

ODISHA TRANSMISSION CORPORATION LIMITED



TECHNICAL SPECIFICATION FOR 250 KVA, 33/0.433 KV STATION TRANSFORMER

TECHNICAL SPECIFICATION FOR 250 KVA, 33/0.433 KV STATION TRANSFORMER

1. **TYPE:** The Transformers shall be of the outdoor core type double wound oil immersed self cooled type 'ON' and conform to ISS 1183/1964 and 2026/1977 with up-to-date amendments.

All the transformers shall be suitable for operation in humid atmosphere in the tropical place with ambient temperature ranging from 50° to 60°C.

2. **STANDARD:** The transformers shall comply with ISS 2026/1977, 1183/1964 & the latest version thereon & CBIP standards with Class-A materials specified therein and should be designed taking ambient temp. as 50° C.

3. **RATING:** The transformer shall have core type copper wound construction, oil immersed 'ON' suitable for out-door service as a step down transformer. The rating and electrical characteristics of the transformers shall be as follows:

SI No	Description	Specification
I	Frequency	50 Hz \pm 5%
II	Continuous rating	250 KVA
III	Rated HT/LT voltage	33/0.433 KV
IV	Number of phase	3 phases
V	Connection HT	Delta
VI	Connection LT	Star
VII	Vector group	Dyn –11
VIII	Taps	-5% to +7.5% in steps 2.5% in high voltage side
IX	Percentage impedance at Continuous maximum Rating at 75° C	+5% (Minimum) (No negative tolerance is allowed)
X	Terminal connection	Bimetallic clamp suitable for ACSR conductor as per system requirement.
XI	1.1 Maximum flux density at normal BIL Voltage & normal frequency 1.4 Tesla	170 KVP
XII	Type tap changer for transformer	Rotary type, off load control tap changing gear.

4. The primary-winding shall be connected Delta and secondary winding star as per vector symbol Dyn-II (IS:2026/1977). The terminal arrangement shall be out door bushing suitable for bare ACSR – Twin Zebra conductors for 33 KV side and to suit 3 ½ x300 mm² armoured PVC cable with cable end box for 433volt side.

The temperature rise should not exceed the limits stated in relevant standards. The transformer shall be capable of withstanding thermal and mechanical effects, of a short circuit on the terminals of any winding with full voltage maintained on other windings for duration of at least five seconds.

5. INSULATION:

5.1 The electric strength of the winding insulation and of bushings shall conform to the values given in the IS:2026/1977.

5.2 For rated system voltage of 33 kV the impulse test voltage is 170 kV (Peak).

5.3 All windings of the transformer shall have uniform insulations.

6. VOLTAGE RATIO

- 6.1 The transformers shall be for the rated kV specified on the HV side and on the LV side.
- 6.2 The insulation and magnetic circuit shall be suitable for working continuously at 10% in excess of the normal voltage and at the same time at a frequency of 3% below the normal.

7. CURRENT DENSITY

The current density in windings shall be kept within 2.4 A/sq.mm.

8. FLUX DENSITY

The maximum induction with maximum system voltage i.e. 36 kV & frequency, and the type of steel used for core laminations should be stated in the tender. Flux density at maximum system voltage i.e. 36 kV and lowest frequency 48.5 C/S shall not exceed 1.6 Tesla.

9. FREQUENCY

The transformers shall be suitable for continuous operation with a frequency variation of plus or minus 3% from the normal frequency of 50 Hz without exceeding the temperature rise specified in clause – 17.

10. TERMINAL ARRANGEMENTS

HT side–Bimetallic clamp type, suitable for ACSR conductor as per requirement and layout.

LT side – cable connection, 3 ½ x 300 mm² armoured PVC aluminium cable. The neutral of the star end brought to a separate insulation terminal for earthing purpose.

11. TAPPINGS

Tappings range shall be 12.5% in steps of 2.5% and it shall be off load type with local control. The taps shall provide for voltage adjustment on the high voltage side from –5% to +7.5% of the rated voltage, the tapplings being located on higher voltage winding.

The transformer shall be so designed that the temperature rise is maintained within limits, specified in relevant standards when operated at full output or constant primary service voltage on any primary tapplings irrespective of the tapping corresponding to the service voltage.

An externally operated off circuit tapping switch shall be provided to enable changing of taps without removing the transformer cover or lowering of the oil level. The transformer shall give full rated KVA output of each winding at all the taps.

