TECHNICAL SPECIFICATION FOR OUTDOOR SINGLE PHASE OIL IMMERSED CSP DISTRIBUTION TRANSFORMERS.

1. SCOPE: The specification covers oil immersed, naturally cooled 11 KV / √3/250V 16 KVA Single Phase 50 Hz double wound, outdoor type, CSP **distribution transformers**.

2. APPLICABLE STANDARDS: Unless otherwise modified in this specification, the single phase distribution transformers shall comply with the Indian Standard specification IS:1180 and IS:2026 as amended from time to time.

3. FREQUENCY: The transformer shall be capable of operating satisfactorily at any frequency between 48 & 51.5 cycles/second.

4. VOLTAGE FLUCTUATIONS: The transformer shall be able to withstand fluctuation of voltage up to ±12.5% on the HV side.

5. NO-LOAD VOLTAGE RATIO : The No-load voltage ratio shall be 11000 / /3/250 V.

6. TAPS: No taps are to be provided on these transformers.

7. WINDING CONNECTIONS & TERMINAL ARRANGEMENT:

7.1 One end of the primary winding shall be brought out through on appropriate HV Bushing. The other end of HV winding shall be brought out through 1.1 KV LV Bushing and connected to the tank externally solidly connected to the tank internally. The secondary winding shall be connected to two LV bushings.

7.2 BUSHINGS:

i) The Bushings shall confirm to IS 2099/1973 specification for High Voltage bushings.

ii) For HV 12 KV class bushings shall be used and for LV 1.1 KV class bushings shall be used.

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

Voltage class	**Indian Standards**
1.1 KV	For porcelain parts IS-3347/Part-I/Sec.I/ for metal parts IS-3347/Part-I 1965/1967 Sec.2/1967
12 KV	IS-3347/Part-III/Sec.I/1972 IS-3347/Part-III/Sec.2/1967

iv) The terminal arrangement shall not require a separate oil chamber not connected to oil in the main tank.

v) HV bushings shall be fixed to the top cover of the transformer and the LV bushings shall be fixed to the transformer on sides and in the same plane. The bushing rods and nuts shall be of brass.

vi) The HV bushing shall not have arcing horns.

8. <u>TRANSFORMER TANK</u>:

8.1. The transformer tank **should be round** and made of good quality steel sheet of adequate thickness suitably stiffened to provide sturdy and robust construction to withstand extreme pressure conditions. The tank shall be capable of withstanding a pressure up to + 0.8 Kg./cm2 and –0.7kg/cm2 guage pressure without any deformation. Sealing on the transformer cover shall be achieved by providing a continuous (without break) oil resistant high quality Nitrile rubber gasket on the top of the tank rim and the cover shall be suitably clamped to provide a uniform pressure on the rubber seal.

8.2. The air plus the oil volume inside the tank shall be such that even under the extreme operating conditions, the pressure generated inside the tank does not exceed 0.45 kg/Cm2 positive or negative. There must be sufficient space from the core to the top cover to take care of oil expansion.

8.3. The tank cover shall have plasticised surface at the top to guard against bird faults. Alternatively suitable insulating shrouds shall be provided on the bushing terminals.

8.4. Thickness of the sheet of top & bottom portion of the tank should be 2.2 mm (min) and thickness of the side of the tank should be 2.5 mm (min)

9. <u>CORE AND WINDINGS & OIL</u>:

CORE MATERIAL: **CRGO M4 or better grade / Amorphous**.

9.1 Transformers core shall be stacked/wound core type construction using high quality CRGO steel core with heat resistant insulating coating/**Amorphous**. The core shall be properly stress relieved by annealing. The transformer shall be suitable for over fluxing (due to combined effect of voltage and frequency) up to 12.5% without injurious heating.

Only prime quality **CRGO M4 or better grade / Amorphous** sheets should be used in the transformers and no Second/Defective/Scrap **CRGO M4 or better grade / Amorphous** finds way into transformers. Therefore regarding quality control following documents are to be furnished along with bid documents.

1. Invoices of supplier
2. Mill's test certificate
3. Packing list.
4. Bill of landing
5. Bill of entry certificate by custom
6. Description of material, electrical analysis, Physical inspection, certificate for surface defects, thickness and width of the material.
7. Subjecting to at least 10% of the transformers to routine tests and no load and load loss measurement.

