TAMILNADU TRANSMISSION CORPORATION LIMITED
CHENNAI

(JAPANESE ODA LOAN FINANCED PROJECT)

VOLUME-II

TECHNICAL SPECFICATION FOR

SUPPLY AND ERECTION OF 14 NOS 100MVA,230/110KV AUTO TRANSFORMERS FOR AUGUMENTATION OF AUTO TRANSFORMERS IN VARIOUS 230/110 KV SS.

(Package No. - 57)

BID IDENTIFICATION NUMBER: TANTRANSCO/ T BID NO.T-2237

VOLUME- II

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TECHNICAL SPECIFICATION

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SECTION –I

TECHNICAL SPECIFICATION

GENERAL TECHNICAL REQUIREMENT

TECHNICAL

1.0. SCOPE:

1.1. The scope of supply of the Auto Transformers include design, manufacture, inspection, testing, packing & forwarding, arranging insurance cover towards transit & storage for 90 days, transporting the Auto Transformers complete with all fittings, accessories & associated equipment detailed herein, and placing on at our substation sites, any where in Tamil Nadu, by unloading on the plinth or nearer to the plinth, in case the plinth is not ready, as decided by the site Engineer.

1.2. The equipment shall be manufactured in the manner set out in this specification or where not set out, to the reasonable satisfaction of the purchaser. The transformers shall conform in all respects to high standards of engineering, design and workmanship and latest revisions of relevant standards at the time of offer, and the purchaser shall have the power to reject any work or material, which, in his judgment is not in full accordance therewith.

1.3. All fittings and accessories or apparatus which may not have been specifically mentioned below, but which are necessary and essential for the efficient working of the equipment, shall be deemed to be included in the contract. All outdoor apparatus including bushing insulators with their mountings shall be designed so as to avoid any accumulation of water.

2.0. CLIMATIC CONDITIONS

The climatic conditions at site under which the equipment shall operate satisfactorily, are

(a) Atmosphere	:	Highly polluted
(b) Maximum ambient air temperature	:	50 º C.
(c) Minimum ambient air temperature	:	5 º C.
(d) Maximum daily average ambient air temperature	:	40 º C.
(e) Maximum yearly weighted average ambient air temperature	:	32 º C
(f) Maximum Humidity	:	95%
(g) Average thunder storm days per annum	:	65
(h) Average dust storm days per annum	:	Occasional
(i) Average rainy day per annum.	:	65
(j) Average annual rainfall	:	100 cm.
(k) Number of months during which tropical monsoon conditions prevails	:	5
(l)Maximum wind pressure	:	150kgf/sq.m.
(m) Altitude above M.S.L	:	<1000 M

3.0. CODES AND STANDARDS

3.1. The design, material, construction, manufacture, inspection, testing and performance of the Auto transformers shall comply with all currently applicable statutes, regulations and safety codes.

3.2. Except otherwise stated, the transformers and associated accessories shall conform in all respects to the latest issues of relevant Indian/International standards. Some of them are given below:

Indian Standard No.	TITLE	International and Internationally recognised Standards
IS-325	Three Phase Induction Motors	IEC- 34
IS-335	Insulating oils for transformers and Switchgears	IEC-296, BS-148
IS-778	Gun metal gate, globe and check-valves for general purpose.	
IS-1866	Code of practice for maintenance and supervision of insulating oil in service.	
IS-1886	Code of practice for installation and maintenance of transformers.	
IS-2099	Bushings for AC voltage above 1000V	IEC-137, BS 223
IS-2026	Power transformers	IEC-76
IS-2147	Degrees of protection provided by enclosures for low voltage switchgear and control gear	
IS-2705	Current Transformers	IEC-185
IS-3203	Code of practice of climatic proofing of electrical equipments.	
IS-3347	Specification for Outdoor Bushings.	
IS-3401	Silica gel	
IS-3637	Gas operated relays	
IS-3639	Fittings & Accessories for power transformers.	
IS-4253	Cork and rubber	
IS-5561	Electric power connector	
IS-5578	Marking and arrangements for switch gear, bus bars, Main connections and auxiliary wiring.	
IS-6272	Industrial cooling fans	
IS-6600	Guide for loading of oil immersed transformers	BSCP-0160
IS-8468	ON load tap changer	IEC-60214
IS-8478	Application guide for OLTC	IEC-60542
IS-9434 IS-10593	Guide for sampling and analysis of dissolved gas in oil filled equipments,	

IS-12676	Oil impregnated paper-insulated condenser Bushing Dimension and requirements.	
IEC-60137: 2017	**Resin Impregnated Bushing**	
	Insulation Coordination, Indian Electricity Rules 1959	IEC-71
	High voltage test techniques	IEC-60
	IEMA Standard publication - Transformer -1	
	CBIP Manual on Power Transformers-1999 & 2006	
IS	BUREAU OF INDIAN STANDARDS, Manak Bhawan, No.9, Bahadur Shah zafar Marg, New Delhi - 110 001, INDIA.	
IEC	INTERNATIONAL ELECTRO TECHNICAL COMMISSION, Bureau Central de ta Commission Electro Technique International I, Rue de Verembe, Geneva, SWITZERLAND.	
IS1554 Part 2 1988	Control cables	

3.3 Wherever the relevant ISS are not applicable, the specifications of IEC, CBIP and BSS may be adopted.

3.4. The equipment or materials, meeting recognised National or International Standards which ensure an equal or superior quality than Indian/IEC standards specified, will also be accepted. When the equipment offered by the supplier conforms to other standards, salient points of difference between standards adopted and the standards specified in this specification shall be clearly brought out in the offer.