The switch mechanism shall be so designed as to prevent the entry of moisture into the tank. The design of the switch mechanism shall ensure that the switches are making full contact and then only it shall be possible to look the operating mechanism. The tap mechanism shall be provided with a locking device.

12. BUSHING TERMINALS

All main winding and neutral leads shall be brought out through outdoor type bushing suitable for bare copper or ACSR conductors for 33 kV side and to suit for 3 ½ x 300 mm² armoured PVC cable for 433 volt side & so located that the full flash over strength will be utilized.

Each bushing shall be so coordinated with the transformer insulation that all flashovers will occur outside the tank. The porcelain used for the bushings shall be of the wet processed type, homogenous and free from cavities or other defects. The glaze of the porcelain parts shall be uniform in colour and free of blisters, burns and other defects.

The bushings should conform to IS:2099/73 and with 3347(Part-I & II Section – 1 & 2) with it's latest amendments.

13. FLASHOVER CHARACTERISTICS OF BUSHINGS

The spacing between the bushings must be adequate to prevent flash over between phases under all condition of operation. Special adjustable coordinating gaps should be provided on the high-tension terminals and the gap setting adjusted with reference to the impulse coordination of the system. The tenderer is requested to give the guaranteed withstand voltage for the impulse and flash over values of the bushings.

14. SUPPRESSION OF HARMONNICS

The transformers shall be designed with particular attention for suppression of harmonic voltages especially the 3rd and 5th so as to eliminate wave form distortion and any possibility of high frequency distortion and any possibility of high frequency disturbances, inductive factor or of circulating current between neutral point at the different transformer station reaching such a magnitude as to cause, interference with post office or other communication circuits.

15. CENTRE OF GRAVITY

The center of gravity of the assembled transformer shall be low and as near the vertical centerline as possible. The transformer shall be stable with or without oil. If the center of gravity is eccentric to the vertical line either with or without oil, its location shall be shown on the outline drawing.

16. VIBRATIONS AND NOISE

The transformers shall operate without undue vibration and noise and shall comply with NEMA publication – TR – 1.

17. TEMPERATURE RISE

Each transformer shall be capable of operating continuously at this normal rating without exceeding temperature rise limits as specified below:

- (i) Winding 55°C by resistance measurement.
- (ii) Top oil 50°C by thermometer measurement.

The above limits are with an ambient temperature of 50° maximum. All transformers shall comply with requirement of IS:2026/77 & it's latest amendments as regard the rating and temperature rise.

18. EFFICIENCY

The efficiencies of the transformer corresponding to 25%, 50%, 75%, 100% and 125% load may be specified. Maximum efficiency should occur at 50% load.

19. PERCENTAGE IMPEDENCE

The transformer offered must be designed for a minimum impedance of +5% at 75° C. No negative tolerance on impedance is allowed.

20. LOSSES

The no load & load losses shall not exceed the values given in the following table.

RATINGS	NO LOSS WATTS	LOAD IN	LOAD LOSS IN WATTS AT 75DEGREE C AT NORMAL TAP	PERCENTAGE IMPEDANCE AT 75 DEGREE C AT NORMAL TAP
250 KVA (Copper wound)	620		3700	5 (Minimum)

The above losses are maximum allowable losses & there shall not be any + ve tolerance on the losses for the transformers. Bid evaluation will be done taking in to consideration the quoted no load & load loss figures. The purchaser reserves the right to reject the whole lot of supply in case the loss figures exceed the limit given in above table at the time of testing.

21. PARALLEL OPERATION

The transformers with similar connection shall be capable of operating in parallel on corresponding taps and of sharing loads in proportion to their ratings subject to the tolerances of impedance.

22. WINDING AND INSULATION

All permanent current carrying joints shall be welded or brazed.

All threaded connections shall be provided with locking facilities.

The assembled core and coils shall be properly dried before impregnation. The process of impregnation should be stated.

All leads from the winding shall be rigidly supported to prevent injure isolation due to vibration. Flexible tubes shall be used where practicable.

- The HT and L T winding of all transformers shall be of the fully insulated type.
- (a) Special attention should be given to provisions of adequate insulation and clearances between HT and LT windings and live parts must be adequate for normal voltage of operation plus 10%.