It is to note that, using seconds/defective CRGO sheets or load losses found to be more than stipulated limit, heavy penalty will be imposed or the suppliers will be black listed.

9.2 HV(wire) and LV (strips) windings shall be wound from : **DPC copper conductor/foil shall be used** (0.25mm for HV and 0.4mm for LV). **Current density for HV and LV should not be more than 2.5 A/Sq.mm for copper Conductor.** The windings shall be progressively wound in LV HV coil design for better voltage regulation and mechanical strength. The interlayer insulation shall be of resin bond paper. The type of winding shall be indicated in the tender whether LV windings are of conventional type or foil wound. The core/coil assembly shall be securely held in position to avoid any movement under short circuit conditions.

9.3 **OIL**: The insulating oil shall comply with the requirements of IS:335 (Latest version).

10 .SURFACE PREPARATION AND PAINTING

GENERAL

10.1.1. All paints shall be applied in accordance with the paint manufacturer's recommendations. Particular attention shall be paid to the following:

a) Proper storage to avoid exposure as well as extremes of temperature.
b) Surface preparation prior to painting.
c) Mixing and thinning
d) Application of paints and the recommended limit on time intervals between coats.
e) Shelf life for storage.

10.1.2 All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

10.1.3 All primers shall be well marked into the surface, particularly in areas where painting is evident, and the first priming coat shall be applied as soon as possible after clearing. The paint shall be applied by airless spray according to manufacturer's recommendations. However, where ever airless spray is not possible, conventional spray be used with prior approval of purchaser.

10.1.4 The Supplier shall, prior to protect nameplates, lettering gauges. Sight glasses, light fittings and similar such items.

10. 2 Cleaning and Surface preparation

10.2.1 After all machining, forming and welding has been completed, all steel work surfaces shall be thoroughly cleaned of rust, scale, welding slag or spatter and other contamination prior to any painting.

10.2.2 Steel surfaces shall be prepared by Sand / Shot blast cleaning or Chemical cleaning by Seven Tank process including Phosphating to the appropriate quality.

10.2.3 The pressure and volume of the compressed air supply for blast cleaning shall meet the work requirements and shall be sufficiently free from all water contamination to ensure that the cleaning process is not impaired.

10.2.4 Chipping, scraping and steel wire brushing using manual or power driven tools cannot remove firmly adherent mill-scale shall only be used where blast cleaning is impractical. Manufacturer to explain such areas in his technical offer clearly.

10.3. Protective Coating

As soon as all items have been cleaned and within 4 hours of the subsequent drying, they shall be given suitable anti-corrosion protection

10.4 .Paint Material

Followings are the types of paint that may be suitably used for the items to be painted at shop and supply of matching paint to site:

10.4.1. Oil resistant paint for inside surface.

10.4.2. For external surface one coat of Thermo Setting paint or 1 coat of Zinc chromate primer followed by 2 coats of Polyurethene base paint. These paints can be either air drying or stoving.

10.4.3. The color of the finishing coats shall be dark admiral gray conforming to No. 632 of IS – 5 of 1961.

10.5. Painting procedure

10.5.1. All painting shall be carried out in conformity with both specification and with the paint manufacturer's recommendation. All paints in any one particular system, whether shop or site applied, shall originate from one paint manufacturer.

10.5.2. Particular attention shall be paid to the manufacturer's instructions on storage, mixing, thinning and pot life. The paint shall only be applied in the manner detailed by the manufacturer e.g. brush, roller, conventional or airless spray and shall be applied under the manufacturer's recommended condition. Minimum and maximum time intervals between coats shall be closely followed.

10.5.3. All prepared steel surfaces should be primed before visible re-rusting occurs or within 4 hours, whichever is sooner. Chemical treated steel surfaces shall be primed as soon as the surface is dry and while the surface is till warm.

10.5.4. Where the quality of film is impaired by excess film thickness (wrinkling, mud cracking or general softness) the Supplier shall remove the unsatisfactory paint coating and apply another. As a general rule, dry film thickness should not exceed the specified minimum dry film thickness by more than 25%. In all instances where two or more coats of the same paint are specified, such coatings may or may not be of contrasting colours.

10.5.5. Paint applied to items that are not be painted shall be removed at supplier's expense, leaving the surface clean, unstained and undamaged.

