WEST BENGAL STATE ELECTRICITY DISTRIBUTION COMPANY LIMITED.
TECHNICAL SPECIFICATION OF 11/0.415 KV 160 KVA,630 KVA & 11/0.433 KV 315 KVA INDOOR & OUTDOOR TYPE DISTRIBUTION TRANSFORMERS.

PART-B

1.00	SCOPE : This specification covers design, manufacture, testing and supply of **11/0.415KV, 160 KVA & 630KVA** Outdoor type with cable termination arrangement & **11/0.433KV, 315 KVA**, Outdoor & Indoor type, ONAN Distribution Transformers as per details furnished.
2.00	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 meters.
3.00	SYSTEM DETAILS : The 11/0.415 KV & 11/0.433 KV systems are effectively earthed at the neutral points of the star connected windings of the transformers.
4.00	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
5.00	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.
6.00	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. Rating: please refer to Annexure-"A". 03. Number of phase : three 04. 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. 05. Type of cooling : ONAN 06. Voltage Ratio : refer to Annexure –"A" 07. Vector group reference : Dyn.11, unless otherwise stated. 08. CRGO material.
7.00	CONNECTIONS : The primary (HV) winding shall be connected in delta and the secondary (L.V) 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 the phase connecting conductors and jumpers which shall be properly supported and insulated.
8.00	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.

9.00	Short Circuit Impedance : As per Annexure –"A"
10.00	TERMINAL ARRANGEMENT : **i)160 KVA Outdoor Type Transformers but both end cable termination** - 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 , 3 C x 95 sq. mm XLPE cable and for L.V side - 1.1 KV grade 1 x 3½C 300 Sq.mm XLPE/PVC cable. **ii) 315 KVA 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. **iii)315KVA Indoor type transformers-** Suitable size cable end box with No- 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. **iv) 630 KVA 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 DTR- 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. And iv) The above terminal arrangement may change during detailed engineering while approval of drawing.
11.00	TAP CHANGING SWITCH FOR 315 KVA & 630 KVA DTR. 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.
12.00	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.**

13.00 Tank :

13.01 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 stiffener 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. Stiffener shall be continuously welded on the tank wall.

13.02 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.

a) 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

13.03 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.

14.00

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 detanking of the live part of the transformers. The whole core shall be electrically connected by tinned 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.

9.The max^{m} 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.

15.00

WINDING :

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.

A) 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 frequen (KV)
433/415V	-	3
11000	95	28

B) 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 equipment.

15.01	BRACING OF WINDINGS: i) 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. ii) Coil clamping rings, if provided, shall be of steel or of suitable insulating material. Axially laminated material other than bakelite paper shall not be used.
15.02	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) 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 for 315 KVA & 630 KVA transformer. For 160 KVA the No. of HV coils per phase/limb shall be minimum 6 nos. for voltage ratio of 11/.415KV. 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. xi) 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.

16.00 **Conformation to IS standards relating of conductors and insulation.**

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.

17.00 Bushing:
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	Impulse 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	

18.00 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 elliptical tubes, or a pressed steel plate assembly formed into elliptical 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 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 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.

19.00 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.
20.00	**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)
21.00	Transformer Oil: The oil shall be as specified in iS:335-1980 and it shall be free from moisture and have uniform quality throughout.
22.00	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.
23.00	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.
24.00	Anything not covered by this specification will be as per relevant I.S.S./REC Specification.
25.00	Cable End Box: Suitable Cable end Box with Gland Plate is to be provided at both HV &LV side of 160 KVA , 315KVA & 630 KVA transformers to accommodate terminal arrangement as per Terminal arrangement Clause(Cl.10) of this specification.
26.00	**Fittings:-** The following fittings shall be provided with the transformers