- (b) The end turn insulation of the transformers shall in conformity with latest practice.
- (c) Windings shall be circular and concentric with the HT windings on the outside. All similar coils shall be inter changeable.
- (d) The insulation of the transformer winding and connection shall be free from insulating compound which may so often coagulate shrink or collapse during service. None of the materials used shall shrink, disintegrate, carbonized or become brittle under the action of hot oil when the transformer is operated continuously with the conductors at any temperature which may be reached at the specified loading conditions.

The finished width of any oil ducts shall be such and the clamping arrangement shall be so designed as not to impede the free circulation of oil through the ducts.

23. BRACING OF WINDINGS

Windings connections and tapings of the transformers shall be braced to withstand the shocks, which may occur during transport and during service due to short circuit, switching or other transient condition. No mechanical movement of coils shall be possible with dead short circuit on either side of the transformer. The short circuit rating shall be as per Clause 9.1 ISS: 2026/1977.

24. MAGNETIC CIRCUITS

The transformers core shall be of high grade non-ageing, electrical silicon steel cold-rolled laminations each coated with hot oil proof, lead enamel insulation clamped together firmly to the frame to ensure even pressure over the whole of the core laminations and to prevent undue vibration and noise. After being sheared the laminations shall be treated to remove all burns and shall be re-annealed to remove all strains.

Paper or varnish insulation shall not be accepted. The joints in the core shall be inter leaved and in no account will 'Butt Joints' be accepted. Suitable axial cooling ducts suitable proportioned to prevent excessive temperature rise must be provided to ensure, free circulation of oil and efficient cooling of the core. The clamping structure shall be so constructed with MS Channels, and insulated bolts and so designed that eddy currents is minimum and hood must not be used for the purpose. The core shall be designed and build up in such a manner as to avoid accidental or slow development of short circuit plates through iron and frame.

The core and coils shall be so fixed in the tank that their shifting will not occur when the transformer is moved.

Means shall be provided for earthing the core and framework at one point only.

25. TRANSFORMER TANK

The tank and cover of each transformer shall be of welded boilerplate with suitable stiffeners so constructed that all joints are hot oil tight and bulging does not occur in service. The tank shall be so designed that with the minimum dismantling necessary, the core and winding can be lifted free of the case. External lugs or eyes for lifting the core or windings shall be provided. Ample space shall be provided with an appropriate arrangement of things, suitable for lifting transformer core with winding. The tank shall be fitted with a substantial under carriage and provided with rollers.

26. OIL

Sufficient quantity of oil shall be supplied with each transformer for filling each tank, bushing and conservator to the proper level. The oil shall be in accordance with IS No.335/1972 & it's latest amendments. Oil test certificates shall be furnished at the time of inspection of transformers in support of the use of new unused oil conforming to IS 335 in the transformer.

27. EARTHINGS

The core and tank cover shall be earthed to the tanks by means of copper connection capable of carrying for 30 seconds without injury and over loading with earth fault current not less than full load current of the main transformer. In no case shall the cross sectional area be less than 0.1 sq. inch. Two earthing terminal shall be provided suitable for No 7 SGW bare copper wire with suitable soldering lugs.

28. TANK FITTINGS AND ACCESSORIES

The standard fittings to be provided on each transformer in line with manufacturers practice may be provided including the following:

- a) Oil conservator of sufficient capacity to prevent inadvertent operation of Buchholz relay where used and shall be provided with drain plug/valve oil gauge, with a mark to indicate oil level at a temperature of 50° C filling cap. Silica Gel dehydrating breather to contain minimum 0.5 kg dehydrated silicagel.
- b) Explosion Vent
- c) A safety valve of chimney type shall be provided. The bottom of the safety valve pipe shall project into the tank.
- d) Glass Type Thermometer- Mercury in glass type thermometer mounted on the top of the transformer to read the temperature in the hottest part of the oil.
- e) Drain Valve-1" (15mm) drain valve cum lower filter valve suitable for connection to the flange of the same diameter. The valve should be fitted with an adopter for 16 mm hose for filtering purposes. The valve shall be located so as to enable with drain out of the oil from the tank. This valve shall be equipped with a small sampling cock.
 - i) Earthing terminal and numbers.
 - ii) Air relief vent.
 - iii) Rating and diagram plate
- f) The rating plate should bear the data specified in the proper clauses of ISS-2026/1977. The diagram plate should also show the internal connection and so the voltage vector relationship of the several windings in accordance with ISS:2026/1977 and in addition a plan view of the transformer giving accurate physical relationship with the terminals.
- g) Oil filter valve- The oil filter valves should be fitted with adopter for 16 mm hose. These valves are for oil filtration and for draining of oil for sample and test purpose.
- h) Joint and Gaskets- All joints in the transformer and auxiliary equipment shall be made in such a manner as to prevent ingress of moisture of leakage of oil.

