TECHNICAL SPECIFICATION FOR OUTDOOR 3 PHASE 500 KVA AMORPHOUS / CRGO CORE CSP TYPE COPPER WOUND DISTRIBUTION TRANSFORMERS

1. SCOPE : This standard covers oil immersed naturally cooled, three phase, 50Hz, CSP type double wound outdoor type Distribution Transformer of 500 KVA for use on systems with nominal voltages of 11KV.

The transformers shall be guaranteed for 5 years from the date of supply.

2.0 STANDARDS:

2.1 The materials shall conform in all respects to the relevant Indian/International Standards specifications, which shall mean latest revisions, amendments/changes adopted and published, unless otherwise specified herein before. International and Internationally recognized standards to which these standards generally correspond are also listed below:

Indian Standard	**Title**	**International and Internationally recognised standards**
IS -2026	Specification for Power Transformers	IEC 76
IS - 1180	Outdoor distribution Transformer up to and including 100 kVA	
IS 12444	Specification for Copper wire rod	ASTM B-49
IS -3347	Specification for porcelain Transformer bushing	DIN 42531,23,3
IS-335	Specification for Transformer Oil	BS 148, D-1473, D-1533- 1934, IEC Pub 296
IS - 5	Specification for colors for ready mixed paints	
IS - 104	Ready mixed paint, brushing zinc chromate, priming	
IS – 2099	specification for high voltage porcelain bushing	
IS - 649	Testing for steel sheets and strips and magnetic circuits	
IS - 4257	Dimensions for clamping arrangements for bushings	
IS - 7421	Specification for Low Voltage bushings	
IS - 3347	Specification for Outdoor Bushings	DIN 42531 to 33
IS - 5484	Specification for Al Wire rods	ASTM B - 233
IS - 9335	Specification for Insulating Kraft Paper	IEC 554
IS - 1576	Specification for Insulating Press Board	IEC 641
IS / 6600	Guide for loading of oil Immersed Transformers	IEC 76
IS 2362	Determination of water content in oil for porcelain bushing of transformer	
IS 6162	Paper covered aluminium conductor	
IS 6160	Rectangular Electrical conductor for electrical machines	
IS 5561	Electrical power connector	
IS 6103	Testing of specific resistance of electrical insulating liquids	
IS 6262	Method of test for power factor and dielectric constant of electrical insulating liquids	
IS 6792	Determination of electrical strength of insulating oil	
IS 10028	Installation and maintenance of transformers.	

Material conforming to other internationally accepted standards, which ensure equal or higher quality than the standards mentioned above would also be acceptable. In case the Bidders who wish to offer material conforming to the other standards, salient points of difference between the standards adopted and the specific standards shall be clearly brought out in relevant schedule. Four copies of such standards with authentic English Translations shall be furnished along with the offer. Incase of conflict the order of precedence shall be (i) IS (ii) IEC (iii) Other standards. In case of any difference between provisions of these standards and provisions of this specification, the provisions contained in this specification shall prevail. Anything not covered by this specification, will be as per relevant CEA, REC, IS and CBIP manual in order.

3. SYSTEM DETAILS : 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 under fluctuations in supply voltage upto ±12.5% permissible under Indian Electricity Act and Rules there under.

4. **SERVICE CONDITIONS:**

The Distribution Transformers to be supplied against this specification shall suitable for satisfactory continuous operation under the following climatic conditions.

i)	Location	:	At various locations in the State of A.P.
ii)	Max. ambient air temp. (Deg.C)	:	50
iii)	Min. ambient air temp. (Deg.C)	:	7.5
iv)	Average daily ambient air temperature (Deg.C)	:	35
v)	Max. relative humidity (%)	:	100
vi)	Max. altitude above mean sea level (meters)	:	1000
vii)	Average annual rainfall (mm)	:	9100
viii)	Max. wind pressure (Kg./Sq.mm)	:	200
ix)	Isoceraunic level (days per year)	:	50
x)	Siesmic level (Horizontal accn.)	:	0.10 g.

The equipment shall be for use in moderately hot and humid tropical climate, conducive to rust and fungus growth.

5. RATING

a) Primary voltage : 11KV
b) Secondary voltage : 0.433 KV

The windings of the transformers shall be connected Delta on the primary side and Y (Star) on the secondary side. The neutral of the LT winding shall be brought out to a separate terminal. The vector group shall be Dyn. II.

6. TEMPERATURE RISE : The temperature rise over ambient shall not exceed the limits given below.

Top oil temperature rise measured by thermometer : 35 °C
Winding temperature rise measured by thermometer : 40 °C

7. NO LOAD VOLTAGE RATING: The no-load voltage ratios shall be as follows

11000/433V for all capacities

8. TAPS : The tappings shall be provided on the HV winding for variation of HV voltages as follows:

Voltage Ratio	Range of variation
11000/433	+3% to -9%

Tap changing shall be carried out by means of an externally operated self-position switch when the transformer is in de-energized condition. Switch position No.1 shall correspond to the maximum plus tapping. Each tap change shall result in variation of 3% in voltage. Provision shall be made for locking the tapping switch handle in position.

9. DESIGN & CONSTRUCTION: CORE

9.1. Material –:

1) CRGO Material : Material shall be CRGO sheet (M4 or Better grade) only prime quality material should be used. Prime excesses, Used material, Scrap, seconds, material or core removed from the second hand transformers shall not be used

a) The core shall be of high grade cold rolled grain oriented annealed steel lamination having low loss and good grain properties, coated with hot oil proof insulation, bolted together and to the frames firmly to prevent vibration or noise. All core clamping bolts shall be effectively insulated by Zinc Chromate and paper. The complete design of core must ensure permanency of the core losses with continuous working of the transformers. The value of the flux density allowed in the design and grade of lamination used shall be clearly stated in the offer.