10.6. Damaged paintwork

10.6.1. Any damage occurring to any part of a painting scheme shall be made good to the same standard of corrosion protection and appearance as that originally employed.

10.6.2. Any damaged paint work shall be made good as follows:

The damaged area, together with an area extending 25 mm around its boundary, shall be cleaned down to bare metal.

A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50 mm around the perimeter of the original damage.

The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

10.7 Dry Film Thickness

10.7.1 To the maximum extent practicable the coats shall be applied as a continuous film of uniform thickness and free of pores. Overspray, skips, runs, sags and drips should be avoided. The different coast may or may not be of the same colour.

10.7.2 Each coat of paint shall be allowed to harden before the next is applied as per manufacturer's recommendation.

10.7.3 Particular attention must be paid to full film thickness at edges.

10.7.4. The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as given below:

S.l.No.	Paint type	Area to be painted	No. of coats	Total Dry film thickness 9min.)
1	Thermo setting paint.	inside outside	01 01	20 microns 60 microns
2	**Liquid paint** Zinc chromate (primer) Polyurethene (Finish coat) Hot oil paint / Varnish	 outside outside inside	 01 02 01	 30 microns 25 microns each 35 / 10 microns

10.8. Tests

10.8.1 The painted surface shall be tested for paint thickness.

10.8.2 The painted surface shall pass the Cross Hatch Adhesion test, Salt spray test and hardness test as per the relevant ASTM standards.

NOTE: **S**upplier shall guarantee the painting performance requirement for a period of not less than 5 years

11. <u>BUSHING TERMINALS</u>: HV terminal shall be designed to directly receive ACSR conductor up to 7/2.59 mm (without requiring the use of lugs) and the LV terminals shall be suitable for directly receiving LT cables (aluminium) ranging from 10 mm sq. to 25 mm sq., both in vertical and horizontal position and the arrangements should be such as to avoid bimetallic corrosion.

12. <u>MOUNTING ARRANGEMENT</u>: The transformers shall be provided with two mounting lugs suitable for fixing the transformer to a single pole by means of 2 bolts of 20 mm dia.

13. <u>RATING AND TERMINALS PLATES</u>: There shall be a rating plate on the transformer containing the information specified in 15.2 of IS:2026/1977 (latest version). The HV winding terminals shall be marked IU/IU and IN/IN. The corresponding secondary terminal shall be marked as 2u and 2n.

The letters RGGVY or as specified by AP_PDCL should be clearly embossed

14. <u>PRESSURE RELEASE DEVICE</u>: The transformer shall be provided with suitable pressure release device to release pressure under fault conditions. Alternatively self/venting type of cover assembly shall be used to serve the above purpose.

15. FITTINGS:

The following standard fittings shall be provided:

a) Two earthing terminals
b) Two lifting lugs
c) Rating and terminal marking plates
d) Metal Oxide lightning Arrestor

16. <u>LIMITS OF TEMPERATURE RISE</u>: The temperature rise shall not exceed the limits of 40 deg.c (measured by resistance) for transformer windings and 35 Deg. C (Measured by thermometer) for transformer top oil temperature **rise 40 Deg.C when** tested in accordance with IS:2026 over and above the maximum ambient temperature mentioned in the specification.

17. LOSSES: The bidder should guarantee individual no-load loss and load loss without any positive tolerance. The bidder should also guarantee the total losses at 50% and 100% load condition (at rated voltage and frequency and at 75 0C without any positive tolerance).

KVA rating	**Voltage ratio**	**Max. Losses @ 50% load, Watts**	**Max. Losses @ 100% load, Watts**
16	**11000/ 250 V**	**100 W**	**250 W**

These losses are maximum allowable and there would not be any positive tolerance. No weightage in prices for offers with lower losses shall be given for these transformers.

Transformer with low losses will be preferred. Transformers with higher losses than the above specified losses would be rejected.

PENALTY FOR EXCESSIVE LOSSES: (During Guarantee period)

During testing, if it is found that the actual measured losses are more than the values as quoted by the bidder, penalty should 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.

18. IMPEDANCE: The recommended percentage impedance at 75 deg. C is 2.75 per cent with a tolerance as per IS-2026.

19. PROTECTION: The transformer shall have the following additional fittings as an integral part.

20.1 i) The transformer shall have the following CSP features.