- (i) Arcing horn with each HT bushings.
- (ii) Pad lock for tap changing switch.

Accessory equipment not specifically listed above but normally regarded as standard shall be provided in accordance with relevant clauses of ISS:2026 /1977 & CBIP practice.

29. PACKAGE

The packing may be in accordance with the manufacture's standard practice. The bushings shall be packed and dispatched separately. Full details of packing for approval of the purchaser should be given. The package shall be such to satisfy the conditions of transport by rail and road to existing place where the transformer is to be erected and also be suitable for rough handling.

30. PAINTING

Before dispatch all steel work not under oil shall be painted with a primary coat of anti-corrosive paint of durable nature and one coat of final finishing paint. The transformers shall be painted with heat resisting dark grey paint sand blast painting will be preferred.

15 TESTS

The transformers shall be subjected to stage inspection of core, windings, tanks and fittings before the final inspection. Test certificates from manufacturer for core, conductors, oil, mild steel used for tanks, insulations and etc. shall be furnished to the purchaser before calling for stage inspection. After the successful stage inspection, final inspection will be carried out as per the attached Appendix 'A' & in accordance with Indian Standard Specification No. 2026/1977 at Manufacturer's works before dispatch to site.

The purchaser reserves the right of having other reasonable tests carried out at his own expenses either before dispatch or at site to ensure that transformer complies with the requirement of the specification. The test certificates (for both stage inspection & final inspection, tests) in triplicate shall be submitted as soon as the tests are completed for approval.

15.1 Before calling for final inspection, the supplier shall furnish the factory test results (routine and additional routine test results) of the offered transformer along with list of equipment used during testing with serial number, make, class of accuracy, the valid calibration certificates of the equipments/instruments used during testing to the owner for owner's information and reference. On verification of the test results, measuring instruments & calibration certificates, the owner may direct the contractor for use of better equipments/meters during inspection/testing.

16 TEST REPORT

After all tests have been completed seven certificated copies of each test report shall be furnished. Each report shall supply the following information.

- i) Complete identification data including serial number of the transformer.

- ii) Method of application where applied, duration and interpretation of the results for each test.
- iii) Temperature data corrected to 75 °C including ambient temperature.

Type test.

16.1.1 Temperature rise test

16.1.2 Oil Leakage & Pressure Test:- The transformer tanks shall be subjected to a pressure equal to the normal pressure + 35 KN/m² measured at the base of the tank. Pressure shall be maintained for a period of 12 hours for oil during oil leakage test and 1 hour for air during Pressure test on the Tank where there shall not be any leakage.

In addition to the routine tests, the type and special test certificates for the tests as indicated below, conducted by the supplier on proto type of transformers of identical design at CPRI or any Govt. approved laboratory within the last 5(five) years from the date of opening of this. CPRI/Govt. approved laboratory test certificate along with CPRI/Govt. approved laboratory drgs (Internal and external drgs.) must accompany along with the drawings for approval.

Type & Special Tests

1. Impulse Voltage withstand test
2. Temperature rise test
3. Short Circuit Test.

The test results of CPRI tested transformer should confirm with the technical particulars as stipulated in this specification .The bidder shall indicate the values of resistance , stray loss, %Impedance, % regulation, no load losses, load losses at rated output , voltage & frequency along with the drawing submitted for approval. These values will be guaranteed **MAXIMUM VALUES.**

iii) The losses shall be measured during routine tests. If losses will be arrived outside the limits of the guaranteed losses as quoted by the bidder in the Guaranteed technical particulars but will remain within the losses as stipulated.

The successful bidder will be penalized at the above rates for any loss in excess of the values stated in the bid considering iron & copper losses separately. No bonus shall be payable for the losses which are less than those stated in the bid.

iv) Also on testing if any of the test results do not match with the values given in the guaranteed technical particulars & as per technical specification, the owner reserves the right to reject the transformer or free to take any other decision.

v) The owner also reserves the right to retain the rejected transformer & take in to service until the supplier replaces it with a new transformer at no extra cost.