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

c) Flux density should not be more than 1.55 webers/m^2 (Tesla). No load current shall not exceed 1.25% and will be measured by energizing the transformer at 433 volts, 50Hz on the secondary. Increase of voltage of 433 volts by 10% shall not increase the no load current disproportionately high. Test for magnetic balance by connecting the LV phase by phase to rated phase voltage and measurement of an, bn, cn voltages will be carriedout.

d) Number of steps of core shall be minimum of 9 Nos.

e) Diameter of core should not be less than 195 mm.

f) Effective area of core should not be less than 270 mm^2

g) Core clamping :

i. MS Channel to be used 125 x 65 mm size on top and bottom.
ii. 2 x 16 mm high tensile bolts to be used in parallel at each end.

iii. Channel on LV side to be reinforced at equidistance, if holes/cutting is done for LT lead in order to avoid bending of channel.
iv. MS channels shall be painted with varnish or oil-resistant paint.

h) Tie-rods : 8 Nos. of M16 size of high tensile steel rods effectively insulated shall be used.

i) i) All top and bottom yoke nuts & bolts and tie rods shall be painted with oil and corrosion-resistant paint / parkarised before use.
ii) Core base and bottom yoke shall be supported with 75 x 40 mm MS channel with proper bolting. Flat or cut channels will not be accepted.

2) AMORPHOS METAL:

1. The core shall be high quality Amorphous ribbons having very low loss formed into wound cores of rectangular shape, bolted together to the frames firmly to prevent vibration or noise. The complete design of core must ensure permanency of the core loss with continuous working of the transformers. The value of the flux density allowed in the design shall be clearly stated in the offer. Curve showing the properties of the metal shall be attached with the offer.

a. Core Clamping – Amorphous Metal Transformers
i. Core clamping shall be with top and bottom U-shaped core clamps made of sheet steel clamped with MS tie rods for efficient clamping.
ii. MS core clamps shall be painted with varnish or hot oil resistant paint
iii. Suitable provision shall be made in the bottom core clamp / bottom plate of the transformer to Arrest movement of the active part.

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

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c. No load current shall not exceed 2% of full load current and will be measured by energizing the transformer at 433 volts, 50 c/s on the secondary. Increase of voltage of 433 volts by 12.5 % shall not increase the no load current by Max. 5% of full load current. Test for magnetic balance by connecting the LV phase by phase to rated phase voltage and measurement of an, bn, cn voltage will be carried out.

Note : 1) The tenderer shall furnish the design details of the core construction along **with their offer with reference to the losses quoted.**
2) Equal weightage shall be given to the transformers with Amorphous metal core and CRGO.

10. WINDINGS :

a) Material : Double paper insulated(DPC) electrolytic grade insulated Copper shall be used.
b) Current density for HV and LV should not be more than 2.5A/mm^2 for copper (with a tolerance of +5% for LV winding).
c) H.V.Cross Section shall be not less than 5.5 mm^2.
d) L.V.Cross Section shall be not less than 240 mm^2

e) L.V winding shall be in even layers so that `neutral' formation will be at top.

Vertical ducts and spacers shall be provided within each coil for HV & LV windings.

11. LOSSES & IMPEDANCE : The maximum losses and impedance should be as shown below.

TABLE – 1

KVA rating	**Voltage ratio**	**Max. Losses @ 50% load, Watts**	**Max. Losses @ 100% load, Watts**	% impedance (subject to tolerance to as per IS-2026)
500	11000/ 433 V	1600 W	5500 W	5.0%

The above losses are maximum allowable and there would not be any positive tolerance. Bids with higher losses than the above specified values would treat as non-responsive. There is no price preference for lower losses. Bidder has to supply the transformer as per no load losses, load losses and Maximum losses at 50% and 100% as mentioned GTP.

11.1. PENALTY FOR EXCESSIVE LOSSES: (During Guarantee period).

11.1.1. During testing, if it is found that the actual measured losses are more than values quoted by the bidder, penalty shall be recovered from the bidder at double the loss capitalization formula as mentioned below.

(a) No load losses Rs. 217.51 per watt or part there of excessive loss.
(b) Load loss: Rs. 28.77 per watt or part there of excessive loss

For fraction of a KW, proportionate penalty will be recovered.

11.1.2 Transformers with temperature rise and impedance beyond guaranteed values not be accepted.

11.1.3 Purchaser reserves the right to reject any transformer during the test at supplier's works, if the losses, temperature rise and impedance values differ from the guaranteed values.

11.1.4 Purchaser also reserves the right to retain the rejected transformer and take it into service until the Bidder replaces it with a new transformer at no extra cost. The delivery as per contract will be counted when the new transformer as per specification is provided by the manufacture.