INTERNAL HV FUSES ON THE HT SIDE OF TRANSFORMER: Specification for the HT Fuses: Expulsion/any other suitable fuse placed in series with the primary winding.

This fuse is mounted normally inside of the primary bushing and is connected to the high voltage winding through a terminal block. This has to protect that part of the electric distribution system which is a head of the distribution transformer from faults which occur inside the distribution transformer i.e. either in the windings or some other part of transformer. It shall be ensured that this fuse does not blow for faults on the secondary side (LT side) of the transformer i.e. the blowing characteristic of the fuse and LT break shall be so coordinated that the fuse shall not blow for any faults on the secondary side the transformer and these faults shall be cleared by the LT breaker only.

20.1 ii) INTERNALLY MOUNTED OIL IMMERSED LT BREAKER ON THE LV SIDE OF THE TRANSFORMER: LT circuit breakers: All LT faults after the breaker shall be cleared by this breaker. As such it shall be designed for perfect coordination with the HT fuse link. The supplier shall furnish the time/current characteristics of LT circuit breaker and 11 KV fuses for various current multiples. The two characteristics shall be drawn on the same sheet to indicate coordination between the circuit breaker and fuse. This shall be based on the type test carried out on one of the transformers. In addition, the supplier shall carry out coordination test as indicated above, and this forms one of the tests for acceptance.

The breaker is to be mounted on the secondary side of the transformer under oil to minimize premature operations from primary surges as would be with undersized line fuses. Two single pole elements is preferred. THE BREAKER SHALL BE COORDINATED THERRMALLY WITH THE TRANSFORMER RATING TO FOLLOW CLOSELY THE VARIATIONS OF COIL TEMPERATURE DUE TO FLUCTUATING LOADS AND AMBIENT TEMPERATURES.

This is to be accomplished by connecting the breakers in series between the secondary winding and the load current. The breaker shall loomed in the same oil as the core and coil assembly so that the bimetal are sensitive to the temperature of oil as well as the load current (offers with LV breakers of M.C.C.B type are not acceptable to the purchases).

The circuit breaker may be an electro-mechanical device with three main elements viz: (a) temperature sensing: (b) latching and tripping, and (c) current interrupting. The temperature sensing function might be accomplished through the used of bimetallic strips which would be built into the breaker, such that load current of the transformer flows through them. The circuit breaker shall be mounted inside of the transformer so that these bimetallic strip are within the top oil layer of the transformer. The latching and tripping functions of the circuit breaker may be carried out within an assembly parts similar to those used in industrial type air circuit breaker. The circuit breaker shall also be closed and opened manually standing on ground and with a magnetic trip device also. The current interruption element shall consist of copper current carrying parts plus a set of copper tungsten current interrupting contacts. The magnetic element shall increase the opening speed of the circuit breaker under high fault current conditions. The response of circuit breaker to the activity shall remain unchanged by the addition of the magnetic trip element. The specification to which the breakers confirm shall be indicated sides, a signal light, controlled by a bimetal in the breaker shall switch on when the transformer load reaches a predetermined level indicting that the transformer has been over-loaded and change out shall have to be scheduled without causing an unplanned service interruptions.

20.1. iii) LOAD MANAGEMENT SIGNAL LIGHT: The load management signal light shall perform two functions. It shall show visually when the particular transformer has been operating in an over load condition and shall provide knowledge that for good system management, the economical change out point for the transformer is fast approaching. The signal light need not indicate temporary over loads and shall turn on only when the over load condition has existed at a given level for a certain length of time.

The LT CSP circuit breaker shall have asset of auxiliary contacts built-in for signal light operation. These, normally open contact, shall form part of the signal light circuit. The signal light circuit shall consist of an auxiliary transformer winding (one or two turns) which generates about 4 V, for the signal light contact set within the circuit breaker, and the signal light is to be mounted on the transformer tank. The signal light contact set is mechanically connected to the main circuit breaker latching and bimetal system. The signal light mechanism is adjusted so that the signal light contacts will close at a pre-set thermal condition which occurs before the main latching system opens the main contact. The not result in a visual external indication that a pre-sel load condition has reached by the transformer. The signal light mechanism does not re-set it self when the load drops of, the signal light remains lighted once the signal light contract case and can only be turned off by manually operating the external circuit breaker handle.