The tenderer shall give the guaranteed technical particulars required as indicated in Vol-II-A along with the drawing for approval.

The tenderer shall submit the detailed dimensional drawing, short circuit , impulse & temperature rise test reports conducted in a govt. approved laboratory for the

transformer offered along with the offer ,failing which the offer will not be considered.

17. REJECTION

The transformer may be rejected at the discretion of the purchaser if the test results are not satisfactory and tolerances are exceeded.

The supplier should guarantee for after sales service for minimum period of one and half years from the date of receipt of the equipment in complete shape or one year from the date of commissioning of the equipment whichever is earlier.

The supplier also should guarantee after sales services beyond the free service period as stipulated in.

The supplier also should provide after sales services within 15 days of receipt of intimation from the field engineer in charge of the equipment.

APPENDIX – A

TESTS

Routine & type tests are to be conducted at the manufacturer's factory as per IS: 2026/1977 & as indicated below, in presence of purchaser's representative. Routine and type test certificates are to be submitted in support of the tests conducted successfully, after which dispatch clearance will only be issued. Type tests as indicated below will only be conducted on one transformer of each rating.

1. Routine Test

All transformers shall be subjected to routine tests at the manufacturer's works. The tests shall comprise as per the followings:-

- a) Measurement of winding resistance at normal & extreme taps.
- b) Ratio, polarity and phase relationship & vector group test..
- c) Impedance voltage / short circuit impedance at the normal tap & extreme taps.
- d) Measurement of load loss and neutral unbalance current

This test shall be a carried out with three wattmeter's method with low power factor wattmeter low range Ammeters and phase sequence meters. The measurement shall be made at 100% rated current & rated frequency, but in no case not less than 80% current of the rated current (Principal tapping) or tapping current (in case of extreme taps). Load loss measurement to be done on the normal tap (rated voltage tap) and extreme taps.

- e) Measurement of no- load loss and no load current.

This test to be carried out with 3 wattmeter method by using low power factor watt-meters, 3 power factor meters, phase sequence meters, three low range ammeters and three each average value and RMS value voltmeters. The test voltage from 10% voltage to 121% voltage shall be applied and currents, voltages (Average value and RMS value), wattmeter, power factor and frequency meter readings in all the 3 phases to be recorded

during the test. A voltage (RMS) vrs Measured current graph shall be plotted by the supplier and handed over it to the purchaser for analysis.

During the test, supplier's own generator set shall be used for feeding the rated voltage at rated frequency. If the applied frequency is greater than the rated frequency, then proportionate voltage to the rated frequency will be fed during the test and following frequency correction formula along with the formula given in Clause 16.5 IS:2026(Part-I) shall be used.

$$K = 0.5/f + 0.5 (f/f_1)^2$$

Where f = rated frequency & f_1 = applied frequency.

For example: - If measured loss = x , correction factor due to rms & Average voltage as per ISS = k_1 , and frequency correction factor = k . Then corrected loss will be calculated as = measured loss $x \cdot k_1 \cdot k$.

If applied frequency is less than the rated frequency, then no frequency correction formula will be applied. Rated voltage at that frequency will be fed during the test.

- f) Insulation resistance Test by motorized megger. Insulation resistance values to be taken at 1 minute & at 10 minutes intervals. Ratio of insulation resistance taken at 10 minutes and at 1 minute should not be less than 1.5.
- g) Induced over voltage withstand.
- h) Separate sources voltage withstands.
- i) Magnetic balance test
- j) Oil BDV Test
- k) Oil Leakage Test
- l) Measurement of dimensions & etc.

18.0 Following are the list of annexures enclosed with this technical specification.

1. Annexure-1 --- Schedule of technical particulars (to be furnished by the manufacturer)
2. Annexure-II--- Format for stage Inspection
3. Annexure-III--- Quality & Delivery schedule
4. Annexure-IV--- Calibration status of testing Equipment (To be furnished by the manufacturer)
5. Annexure-V---- Check list towards type test reports(To be furnished by the manufacturer)
6. Annexure-VI--- Check list for delivery schedule(To be furnished by the manufacturer)

ANNEXURE-I.