12. INSULATION MATERIAL & CLEARANCES :

a) Materials : Electrical grade insulation Kraft paper of Triveni/Ballarpur or equivalent make subject to approval of the purchaser. Press Board of Senapaty Whitelay or Raman make or equivalent subject to approval of purchaser.

b) Radial clearance of LV coil to core (bare conductor) shall not be less than 5.0 mm.

c) Radial clearance between HV & LV shall not be less than 11 mm

d) Phase to Phase clearance between HV conductors shall not be less than 10 mm for 11kV with a minimum of 2x1 mm press board to cover the tie rods.

e) The minimum electrical clearance between the winding and body of the tank (between inside surface of the tank and outside edge of the winding) should be 30mm.

f) Minimum end insulation to earth shall be 25 mm.
g) No. of coils HV/Phase shall be a minimum of 6.
h) Thickness of locking spacers between HV coils - 10 mm min.
i) No. of axial wedges between LV and HV winding equi spaced around 12.
j) Tap lead shall be insulated with 1.5 mm (minimum) thick paper insulation.
k) Manufacturing drawing showing various clearances shall be got approved.

13. TANK :

a) The transformer tank shall be of robust construction rectangular in shape and shall be built up of tested MS sheets of the following thickness with tolerance as per IS 1852
i) Side walls (Min) : 4.00 mm thickness
ii) Top & bottom plates (Min) : 6.00 mm thickness

The four walls of the tank shall be made of TWO "L" shaped sheets (without joints) fully welded at the corners from inside and outside of the tank for withstanding a pressure of 1Kg/Sq.cm for 10 minutes. All the tank plates shall be of such a strength that the complete transformer with oil and fittings can be lifted bodily my means of lifting lugs provided. The top cover of the tank shall be bent "L" shape 4 sides to avoid entry of water through cracks of gasket.

Reinforced of welding stiffener angle (50x50x6 mm) on all the outside walls of the tank shall be provided to form three equal compartments (applicable for tanks with cooling tubes / radiators). The tank through longer sidewalls shall be reinforced additionally by welding suitable size flat/angle vertically to provide sturdy and robust construction to withstand extreme pressure conditions. All joints of tank and fittings shall be oil tight and no bulging should occur during the service. The tank design shall be such that the core coil assembly can be lifted freely. The hooks that will be used for anchoring the core shall be so located as not to fould with the core coil assembly. "U" shaped pressure relief vent of 2" dia pipe with 0.025mm copper shim sheet / 0.4 mm bakelite sheet as diaphram shall be provided on the top cover of the tank such that the pressure released should be directed to the ground. The diaphragm shall be provided near to the top cover and other end of the vent pipe shall guarded with suitable mesh against entering of worms and resting. The diaphragm should burst at a pressure between 0.76Kg./Sq.cm to 0.95Kg./Sq.cm Permanent deflection when the tank without oil is subjected to vaccum of 760mm Mercury shall not be more than 5mm upto 750mm length 6mm upto 1250mm length. The tank shall be capable of withstanding a pressure upto 0.7Kg./Sq.cm without any deformation. Inside of the tank shall be painted with hot oil proof paint.

b) Pressure test will be conducted by the inspecting officer on a transformer vent pipe against each lot offered for inspection. The diaphragm should burst at a pressure between 0.76Kg./Sq.mm to 0.95Kg./Sq.mm. For any operational failure of vent pipe and consequent damaged to the tank an addition to insisting for free replacement of the tank, the AP_PDCL may at its option, recover an estimated loss sustained by it from the manufacturer.

c) The transformer tank top cover shall be fixed with bolts and four M12 anti theft fasteners shall be provided at corners, to prevent opening of the cover at site by miscreants.

d) The tank shall be fitted with round cooling tubes of minimum of 38mm outer dia and 1.25mm thick bent and directly welded on both sides i.e., inside and outside of the tank. The cooling tubes shall not be provided underneath the LV bushing to avoid puncturing of the tubes due to falling down of LV lead on them or In addition to the cooling tubes. The radiators can be Press fin type of 1.2mm thickness to achieve the desired cooling to limit the specified temperature rise. They should be fixed at right angles to the sides and not diagonally. The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. The size of the radiator shall be such that it covers at least 50% of the bottom yoke, full core and complete top yoke. Bidder shall submit the calculation sheet.

e) Heat dissipation by tank walls excluding top and bottom should be limited to 500W/Sq.mt upto the oil level, 250 Watts/Sq.mt above oil level and 300Watts/Sq.mt for cooling tubes. The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. Tenderer shall submit the calculation sheets.

CORRUGATED TANK : The bidder may offer corrugated tanks for 500 KVA Distribution Transformers with top mounted bushes

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

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

3. All joints of tank and fittings shall be of oil tight and no bulging should occur during service. The tank design shall be such that the core and windings can be lifted freely.

4. Tanks with corrugations and without conservator shall be tested for leakage test at a pressure of 0.25 Kg/sq. cm measured at the top of the tank.

5. The transformers with corrugation should be provided with a pallet for transportation the dimensions of which should be more than the length and width of the transformer tank with corrugations

f) Total minimum Oil volume.

Sl. No.	KVA Rating	Oil in Ltrs. incl. of oil observed in Core coil assembly	Permissible oil absorption in Ltrs.
1.	500 KVA	700	22

g) Total minimum weights.

Sl. No.	KVA Rating	Core lamination in Kgs.	Winding with insulation in Kgs.
1.	500 KVA	630	334

h) Lifting Lugs : 4 Nos. welded heavy duty lifting lugs of MS plate 8 mm thick suitably reinforced by vertical supporting flat welded edgewise below the lug on the side wall.

(i) Pulling Lugs : 4 Nos. of welded heavy duty pulling lugs of MS plate 8 mm thick shall be provided to pull the transformer horizontally.