4.0. TYPE, RATING AND OTHER TECHNICAL REQUIREMENTS

The requirement of Auto transformers shall be as per ANNEXURE – I.

5.0. INSULATION:

The insulation requirement of windings shall be as per ANNEXURE - I

6.0. IMPEDANCES:

6.1. The percentage Impedance Voltage at principal tapping **(12.5%)** and on the rated primary/ secondary MVA base shall be as per ANNEXURE – I.

6.2. Impedance shall include positive and zero sequence and shall be expressed in terms of branches of the star connected equivalent diagrams, all on the same MVA base, and the range shall be given for each branch of the equivalent circuit in turn.

6.3. The tenderer shall indicate the guaranteed impedance, tolerances and upper and lower limit of impedance which can be offered without an increase in the quoted price. Tender shall also indicate the percentage variation from the normal tap to extreme taps.

6.4 Positive tolerance of + 10% for Impedance is accepted. (Negative tolerance shall not be accepted)

6.5. To achieve the above percentage impedance values, no reactor, either inside or outside the tank, shall be used.

6.6 **Tap 1 should correspond to highest voltage/lower impedance and the last Tap should correspond to the lowest voltage/higher impedance.**

7.0. LOSSES

7.1. The No load loss at rated voltage & frequency, Load loss & I^2R Loss at the rated current, frequency and rated output at 75˚C at principal tap and auxiliary loss for the Power Transformer, shall not exceed the limits as follows.

1) No Load Loss at rated voltage and frequency **: 28 KW (Max.)**

2) Load Loss at rated current and at 75°C for HV and LV windings at principal tap position **: 170 KW (Max.)**

3) I^2R Loss at rated current and at 75°C for HV and LV windings at principal tap position **: 125 KW (Max.)**

4) Auxiliary Loss at rated voltage and frequency **: 5 KW (Max.)**

In addition, the conditions laid down in Clause 12.0 and 13.0 of SECTION -V of specification shall apply.

Offers with losses higher than the maximum losses specified will be rejected and their price bids will not be opened.

7.2 If the losses exceed the guaranteed losses during routine test at the supplier's works, the unit will be rejected or order placed on them may be cancelled. If the figures of the losses are less than the guaranteed values, then no bonus will be allowed.

7.3 TANTRANSCO reserves the right to conduct tests to determine the losses on one or more units at its cost. The vendor shall provide all assistance to conduct the above tests.

7.4 Apart from 12.3 & 12.4, one unit of ordered auto transformer selected at the discretion of TANTRANSCO shall be tested for measuring No-load and Load losses by CPRI or any other Govt. recognized High Voltage testing laboratory as decided by TANTRANSCO.

7.5 The following penalties will be levied on the manufacturer (as the case may be) if losses measured during routine test are found to be within +2% tolerance of the losses specified in Annexure– IA, beyond which the transformer shall be liable for rejection. No benefit shall be given for supply of transformer, with losses (measured during routine tests) less than the losses specified.

S.No.	Differential of specified losses vs Measured losses	RATE (in INR per KW)
1	No load Loss	10,00,000/KW
2	I^2R Losses/Load Losses (Differential of whichever loss is higher shall be considered for penalty)	8,00,000/KW
3	Auxiliary Losses	8,00,000/KW
Note: For a fraction of a kW, the penalty shall be applied on pro rata basis.		

The compensation shall also be applicable to the units supplied prior to the selected unit by TANTRANSCO for which loss measurement test conducted at CPRI or Govt. approved testing agency and to the subsequent units, even if all the test results are within specified limits in respect of those units. The arrangements connected towards testing shall be made by the supplier and recouped from TANTRANSCO on actuals, if the losses are proved to be within the guaranteed limits.

8.0. TEMPERATURE RISE:

The transformer shall be capable of operating continuously at full rating giving rated output without exceeding the temperature limits specified below, over and above the ambient temperature of 50^{o} C.

Permissible Temperature rise of top oil, measured by thermometer : **50^{o} C.**

Permissible Temperature rise of winding, measured by resistance : **55^{o} C.**

9.0. DUTY REQUIREMENTS

9.1. The transformers would be used for Bi-directional flow of rated power.

9.2. The transformer and all its accessories like bushing CTs, etc. shall be designed to withstand, without injury, the thermal and mechanical effects of any external short circuit to earth and of short circuits at the terminals of any winding for a period of **2 seconds**. Transformer windings shall be capable of withstanding the thermal and mechanical stresses caused by symmetrical or asymmetrical faults.