i) Name, Rating & Terminal Marking Plates	x) Steel drain-cum-sampling valve- wheel/screw type- P- ¾" & 1¼" for 315 & 630 KVA respectively. For 160 KVA Rec type with ¾" plug.
ii) Earthing Terminal – 2 nos.	xi) Filter Valve wheel/screw type- with ¾" & 1¼" for 315 & 630 KVA respectively. For 160 KVA with ¾".
iii) Lifting Lugs – 2 nos.	xii) Explosion vent with air release plug (315KVA)
iv) Platform mounting arrangement	xiii) Explosion vent (double diaphragm) with pressure equalizer connection (630 KVA).
v) Silica gel type breather	xiv)TI with mercury(A&T) contact(630KVA)
vi) H.V. bushings with arcing horns	xv) Buccholz relay with (A&T) contact(630KVA)
vii) L.V .bushing for phases & Neutral	xvi) Isolating valve between conservator & Buccholz relay (630KVA)
viii) Conservator with Oil gauge (160 & 315KVA)	xvii)Marshaling box for OTI & all accessories connection termination.
ix) Conservator with Oil gauge and MOG (630 KVA)	

Annexure-A

TRANSFORMER LOSS FIGURES :

DTR KVA Rating	Voltage Ratio	Maxm. allowable NO load loss (In Watts)	Max[m] allowable Load loss at 100% loading at 75° C (In Watts)	Max[m]. TOTAL LOSS (NLL+LL) at 100% loading at 75°C (In Watts)	% Impedance (± 10% variation as per ISS)
315 KVA	11 / 0.433 KV	800	3600	3630	5 %
630 KVA	11 / 0.415 KV	1200	6500	6640	5 %

Sl. no.	Voltage Ratio	Rating in KVA	Max[m] Total Loss (NLL + LL) at 75° C		Maximum Allowable No load losses	Maximum Allowable Full Load losses at 75° C
			50 % Loading	100 % Loading		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	11 / 0.415 KV	160	770 Watts	2200 Watts	425 Watts	2100 Watts

Max[m] Limit of No load loss , Load Loss & Total Loss figures as mentioned above are without any positive tolerance .

ROUTINE & TYPE TEST AND OTHER COMMON DETAILS FOR 160 KVA AND 315 - 630KVA DISTRIBUTION TRANSFORMER

27.00 Test & Inspection:-

27.01 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) 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) Magnetizing current at rated voltage & frequency and 110 % of rated voltage i.r.o. 315KVA & 630 KVA shall be as per declared value in GTP.

27.02 **Type Tests & Special Test:-**

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.

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

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

27.05 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 2secs. The temperature in the windings after 2secs. of over current must not exceed 200^0C for Al and 250 ^{0}C for Cu windings.

27.06 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.

27.07 WBSEDCL may also make a testing arrangement for carrying out short circuit tests with duration not exceeding 2secs. 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.

27.08 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

27.09 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.

27.10 **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.**

27.11 **However, if it is found that the bidder has submitted Tests Report of identical rating and type 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 of third party /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 & Special Test.

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

28.00 Inspection & Testing:-

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

28.02 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 equipment from the lot offered for tests.

28.03 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.

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

28.05 **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.**

28.06 **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 the programme for stage inspection of the Purchaser.**

28.07 **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.

29.00 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.

30.00 Drawings & Manuals :-

30.01 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) Drawing for rating & diagram plate, complete list of fittings, Net weight of core, winding, tank, oil, total weight, No Load Loss , Load loss at 100% loading at 75° C, Total Loss at 75° C at 50% / 100% load ,Temperature rise in oil and winding, fixing arrangement of transformer in structures.

30.02 The following drawings in six sets shall be submitted for approval within ten (10) days from the date of placement of L.O.I./Order.

1. As stated in clause 30.01 above
2. Cross sectional details with Plan, Elevation, End view showing all internal clearance..
3. Property plate drawing.

31.00 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.

32.00 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.

33.00 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 opening of bid (If opening date extended, the 1st mentioned date for opening, shall be considered for submission of credential).