(j) Top cover fixing bolts of M12/M10 bolts (hot dip galvanized) spaced not more than 100 mm between each bolt, 6 mm Neoprene bonded cork gaskets conforming to IS: 4253 Part-II will be placed between tank and cover. The bolts outside tank shall have 2 flat washers & one spring washer.

(k) The top cover shall be provided with two sealing bolts of M12 anti theft at all corners with 2 mm hole on tail side

l) All transformers shall be capable of giving their continuous rated output without exceeding the specified temperature rise.

14. CONSERVATOR : a) The total volume of conservator shall be such as to contain 10% quantity of the oil. Normally 3% quantity of the total oil will be contained in the conservator. Dimensions of the conservator shall be given in the general arrangement drawing.

b) Oil level indicator shall be provided on the side which shall be fixed with fully covered detachable range with single gasket and belted with MS nuts and bolts.

c) The pipes from conservator tank connecting to main tank shall have a sloping flaps so that oil falling from the pipe shall not fall directly on the active parts but on the side walls only. The pipe shall be of 25-50 mm dia and it should project atleast 20mm above the bottom of conservator.

d) The conservator shall be provided with a drain plug and a plugged filling hole.

15. BREATHER : Clear view design based on DIN standard 42567 Silica gel Breather housed in a transparent compartment. Approval of Board to be taken for the make of breather. Volume of breather shall be suitable for 500 gms. of Silica gel.

16. BUSHINGS : i) The bushings shall conform to IS:2099/1973 “Specification for High Voltage Porcelain Bushings”. The bushing rods and nuts shall be made of brass.

ii) For 11KV, 17.5 KV class bushings shall be used and for 0.433 KV, 1.0 KV class bushings shall be used. Bushings of plain sheds as per IS-3347 shall be mounted on the side of the Tank and not on top cover.

iii) Dimensions of the bushings of the following voltage class shall conform to Indian Standards mentioned below :

Voltage Class	Indian Standards	
	For Porcelain parts	For metal parts
1.0 KV	IS:3347/Part-I/ Sec.1/1965-1967	IS:3347/Part-I/ Sec.2/1957
17.5 KV	IS:3347/Part-III Sec.1/1972	IS:3347/Part-III/ Sec.2/1967

iv) A minimum phase to phase clearance of 75 mm for LV (upto 1.0 KV Bushing) and 255 mm for HV (3.3 Kv and above) bushings shall be obtained with the bushing mounted on the transformer.

v) The bushings shall be fixed on sides with pockets in the same plane. Arcing horns shall not be provided and instead brass gaps shall be provided.

vi) Brazing of all inter connections, jumpers from winding to bushing shall have cross section larger than the winding conductor. For copper, silver brazing alloy to be used. For Aluminium, L&T Aluminium Brazing rods shall be used.

17. LIGHTNING ARRESTERS: 9 KV, 5 KA metal oxide Lightning Arrestors (Disconnector Type) as per IS-3070/Part-I/1974 and IEC-99-1 (latest version), one number per phase shall be fixed under the HV bushings with earth connected to the body of the transformers with necessary clamping arrangements.

18. TERMINALS : a) Brass rods 12mm dia for HT.

b) Tinned copper rods of 20mm dia for LT.

19. TERMINAL MARKING PLATES AND RATING PLATES: The transformers shall be provided with a plate showing the relative physical position of the terminal and their markings engraved on it. The transformers shall be provided with non-detachable rating plate of Aluminium anodized material fitted in a visible position, furnishing the information as specified in IS:2026. The rating plate shall be embossed/ engraved type. The relative position of tapping switch and corresponding voltages may also be shown on the rating plate. Further M.S. plate of size 125 mm X 125mm be got welded on width side of transformer on stiffener angle. On this plate, name of firm, orders No. and date, rating, serial No. and date of dispatch should be engraved.

20. FITTINGS : The following standard fittings shall be provided.

a) Rating and terminal marking plates non detachable -2Nos.
b) Earthing terminals with lugs - 2 Nos.
c) Oil level gauge indicating three positions of oil marked as follows : Minimum 5 Deg.C, 30 Deg.C, Maximum 98 Deg.C
d) Lifting lugs -4Nos.
e) Silicagel breathing device of weather proof design – 1 No. (500 gms. capacity)
f) Drain pipe of adequate size at the corner from bottom of the tank to the top cover where it is duly bent – 1 No.
g) Oil filling hole having 1-1/4 thread (with cover) on the transformer body/conservator – 1No.

h) Bimetallic terminal connectors on the HV/LV bushings as per drawing enclosed - 7 Nos.
i) Conservator with drain plug – 1 No.
j) Thermometer pocket - 1No.
k) Platform mounting channel – 2 Nos. (size is to be mentioned) (with holes suitable for axle of roller).
l) HT/LT bushings – 3 Nos. on HT & 4 Nos. on LT, (LT & HT bushings shall be provided with 3 brass nuts & 2 brass washers).
m) Pulling lugs – 4 Nos.
n) Explosion vent – 1 No.
o) Off-circuit tapping switch with locking arrangement – 1 No.
p) Filter valve 32 mm dia.
q) Rollers : 4 Nos. of sufficient size.
r) Cooling tubes.
   c) Weight content of a) core b) Windings c) Tank & fittings d) Weight/Qty of oil, e) over all weight.
   d) 5 year guarantee embossed plate welded below name plate.
v) Die cast oil level gauge indicating three positions of oil marked as minimum 5 degrees, 30degrees and maximum as 98 degrees

The transformers shall be provided with a plate showing the relative physical position of the terminal and their markings. The relative position of the tapping switches, wherever necessary, shall also be shown in the plate, corresponding to the different tapping voltage. This shall be in accordance with IS:2026. The transformers shall be provided with rating plate furnishing the information as specified in IS:2026.