APPENDIX-I.

SCHEDULE OF TECHNICAL PARTICULARS TO BE FURNISHED BY THE MANUFACTURER CONFIRMING TO THE TRANSFORMERS PASSED C.P.R.I TYPE TEST, IN RESPECT OF IMPULSE HIGH VOLTAGE SHORT CIRCUIT CURRENT, TEMPERATURE RISE TEST AND OTHER DESIGN DATA.

STANDARD FORM OF GUARANTEED TECHNICAL PARTICULARS:-

1. **Name of the manufacturer.**
2. **Service.**
3. **KVA Rating:-**
 - a) H.V. Winding. KVA
 - b) L.V. Winding. KVA
4. **Highest system voltage/Nominal voltage.**
 - a) H.V. Winding. KV
 - b) L.V. Winding. KV
5. **Rated frequency.** Hz
6. **Number of phases.**
7. **Connections:-**
 - a) H.V. Winding.
 - b) L.V. Winding.
8. **Connection symbol (See IS: 2026 (Part-IV-1977)).**
9. **Tappings:-**
 - a) Range
 - b) Number of steps for high voltages variation.
10. **Reference ambient temperature:-**
 - a) Maximum ambient air/temperature. °C.
 - b) Maximum daily average ambient air temperature. °C.
 - c) Maximum yearly average ambient air temperature. °C.
 - d) Minimum ambient air temperature. °C.
 - e) Maximum cooling water temperature. °C.
11. **Type of cooling (See IS-2026 (Part-II)/1977.)**
12. **Temperature rise (See 2026 (Part-II)/1977)**

- a) Temperature of oil °C.
b) Winding. °C.
13. i) Total loss at rated nominal voltage at normal tap & rated frequency. KW
ii) Stray loss at 75°C.
iii) % Regulation.
14. (A) Component losses.
a) No-load loss at rated nominal voltage and normal frequency. KW
b) Load loss at rated current and rated frequency at normal tapping at 75°C. & at extreme taps.
- (B) Resistance at normal tap & at 75°C.
i) H.V.
ii) L.V.
15. Impedance voltage & percentage Impedance at full rated current at 75°C. for the
a) Normal tap.
b) Lowest tap position
c) Highest tap position.
16. Reactance at rated current and rated frequency. Percentage.
- i) No load current at rated nominal voltage and rated frequency and at 50%, 75%, 100%, 110% & 121% voltage & at rated frequency.
18. Insulation level (See IS-2026 (Part-III/1977)).
a) Separate source power frequency voltage withstand
i) H.V. Winding KV rms.
ii) L.V. Winding. KV rms.
b) Induced over voltage withstand.
i) H.V. Winding. KV rms.
ii) L.V. Winding. KV rms.
c) Full wave lightning impulse withstand voltage with time vrs. peak voltage characteristic curves.
i) H.V. Winding. KV Peak.
ii) L.V. Winding. KV Peak.
d) P.I. value.
19. Efficiencies at 75°C at unity power factor.
a) At full load. Percent
b) At $\frac{3}{4}$ full load -do-
c) At $\frac{1}{2}$ full load -do-
d) At 120% of full load.

20. Regulation at full load at 75°C
- a) At unity power factor. -do-
- b) At 0.8 power factor loading & lagging. -do-
21. Equipment for ONAN cooling.
- a) State.
- i) No. of Radiators on main tank.
- ii) Make & type
- iii) Total radiating surface
- iv) Thickness of radiator fins
- v) Clear distance between fins
- vi) Width of radiator fins
22. Number of coolers or cooler banks per transformer
23. Rating of each cooler or cooler bank.
24. Terminal arrangement.
- a) High voltage.
- b) Low voltage.
- c) Neutral.
25. Approximate masses:-
- a) Core Kg.
- b) Winding. Kg.
- c) Tank, fittings & accessories. (Name of accessories to be mentioned). Kg.
- d) Oil. Kg.
- e) Core coil assembly Kg.
- f) radiators Kg.
- g) Total mass Kg.
26. a) Approximate quantity of oil required for first filling. Ltrs.
- b) Name of the manufacturer of oil used
27. Approximate tank dimensions for over all dimensions.
- a) Length mm
- b) Breadth. mm
- c) Height. mm
- d) Thickness of main tank cover plate, side & bottom plate. mm
- e) Tank inside & outside dimension. mm
- Length/breadth/height. No. of tubes in each radiator. Tube length in copper, thickness & dia. Each side tubes (Nos.).