20.2 11KV LIGHTNING ARRESTERS: High surge capacity 9 KV 5 KA lightning arrester conforming to IS:3070/1974 shall be mounted on the transformer, clamped securely to the tank, to protect the transformer and associated line equipment from the occasional high voltage surges resulting from lighting or switching operations. The

earthing terminal of the lightning arresters shall be connected solidly to the transformer tank earthing in terminal.

20.3 OVER LOAD CAPACITY: The tenderer should state clearly the per centage overload the transformer can take for a continuous period of one hour. The transformers shall be suitable for loading as per IS:6600/1972.

21. TESTS:

21.1. ROUTINE 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-II) and IS:2026 or as agreed upon between the purchaser and the manufacturer.

a) Measurement of winding resistance.
b) Measurement of voltage ratio and check of voltage vector relationship
c) Measurement of impedance voltage, short circuit impedance and load loss.
d) Measurement of no load loss and no load current.
e) Measurement of insulation resistance.
f) Induced over voltage withstand test.
g) Separate source voltage withstand test.
h) Air pressure Test: (routine test) The transformer tank with all the fittings including bushings in position shall be tested for leakage at a pressure of 0.8 kg./cm2 above atmospheric 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).

21.2 TYPE TESTS:

The Distribution Transformers shall be fully type tested by the bidder as per IS 2026 (Part-I) 1977 latest version including the type tests mentioned below. **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**. If the tenderer fails to send the type test certificates, AP_PDCL reserves the right to cancel the tender besides claiming the financial loss incurred /suffered for want of specified material.

1. Temperature rise tests
2. Impulse voltage test: For insulation level of 95KV.
3. Dielectric type tests.
4. Short Circuit Withstand test: Thermal and dynamic ability.
5. Air pressure test as per IS-1180/Part-II/1979.

21.3 The supplier shall furnish calculation in accordance with IS:2026 to demonstrate the thermal ability of the transformers to withstand short circuit.

21.4 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 manufacture would pay the challenge fee and challenger would get the fee refunded. However as redressal system the challenger would allowed toask 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 manufacture 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.

22. DRAWINGS & LITERATURES: a) Completely dimensioned drawings indicating general arrangement and details of fittings, clearances and winding details shall accompany the tender.
Drawings of internal constructional details, fixing details of the coils should also be indicated. Tank dimensions, position of terminal fittings, clearances between leads within the transformer, core area, grade of laminations, distance of core centers area of conductor bare and with insulation. No. of coils, No. of turns per coils material of busing metal parts etc., shall also be furnished with tender.

23. INSPECTION: All the tests and inspection shall be made at the place of manufacture unless otherwise specially agreed upon by the manufacturer and purchaser at the time of purchase. The manufacturer shall offer the inspector representing the purchaser all reasonable facilities, without charge, to satisfy him that the material is being furnished in accordance with this specification.

The purchaser has the right to have the tests carried out at his own cost by an independent agency whenever there is dispute regarding the quality of supply.

24. PACKING: Transformers shall be delivered suitably packed. Although the method of packing is left to the discretion of the manufacturer, it should be robust enough for rough handling that is occasioned during transportation by ship/rail/road.

25. GUARANTEED TECHNICAL PARTICULARS: The Guaranteed Technical Particulars of the transformers offered shall be given by the tenderer (as per Annexure-I)

26. SPARES: Tenderer shall quote separately for following spares:

i) H.T. Bushings ii) L.T. Bushings.

27. **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.

28.0 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 PARTICULARS FOR COMPLETELY SELF PROTECTED DISTRIBUTION TRANSFORMERS (COPPER)