21. Manufacturer has to emboss his company monogram and The word “PDC of AP _PLtd.,” shall be embossed on the side sheet of the Tank above rating & diagram plate The size of the embossing of the word “CPDC of AP Ltd” is of 2 Inches.

The following information shall also be embossed on a separate MS sheet of thickness 2mm and firmly welded (No Tack welding) on one side of the transformer. The size of the word is of 1” inch.

a) P.O. No. & Date,
b) Year of manufacture
c) Make and Serial No.
d) 5 years Guarantee period.

22. MOUNTING ARRANGEMENT: The under base of all transformers shall be provided with two 125 x 65 channels with holes to make them suitable for fixing on a platform or plinth.

23. OVER LOAD CAPACITY: The tenderer should state clearly the percentage over load the transformers can take for a continuous period of 1 hour. The transformers shall be suitable for loading as per IS.6600/1972.

24. TRANSFORMER OIL : The transformer shall be supplied complete with first filling oil and the same shall comply with IS-335/1983 of latest version. The ageing characteristics after accelerated ageing shall be as given in Appendix-C of IS-335/1983 or latest version.

The characteristics of the oil shall be as follows :

Sl.No.	Characteristics	Specified valve
1.	Electric strength (breakdown voltage)	
	Unfiltered	30 KV (rms) (min)
	Filtered	50 KV (rms) (min)
2.	Electric dissipation factor (tan delta) at 90Deg.C	0.01 (max)
3.	Specific resistance (resistivity) at 27Deg.C (ohm-cm)	$10x10^{12}$
4.	Flash point (PM closed)	140Deg.C (min)
5.	Inter facial tension at 27Deg.C.	0.03 N/M (min)
6.	Neutralization valve (total acidity)	0.05mg/KOH/g (max)
7.	Water content PPM	35 (max)

Test reports for each batch of oil shall be submitted.

25. TESTS:

25.1 TYPE TESTS:

The transformers offered should have been got type tested.

The bidder will furnish Type Test Results. The following type tests must have been conducted on the material offered as per the relevant IS in NABL accredited laboratory as per the latest revision of the Technical Specification and the date of type test will not be later than 5 years.

1. Measurement of winding resistance (IS 2026 (part-I) :1977)
2. Measurement of voltage ratio and check of voltage vector relation ship (IS 2026 (part-I) :1977)
3. Measurement of Impedance voltage/short circuit impendence and load loss (IS 2026 (part-I) :1977)
4. Measurement of No Load loss and current (IS 2026 (part-I) :1977)
5. Measurement of Insulation resistance (IS 2026 (part-I) :1977)
6. Induced of over voltage with stand test(IS 2026 (part-3) :1981)
7. Separate source voltage withstand test(IS 2026 (part-3) :1981)
8. Impulse voltage test: (IS-2026 (Part-III)/1981- Voltage shall be 95KV peak Insulation levels:

Sl. No	Volatage(KV)	Impulse voltage (KV peak)	Power frequency voltage (KV)
1	0.433	-	3
2	11	95	28

9. Temperature rise tests(IS 2026 (part-II) :1977)
10. Short Circuit test (IS 2026 (part-I) :1977) (Dynamic & Thermal ability)
11. Air pressure test (IS-1180/Part-I/1989.)
12. Permissible flux density and over fluxing (IS-1180/Part-I/1989.)

25.2. ROUTINE TESTS/ ACCEPTANCE TESTS :

All transformers shall be subjected to routine tests at the manufacturer's works. The following routine tests shall be carried out in accordance with the details specified in IS:1180 (Part-I) and IS:2026 or as agreed upon between the AP_PDCL and the manufacturer.

1. Measurement of winding resistance (IS 2026 (part-I) :1977)
2. Measurement of voltage ratio and check of voltage vector relation ship (IS 2026 (part-I) :1977)
3. Measurement of Impedance voltage/short circuit impendence and load loss (IS 2026 (part-I) :1977)
4. Measurement of No Load loss and current (IS 2026 (part-I) :1977)
5. Measurement of Insulation resistance (IS 2026 (part-I) :1977)
6. Measurement of Induced over voltage with stand test(IS 2026 (part-3) :1981)
7. Separate source voltage withstand test(IS 2026 (part-3) :1981)
8. *Checking of weights, dimensions fitting and accessories, tank thickness, oil qty., material, finish and workmanship as per purchaser order and contract drawings.*
9. *Checking of di-electric strength of transformer oil*
10. *Load losses as specified in the specification.*
11. *Neutral current measurement – The value of zero sequence current in the neutral of the star winding shall not be more than 2% of the full load current.*

All above acceptance and routine tests shall be carried out by the supplier in presence of purchaser's representative on atleast 10% of quantity offered every time.

In addition to the above measurement of losses at 50% load and 100% load losses calculations at 75 Degrees for 100% transformers is to conducted and report submitted.

Following tests shall be carried out at manufacturer's works on one unit of each rating by the supplier in presence of purchase representative.

I. Heat run test- One unit of the ordered quantity of each rating.

II. Heat run test shall have to be conducted at suppliers cost on one transformer of each rating, generally from first offered lot, during the course of supplies.

