether all the above testing equipments are available in the testing lab of the manufacturer and are calibrated from NABL accrediated lab.		

Signature :

Name :

Designation :

Company Seal :