Sl. No.	Description	Particulars 16 KVA
1	Name of the manufacturer and place of manufacturer and place of manufacturer	
2	Continuous max. rating as per this specification KVA	16 KVA
3	Normal ration transformer KV	11 KV /√3/250V
4	Method of connection HV/LV	Single Phase H.V. one end grounded
5	Max. current density in windings	
	a) Higher voltage Amps/sq.mm	**2.5** A/Sq.mm
	b) Lower voltage Amps/sq.mm	**2.5** A/Sq.mm
	Max. hot spot temp. deg.C (Ambient air temp. on which) above is based) Deg.C	100 **40**
7	**a) Max. observable oil temp. Deg.C (Ambient air temp. on which above is based- 40 Deg.C**	**85**
	b) Max. winding temperature at an ambient temperature of 40 Deg.C	**90**
8	Max. Losses @ 50% load, Watts	**100**
9	**Max. Losses @ 100% load, Watts**	**250**
10	Efficiency at normal voltage ratio at	
	i) Unity Power Factor: a) At 50% load % b) At 75% load % c) At full load %	Shall be furnished
	ii) 0.8 Power factor a) At 50% of load % b) At 75% load % c) At full load %	- do -
11	Regulation as percentage of normal voltage a) At unity power factor % b) At 0.8 Power factor lagging %	Shall be furnished
12	**Impedance voltage at normal ratio between HV & LV windings %**	**2.75%**
13	Type of transformers, shell or core	Shall be furnished
14	**Type of insulation used in** **a) HV windings** **b) LV windings**	**DPC** **DPC**
15	Type of insulation used in a) Core bolts b) Core bolt washers c) End plates d) Core lamination	Shall be furnished

16	**Impulse test voltage level** **HV Windings** **LV Windings**	**60 KV**
17	Characteristics of transformer oil	As per IS-335 latest version
18	**Total content of oil litres**	**66**
19	Whether transformer will be transported with oil?	- yes -
20	Type of transformer tank	- M.S. Circular -
21	Approx. overall dimensions a) Height mm b)Breadth mm c)Length d) Tolerance %	Shall be furnished ± 5%
22	Weight of insulated conductor a) HV (min.) Kg. b) LV Kg.	Shall be furnished
23	Weight of core (Min.) Kg.	Shall be furnished
24	Weight of complete transformer arranged for transport Kg.	Shall be furnished
25	Resistance for winding at 75 deg. C per phase a) H.V. Ohms b) L.V. Ohms	Shall be furnished
26	Resistance at rated current & frequency a) HV Ohms b) LV Ohms	Shall be furnished

27	Bushing characteristics			
	Normal Voltage Rating of bushings	**Dry withstand (KV)**	**Wet withstand (KV)**	**Impulse flashover (KV)**
	12 KV	**28**	**28**	**95**
	1 KV	**5**	**5**	**-**

28	**Material of bushing rod and nuts & KV**	**Brass**
	Bushing caps LV	**Brass**
29	Make, type and technical details of LV Breakers	Shall be furnished
30	Make and rating of L.A.S.	Shall be furnished
31	Make, ratings and type of H.T. fuses	Shall be furnished

ANNEXURE – II

ADDITIONAL DETILS

01. Core grade :
02. Core diameter/size min :
03. Gross Core area cm :
04. Net core area cm :
05. Flux Density Tesla :
06. Wt. Off the core :
07. Loss per Kg. of Core at the specified): Flux Density
08. Core window height :
09. Centre to Centre distance of the core :
10. No. of L.V. Turns :
11. No. of HV conductor bare/covered mm) :
12. Size of L.V. conductor bare/covered mm):
13. Size of H.V. conductor bare/covered mm):
14. No. of parallels :
15. Current density of L.V. winding Amps/mm2):
16. Current density of H.V. winding Amps/mm2):
17. Wt. Of the LV winding Aluminium for Transformers KG. :
18. Wt. Of the HV winding Aluminium for Transformers Kg.
19. No. of LV coils / phase :
20. No. of HV coils / phase :
21. Height of LV winding mm :
22. Height of HV winding mm :
23. ID/OD of LV winding mm :
24. ID/OD of HV winding mm :
25. Size of the duct in LV winding mm :
26. Size of the duct in HV winding mm :
27. Size of the duct between HV & LV mm :
28. HV winding to LV clearance mm :
29. HV winding to tank clearance mm :
30. Calculated impedance % :
31. HV to earth creepage distance :
32. LV to earth creepage distance :

SECTION – III

SOURCE OF MATERIALS/PLACES OF MANUFACTURER TESTING AND INSPECTION

Sl.No.	Item	Source of Material	Place of manufacture	Place of testing and inspection
1	Lamination			
2	Aluminium			
3	Core Plates			
4	Steel Castings/Sections			
5	Tank			
6	LT Circuit Breaker			
7	Insulating Cylinders			
8	HT Fuse links			
9	Bushing HV/LV			
10	Oil			
11	Insulated winding wire			
12	LA's			

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