To facilitate conduction of heat run test on any unit in any lot at any point of time during the supply, the manufacturer will provide a thermometer pocket which gets immersed in oil on the side of the transformer in all the transformers. The depth of the projecting stem of this pocket inside the transformer will be below oil level. It shall not fringe with electrical clearance nor obstruct the untanking of the active part.

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

26. AIR PRESSURE TEST: (Routine Test) : The transformer tank with all the fittings including bushing in position shall be tested for leakage at a pressure of 0.8 Kg./cm^2 above atmosphere pressure maintained inside the tank for 10 minutes. There should be

no leakage at any joint. (This may be carried out periodically, say after every 50 transformers

27. BUSHINGS HT & LT : Tests as per ISS 2099/1962 shall be conducted on the transformer bushings as detailed below :

a) Dry flash over voltage
b) Wet flash over voltage
c) Dry 1Minute withstand voltage
d) Wet 1/2 Minute withstand voltage
e) Impulse withstand voltage (1/50 +ve wave)
f) Minimum oil immersed flashover voltage.

Manufacturer's test certificates may be furnished.

28. TEST CERTIFICATES : The test certificates for all routine and type tests for the transformers and also the bushing and transformer oil shall be submitted with tender.

29. DRAWINGS : 2 copies of the dimensional drawings and internal assembly drawings of each transformer shall be submitted with the tender.

30. TOLERANCES : Unless otherwise specified herein the test value of the transformers supplied should be within the tolerance permitted in the IS 2026 on the guarantee values. No positive tolerance shall be allowed on the maximum losses displayed on the label for both 50% and 100% loading values.

CHALLENGE TESTING:

The other manufacture can also request challenge testing for any test based on specification and losses. The challenger would request for testing with testing fee. The challenge test fees are proposed at least three times the cost of testing. This is likely to deter unnecessary challenges. The challenger would have the opportunity to select the sample from the store and any such challenge should be made within the guarantee period. The party challenged, and the utility could witness the challenged testing.

The challenged testing would cover the

1. Measurement of magnetizing current

2. No Load losses test.

3. Load Losses test (At 50% loading or as per acceptance test)

4. Temperature rise test.

The challenge test could be conducted at NABL accredited laboratory, like ERDA and CPRI. If the values are within limit the product gets confirmed or else not confirmed. No positive tolerance in losses is permitted. If the product is not confirmed the manufacturer would pay the challenge fee and challenger would get the fee refunded. However as redressal system the challenger would allowed to ask for fresh testing of two more samples from the store and the same be tested in NABL laboratory in presence of party challenged, challenger and the utility. If any one or both sample does not confirm the test then the product said to have failed the test. In such cases the manufacturer will be declared as unsuccessful manufacturer

for the said product with wide publicity and would not be allowed to compete in tenders of the Boards for the period of three years and heavy penalty would be imposed.

31. FINISHING : The exterior of the transformer and other ferrous fittings shall be thoroughly cleaned, scraped and given a primary coat and the two finishing coats of durable oil and weather resisting paint of enamel. **The colour of the finishing coats shall be dark admiral gray conforming to No.632 of IS 5 of 1961 colours for ready mixed paints.**

32. GUARANTEED AND OTHER PARTICULARS FOR TRANSFORMERS : To be filled in and submitted by the tenderer.

33. Tenderer will have to produce documentary evidence for the purchase of CRGO sheet, winding copper and oil & Alu. Wire.

34. A) INSPECTION: i) In respect of raw materials such as core stampings, winding conductor, insulating paper and oil, you shall use materials manufactured/supplied by standard and reputed manufacturers approved by the Board and furnish the Manufacturers test certificates as well as proof of purchase.

ii) The AP_PDCL may, at its option, open a transformer supplied to stores in your presence at AP_PDCL's laboratory. If any of the guaranteed technical particulars are found to be at variance during this test the AP_PDCL reserves the right to reject the whole lot supplied.

iii) In addition to the above, the AP_PDCL may pick up any transformer and decide to get it type-tested at CPRI at AP_PDCL cost. The tenderer will have to organize packing etc., at AP_PDCL stores for which charges will be paid by AP_PDCL. If the transformer fails to meet the requirements of type tests, the quantity of transformers ordered on them may be rejected and AP_PDCL may go in for risk purchase.

iv) In respect of CRGO laminations, the following documents shall be furnished as proof of purchase :

B) SEALING OF TRANSFORMERS AFTER TESTING AND INDIVIDUAL TEST REPORTS:

After witnessing testing on sample quantity and physical inspection of all offered Transformers, the purchaser's representative will provide numbered lead/ plastic seal bits to two opposite corners of tank and inspection cover of all offered Transformers, for delivery of correct inspected materials only. The seal bit numbers shall also be mentioned in the test reports signed by purchaser's representative submitted for delivery instructions**.**

Manufacturer should submit the list of equipment for testing along with latest calibration certificates to the purchaser.

"Invoice of supplier; Mill's Test certificate, packing list; Bill of Landing; Bill of Entry Certificate by Customs Dept.; Description of material; Electrical analysis; and Physical Inspection Certificate for Surface defects, thickness & width of the material"

C) In respect of CRGO laminations, the following documents shall be furnished as proof of purchase : Invoice of supplier, Mill's test certificate, packing list, Bill of landing, Bill of entry certificate by custom, description of material, electrical analysis, physical inspection, certificate of surface defects, thickness and width of the material.

D) TESTING FACILITY : The tenderer should have adequate testing facility and also arrange for measurement of losses, resistance etc.