28. Despatch details.
- a) Approximate mass of heaviest package. Kg.
- b) Approximate dimensions of largest package.
- i) Length. mm
- ii) Breadth. mm
- iii) Height. mm
29. Un-tanking height. mm
30. Additional technical particulars.
- i) (a) i. Maximum flux density at highest system voltage & 48.5 c/s frequency. Tesla or Wo/m².
- ii) Maximum flux density at rated system voltage & rated frequency.
- (b) Maximum current density in windings. Amps/Sq.Cm
- (c) Size of conductor used. HV/LV
- High voltage.
- Low voltage.
- ii) Efficiency at 75°C and 0.8 P.F. lagging
- At full load. Percent.
- At $\frac{3}{4}$ full load -do-
- At $\frac{1}{2}$ full load -do-
- Over loading capacity & efficiency.
- iii) Load at which maximum efficiency occurs. -do-
- iv) Maximum efficiency. Percent.
- v) Impulse level with 1/50 Micro.S. Wave.
- High voltage KV
- Low voltage KV
- vi) No-load loss at 110% rated nominal voltage and rated frequency. KV
- vii) No load current at 110% & 121% of nominal voltage & rated frequency. Percentage.
- viii) Type of winding.
- High voltage.
- Low voltage.
- No. of turns of H.V.
- No. of turns of L.V.
- ix) Insulation materials.
- Turn insulation high voltage.
- Turn insulation low voltage.
- Insulation core to low voltage.
- Insulation high voltage to low voltage.
- x) Clearance:-
- Minimum clearance between phases.
- a) In oil. mm
- b) Out of oil. mm
- Maximum clearance high voltage to tank in oil. mm
- Minimum clearance high voltage to

earth in oil. mm
 xi) Minimum clearance height for lifting core & windings from rank. mm.

31. CORE :-

- (i) Core materials used. (grade & thickness).
- (ii) Loss in watts/Kg. of core materials corresponding to desired flux densities. (Watts/Kg. curve to be furnished along with the bid).
- (iii) EMF per turn
- (iv) Core circumcircle dia (d).
- (v) No. of core bolt holes per phase.
- (vi) Dia of each core bolt holes in mm.
- (vii) Net iron section (cm²). Limb/Yoke.
- (viii) Weight (Kg.)
- (ix) Total GI (Kg.)
- (x) Total (KW).

No. of steps.	1	2	3	4
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Stack in mm.

Width of core in mm.

Stacking factor of core.

32.(a) WINDING :-

	LV	HV	HV regulating.
Current per phase (Amp.)			
conductor bare (mm)			
No. of conductor insulation (mm).			
Conductor section (mm ²)			
Current density (A/mm ²)			
Turns per phase (T).			
Coils per limb.			
Arranged.			
Turns per coil.			
Turns per layer.			
Layers per coil.			
Winding depth.			
Coil dia inside.			
Coil dia outside.			
Length of mean turns.			
Resistance at 75°C,			
Total I ² R including stray at 75°C,			
Weight of copper with/without insulations.			

- (b) Radiators provided (Nos.).
- No. of fins provided.

Radiator size in mm (Length x wide x fin Nos.)
 Loss to be dissipated by Radiators in KW.
 Dissipation per fin at 50°C.
 Thermal head in mm.
 Radiator area.

33. Oil data:-
1. Quantity for first filling. Ltr.
 2. Grade of oil used.
 3. Maker's name.
 4. BOV at the time of filling.
 5. Type of oil.
34. Make of breather and type with capacity of silica gal filled in grams.
35. Inter layer insulation provided in design for:-
1. Top and bottom layer. mm
 2. In between all layers. mm
 3. Details of insulation. mm
 4. Whether wedges are provided at 50% turns of the coil.
36. Insulation materials.
- a) For conductors. H.V.
 - b) For core. L.V.
37. Particulars of bushings:-
1. Maker's name.
 2. Type IS-3347/IS-1180.
 3. Rating as per I.S.
 4. Dry flash over voltage KV
 5. We flash over voltage KV.
38. I.R. value at 30°C.
 HV/E
 LV/E
 HV/LV
39. Polarisation Index :-
 Measurement of Insulation resistance at 10 minutes/1 minute.