34.00 Type Test & Special Test Report as pre-requisites

i) **The bidder should submit Test Report of Short circuit Test and Lightning Impulse voltage test of same rating & Sl. No. from CPRI, NABL of third party /Govt. approved laboratories carried out within Five years along with drawing 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.**

ii) For the transformers, not usually used/procured (say 160 KVA DTR), 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 of tendering authority of WBSEDCL.

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//Govt. approved laboratories witnessed by WBSEDCL and also prototype sample of identically designed transformers.

35.00 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.

36.00 Validity Period :-

36.01 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.

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

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

37.01 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 in the 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.

38.00 <u>Store Testing</u> :-

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.

39.00 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.**

40.00 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)**

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.

.....≈.....

ANNEXURE-B

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
1.	Terminal Plate & Terminal Marking Plate. Nos.	1	1	1	1	1	1	1
2.	Steel drain-cam-sampling valve P-3/4" thread (as per REC spec) – Nos.	1	1	1	1	1	1	1
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
	Silica gel 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 filling hole with cover and oil gauge nos.	-	-	1	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.	Diagram 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
22.	Cable end box to be provided	-	-	-	-	(As per - Terminal Arrangement clause)	(As per - Terminal Arrangement clause)	(As per Terminal Arrangement clause)
23.	OTI with Mercury Contacts(A&T)	-	-	-	-	-	-	1 set
24.	MOG with Low Oil Level Ann. contact	-	-	-	-	-	-	1 set
25.	Buccholz relay with Ann & Trip contact	-	-	-	-	-	-	1 set
26.	Isolation Valve betn. Conservator & Buccholz relay no	-	-	-	-	-	-	1
27.	Marshalling Box no.	-	-	-	-	-	-	1
28.	Auxiliary Supply	30V DC±10% and 230VAC ±10%, 1-phase, 4-wire,50 c/s						
29.	Bushing Clearance :	This should be as per ISS Specification. 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 & 630KVA 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 Materials:	Copper – above 300 KVA Rating. For DTR. below 300KVA Al or Cu 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.						

Note : The location of thermometer packet (without tap changer) should be directly above 11 KV windings and as near to the top of the yoke as possible and at the center of top cover. Thermometer pocket (with Tap Changer & inspection cover) should be placed as near to center 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 ^{0} C.) & (b) Winding (in ^{0} C)	::	
	(ii) Maximum hot spot temperature of winding (in ^{0} 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	Max^m No load loss in watt at rated frequency & voltage	::	
16	i) Max^m Load loss in Watt at 75 ^{0} C. at rated output and frequency	::	
	ii) Max^m Total loss in Watt at 75 ^{0} C. at 50 % load and frequency	::	

Sl.No.	PARTICULARS		GTP TO BE FILLED BY THE BIDDER FOR EACH OFFERED RATING
17	Total Loss (including NLL & FLL) at 100% loading at 75^0 C.		
18	Percentage Regulation at full load at 75 Deg.C.	::	
	(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	Impedance 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)	::	

Sl.No.	PARTICULARS		GTP TO BE FILLED BY THE BIDDER FOR EACH OFFERED RATING
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		
(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 ;	::	

Sl.No.	PARTICULARS		GTP TO BE FILLED BY THE BIDDER FOR EACH OFFERED RATING
	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)	::	
	(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	::	
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	::	

Sl.No.	PARTICULARS		GTP TO BE FILLED BY THE BIDDER FOR EACH OFFERED RATING			
	(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	::				
	(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	::				

Sl.No.	PARTICULARS		GTP TO BE FILLED BY THE BIDDER FOR EACH OFFERED RATING
	(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 liters)	::	
41	Approximate overall Dimensions (in mm)	::	
	(a) Length	::	
	(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.	List of Testing equipment available in the Testing Lab of Manufacturer in line with cl.no.31 of Part-C		

Signature :

Name :

Designation :

Company Seal :