E) INSPECTION AND TESTING OF TRANSFORMER OIL : To ascertain the quality of transformer oil, the manufacturer's test report should be submitted at the time of inspection. Arrangements should also be made for testing the transformer oil, after taking out the samples from the manufactured transformer and tested in the presence of AP_PDCL's representative (or) if desired, in an independent laboratory.

35. The schedule of requirements are indicated in Annexure-II. The prices shall be VARIABLE.

36. The schedule of requirements are indicated in Section-IV. The prices shall be Variable as per latest IEEMA formula applicable from January 2009, base date as on 01-12-2012 with 50% ceiling limit on positive side and there is no limit on negative side.

37. WARRANTY:

i The period of warranty will be 5 years (five years) the date of acceptance of the material in stores i.e. Form-13 date of last consignment, last piece transformers received against this specification.

ii If the failure after erection and commissioning at site is more than 5% the AP_PDCL reserves the right to cancel the balance quantity of the order or take such suitable action deemed fit. The same will be treated as failure of basic contractual conditions and same to the organization if any can be claimed.

iii 50% of the performance guarantee (Security) amount will be deducted in case the failure rate of Distribution Transformers is more than 5% and below 10% during warranty period.

iv 100% performance guarantee (Security) amount will be deducted in case the failure rate of Distribution Transformers is more than 10% during the warranty period.

v The recovered performance guarantee (Security) amount will be replenished from the immediately pending bill if any or direct by supplier

vi The supplier shall rectify and return the material failed within guarantee period duly repaired and tested as per approved Guaranteed Technical Particulars and tender specification within 30 days from the date of receipt of intimation without any cost, failing which performance bank guarantee shall be encashed without any notice

vii The above clause it self shall be deemed to be the notice issued to the supplier about encashment of Bank Guarantee incase of failure to adhere to timelines & no separate notice will be served.

ANNEXURE – I

GUARANTEED TECHNICAL &OTHER PARTICULARS FOR DISTRIBUTION TRANSFORMERS

Sl. No.	Description	500 KVA
1	Make & Manufacturer	
2	Place of Manufacture	
3	Voltage Ratio	
4	Rating in KVA	
5.Core Details:		
1	Core Grade	
2	Thickness of core plates	
3	Flux density (Max)	TESLA
4	Over fluxing without saturation	
5	Core Details. 1) No. of Core steps. 2) Max. width of first step lamination. 3) Stacking factor 4) Core building factor.	
6	Core diameter	cm
7	Gross Core area	cm
8	Net Core area	cm
9	Wt. Core	Kg.
10	Loss per Kg. of core at the specified Flux Density	Watts/kg
11	Core loss in watts a) Normal Voltage b) Maximum Voltage	
12	Power factor magnetizing current (lag max)	
13	Magnetizing (No load) current at a) Normal Voltage b) Maximum Voltage	
14	Core window height	mm
15	Center to center distance of the core	mm
16	Maximum temperature rise of Core by Thermometer	
6.Winding Details		
1	Maximum temperature rise of Windings by resistance method	
2	Winding material : LV & HV	
3	Resistance of windings at 20 Deg. C (with 5% tolerance for LV) a) HV Winding (ohms), b) LV winding (ohms)	
4	No. of LV Turns	
5	No. of HV Turns	
6	Size of LV conductor bare/covered	mm
7	Rounding Factor for LV	
8	No. of parallels	
9	Area of LV cross section (sq.mm)	sq.mm

10	Size of HV conductor bare/covered	mm
11	Area of HV cross section (sq.mm)	sq.mm

12	Current density of LV winding	Amp/sq.mm
13	Current density of HV winding	Amp/sq.mm
14	Wt. Of the HV winding for transformers	Kg.
15	Wt. Of the LV winding for transformers	Kg.
16	No. of LV Coils/Phase	
17	No. of HV Coils/Phase	
18	ID/OD of LV winding	mm
19	ID/OD of HV winding	mm
20	Height of LV winding	mm
21	Height of HV winding	mm
22	Axial height of HV coil	mm
23	Axial height of LV coil	mm
24	Radial depth of LV coil	mm
25	Radial depth of HV coil	mm
26	Full load current HV	Amps
27	Full load current LV	Amps
28	Full load losses (watts) at 75 Deg. C	Watts
29	Estimated stray losses	Watts
30	Estimated Breaker Losses	Watts
31	Total Losses(Full load losses+ stray losses+ Breaker Losses)	Watts
32	Calculated Impedance	%
33	Edge strip size on LV coil (top & Bottom)	mm
7.Clearances		
1	Size of the duct in HV winding	mm
2	Size of the duct in LV winding	mm
3	Size of the duct between HV & LV	mm
4	HV winding to LV clearance	mm
5	HV winding to tank clearance	mm
6	HV to earth creepage distance	mm
7	LV to earth creepage distance	mm
8	Clearances (minimum) a) Core & LV b) LV & HV c) HV Phase to phase d) End insulation clearance to Earth e)Any point of winding to tank	mm