 HV/E.
 LV/E.
 HV/LV.

Bidders Name:-

Signature :-
 Designation :-
 Date:-
 Authorised common rubber seal.
 (Certificate against authorization for signature of the bidding document)
 to be furnished.

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ANNEXURE-II

FORMAT FOR STAGE INSPECTION

Sl. No		L.V.	HV
A	WINDING		
1.	Conductor Bare mm		
2.	Conductor Insulated (mm)		
3.	Type of Conductor Insulation		
4.	No. of Conductor in parallel.		
5.	Base Conductor in parallel.		
6.	Current density (A/mm ²)		
7.	Rated volts per phase (volts).		
8.	Turns per phase (T)		
9.	Type of winding.		
10.	No. of discs (Nos.)		
11.	No. of turns/disc.		
12.	Inside diameter (mm)		
13.	Outside diameter ((mm)		
14.	Winding depth (mm)		
15.	Winding Length (mm)		
16.	Gap between disc (mm)		
17.	No. of spacers in one circle.		
18.	Size of the spacer (mm)		
19.	Length of mean turn in meter.		
20.	Weight of winding (Kg/each) (Weight of winding includes the weight of insulated conductor, spacers, runner & other insulations as has been complete required to make the windings).		
B.	INSULATION.		
1.	Between core & L.V. Winding (Details like thickness (mm), length(mm) type of insulation etc. to be mentioned).		
2.	Between H.V. & L.V. Winding (Details like thickness (mm), length (mm), type of insulation etc. to be mentioned).		
3.	Between H.V. & L.V. & Stabilising (Tertiary) Winding (Details like thickness (mm), length (mm), type of insulation etc to be mentioned).		
4.	Between windings to top yoke (Details as		

	above to be mentioned) .		
5.	Between windings to top yoke (Details as above to be mentioned) .		

C	CORE				
1.	Core Diameter in mm=				
2.	Window Height in mm=				
3.	Distance between core leg center in mm=				
4.	Widths of window in mm=				

5.0 OTHER PARAMETERS OF CORE:-

No. of steps	1	2	3	4	5	6	7	8 etc.
Width in mm								
Stack in mm								
Sectional area of stack.								

6. Total gross cross sectional area of the core in mm=
7. Net core iron area=gross C/S area x 0.97
8. Maximum flux density (Bm) in Wb/sq.mm=
9. Total core weight in Kg by weight=
10. Thickness of core lamination in mm=

D. Condition of the Tank:-

E. Any other items/tests which have not been covered above and required & indicated in the specification to be carried out by the OPTCL's representative.

ANNEXURE-IV

CALIBRATION STATUS OF TESTING EQUIPMENT AND INSTRUMENTS/ METERS **AVAILABLE IN THE FACTORY.**

[FOR CONDUCTING TESTS AS PER CLAUSE 18.1 OF SECTION IV OF TECHNICAL SPECIFICATION]

Nam e of the Test	Meters & Equipmen ts required for the correspo nding test with range accuracy make & Sl.No.	Date of Calibratio n.	Due date of Calibratio n	Name of Calibrati ng Agency.	Whether Calibratin g Agency is Govt. approved.	Whether documents relating to Govt. approval of the Calibrating Agency furnished.	Whether the meters/ equipme nt fulfill the accuracy class as per calibratio n report.	Whether the Calibratio n Agency has put any limitation towards the use of the particular meter/ equipmen t. If yes state the limitation.	Whether Green sticker or Blue sticker or Yellow sticker has been affixed on the body of the particular equipmen t/ meter. State the colour of the affixed sticker.	Inspite of imposed ,limitations whether the particular meter/ equipment can still be used” Justify its use for correspon ding during test(s)	Remark s
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12

Signature of the Tenderer with seal & date.

ANNEXURE-V

CHECK LIST TOWARDS TYPE TEST REPORTS.

Name of the Type Test.	Date of Test.	Name of the Laboratory where the Test has been conducted.	Whether the Laboratory is Government approved.	Whether the Test report is valid	Whether the copy of Test report in complete shape along with drawings etc furnished or not?	Whether the type tested Transformers full fill the technical requirements as per TS.	Remaks.
1.	2.	3.	4.	5.	6.	7.	8.

Signature of the Tenderer with seal & date