8.Heat Disspation Calculations		
1	Maximum temperature rise of Oil by Thermometer	
2	Transformer (minimum) 1) Overall length x breadth x height 2) Tank length x breath x height 3) Height of Oil level in tank 4) Thickness of plates a) Side walls (min.) b) Top & bottom plate (min.)	
3	Radiation: 1) Heat dissipation by tank walls exclusive top & bottom 2) Heat dissipation by cooling tube 3) Dia & thickness of cooling tube 4) Whether calculation sheet for selecting cooling area to ensure to ensure that the transformer is capable of giving continuous rated output without exceeding temperature rise & also transformer tank size is sufficient is enclosed. 5) Minimum free space available above oil level.	
4	Weight content of a) Core lamination (min.) b) Windings (min.) c) Tank & Fittings d) Oil e) Oil Qty in liters(min.) f) Core channels, rods, bolts, etc g) Insulation material inside tank. h) Total Weight	
5	Oil Data 1) Qty. for first filling (min.) 2) Grade of oil used 3) Maker's name 4) BDV at the time of filling	
9.Efficiency,Regulation, and other particulars		
1	Efficiency at 75 Deg. C a) Unity P.F. & b) 0.8 P.F. 125% load 100% load 75% load 50% load 25% load	
2	Regulation at a) Unity P.F. b) 0.8 P.F at 75 Deg. C	
3	Percentage Impedance at 75 Deg. C	
4	Flash Test HV 28 KV/50Hz for I minute LV 3 KV/50 Hz for 1 minute	
5	Over potential Test Double Voltage & Double frequency for 1 minute	

6	Impulse test	
7	Inter layer insulation provided in design for 1) Top & Bottom layer 2) In between all layer 3) Details of end insulation 4) Whether wedges are provided at 50% turn of the HV coil.	
8	Insulation materials provided a) For Conductors (1) HV (2) LV b) For Core	
9	Is the name plate gives all particulars are required in tender	
10	Particulars of Bushing HV/LV 1) Maker's name 2) Type IS-3347/IS-1180 3) Rating as per I.S. 4) Dry power frequency voltage withstand test 5) Wet power frequency voltage withstand test	
11	Particulars of metal oxide Lightening arrestor	
12	Medium of free space above oil level Transformer	
13	Details of type tests conducted (indicating rating, year of testing, details of tests)	

NOTE : The following shall be specifically confirmed.

1. Whether the offer conforms to the limits of impedance mentioned in the specification

2. Whether the offer conforms to the limits of temperature rise mentioned in the specification

3. Whether the losses of the transformers offered are within the limits specified

4. Whether the transformer offered is already type tested for the design and test reports enclosed.

5. ***The tenderer shall furnish the design details of the core construction such as number of steps, thickness of core sheet, stacking factor, core building factor, core length, width, stack height per step, core diameter, gross and net areas of core,etc., along with their offer with references to the full load and no load losses quoted and calculation sheets for heat dissipation calculation ,minimum available free space, oil quantity calculation,& cost analysis of the Transformer (Annexure-II)***

ANNEXURE – II

SOURCE OF MATERIALS/PLACES OF MANUFACTURE, TESTING AND INSPECTION

Sl. No.	Item	Source of Material	Place of Manufacture	Place of testing and inspection
1	Core Laminations			
2	Copper winding wire			
3	Steel Castings/sections			
4	Tank			
5	Insulating Cylinders			
6	Bushing HV/LV			
7	Oil			
8	Las			
9	Radiators			
10	Insulators			
11	Insulation Paper			

Note: The bidder has to invariable furnish the above information.

LIST OF FITTINGS AND PARTICULARS TO BE FURNISHED IN THE DRAWING

1. Rating and terminal marking plate (non detachable)
2. Earthing terminal with lugs 2 Nos.
3. Lifting lugs 4 Nos. for main tank and 2Nos. for top cover
4. pulling lugs 4Nos
5. HV bushings 3Nos. with bimetallic terminal connector
6. LV Bushings 4Nos. with bimetallic terminal connector
7. Thermometer pocket with cap
8. Metal oxide lightning Arrestors (Disconnector type)
9. Stiffner angle (40x40x5mm)
10. U shaped pressure relief vent with 0.025mm copper diaphragm / 0.4 mm Bakelite sheet pressure relief vent on the top cover of the tank.
11. Cooling tubes if required (length of the cooling tubes is to be furnished along with heat dissipation calculation)
12. LV Epoxy bushings 4 Nos.
13. Base channels 125x65 mm
14. Tank and over all dimensions
17. 5 year guarantee embossed plate welded below name plate.
18. Weights of (a) Core (b) windings (c) Tank and fittings
    (d) Weight Qty. of oil (e) over all weight
19. Die cast oil level gauge indicating three positions of oil marked as minimum 5 degrees, 30degrees and maximum as 98 degrees

NOTE: 1) The top cover shall be fitted with nut and bolt and continuous neoprene gasket (Rectangular Ring)arrangement.

2) Corner bolts are to be welded to prevent the top cover being removed in the field

3) All bolts shall have spring washers

SOURCE OF MATERIALS/PLACES OF MANUFACTURE, TESTING AND INSPECTION

Sl.No.	Item	Source of material	Place of manufacture	Place of testing
1.	Lamination			
2.	Copper aluminiun			
3.	Core plate			
4.	Steel castings			
5.	Tank			
6.	Radiators			
7.	Insulators			
8.	Cylinders			
9.	Insulation paper			
10.	Bushing HV/LV			
11.	Oil			
12.	Insulated winding wire			
13.	a) Tap changer			
	b)Pressure relief vent			

SCHEDULE OF DEVIATION

TECHNICAL

Sl. No.	**Requirements / Equipment**	**Specification Clause No.**	**Deviations**	**Remarks**

It is hereby conformed that except for deviations mentioned above, the offer conforms to all the other features specified in Technical Specification Section ____ of this Bid Document