9.3. The transformer shall be capable of being loaded in accordance with IS 6600. There shall be no limitation imposed by bushings, tap-changer etc. All accessories like bushings, CTs, OLTC's shall be rated to carry 120% of Transformer current on extreme minus tap

9.4. The overload capacity of the transformer and their emergency short time ratings shall be in accordance with IS 6600.

9.5. The transformer shall be suitable for continuous operation with a frequency variation of ± 5% without exceeding the specified temperature rise.

9.6. The transformer shall be capable of being operated without danger on any tapping at the rated MVA with voltage increase of 10% in the system corresponding to the voltage of that tapping and at the same time with a frequency of 5% below normal.

9.7. Transformers of similar ratio & impedance, now in service in TANTRANSCO shall operate satisfactorily in parallel with each other.

9.8. **Radio interference and Noise Level:**

i) The transformer shall be designed with particular attention to the suppression of harmonic voltages, especially the third and fifth to the maximum extent, so as to minimise interference with communication circuits.

ii) The noise-level, when energised at normal voltage and frequency with fans running, **shall be less than 80 decibels** for 100MVA, when measured under standard conditions.

9.9. The maximum flux density in any part of the core and yoke at the rated MVA, voltage and frequency shall be such that under 10% continuous over-voltage condition it does not exceed 1.9 Tesla at all tap positions.

9.10. The maximum current density in **any part of** winding **at Normal Tap** shall not exceed **240 Amp./ sq.cm.**

Epoxy bonded Continuously Transposed Conductor (CTC) shall be used in main winding for rated current of 400 A or more.

9.11 Transformer shall be capable of operating under the natural air cooled condition up to the specified load. The forced air cooling equipment shall come into operation by pre-set contact of winding temperature indicator and transformer shall operate in forced cooling mode initially as ONAF (or ONAF1, as specified) up to specified load and then as OFAF (ONAF2 or ODAF as specified).

9.12 Transformer shall be capable of remaining in operation at full load for 10 minutes after failure of the fans without the calculated winding hot-spot temperature exceeding 140ºC. Also, stopping of one or two cooling fans should not have any effect on the cooling system. If the Transformers fitted with two coolers each capable of dissipating 50% of the loss at continuous maximum rating shall be capable of remaining in operation for 20 minutes at full load / continuous maximum rating in the **event of failure of the oil circulating pump or fans/blowers** in the event of failure of fans associated with one cooler without the calculated winding hot-spot temperature exceeding **115ºC**.

The contractor shall submit supporting calculations for the above and the same shall be reviewed during design review.

9.13 Transformer shall accept, without injurious heating combined with increased voltage and reduced frequency fluctuation, which produce the following over fluxing conditions.

i) 110% continuously
ii) 125% for 1 minute.
iii) 140% for 5 seconds

Withstand time for 150% & 170% over fluxing condition shall be indicated. Over fluxing characteristics up to 170 % shall be submitted.

9.14 The transformer shall be free from any Electrostatic Charging Tendency (ECT) under all operating conditions and maximum oil velocity shall be such that it does not lead to static discharges inside the transformer while all coolers are in operation.

10.0. CONSTRUCTIONAL FEATURES

10.1. The transformer and accessories shall be designed to facilitate operation, inspection, maintenance and repairs.

10.2. All materials used shall be of the best quality and of the class most suitable for working under the conditions specified and shall withstand the variations of temperature arising under working conditions and atmospheric conditions without undue distortion or deterioration or setting up of undue stresses in any part and also without affecting the strength and suitability of the various parts for the work which they have to perform.

10.3. Patching, plugging, shimming or other such means of over-coming defects, discrepancies or errors are not acceptable.

10.4. Corresponding parts liable for replacement shall be inter- changeable.

10.5. All outdoor apparatus, including bushing insulators with their mounting shall be designed so as to avoid pocket in which water can collect.

10.6. All mechanism shall, wherever necessary, be made out of stainless steel, brass or gun-metal to prevent sticking due to rust or corrosion.

10.7. FASTENERS:

10.7.1 All bolts, studs, screw threads, pipe threads, bolts and nuts shall comply with appropriate Indian Standards for metric threads or the technical equivalent.

10.7.2 Bolts or studs shall not be less than 6 mm. in diameter except when used for small wiring terminals.

10.7.3 If bolts and nuts are placed so that they are inaccessible by means of ordinary spanners, spectral spanners shall be provided.

10.7.4 Taper washers shall be provided where necessary.

10.7.5 Protective washers of suitable material shall be provided front and back of the securing screws.

10.7.6 All nuts and pins shall be adequately locked. Nuts, bolts and pins used inside the transformer and tap-changer compartment where gaskets are not used shall be provided with spring washers or locknuts. Where galvanizing is specified, it shall be applied by the hot dipped process or by electro-galvanizing process and for all parts, other than steel wires, shall consist of a thickness of zinc coating equivalent to not less than 610 gm of zinc per square metre of surface. The zinc coating shall be smooth, of uniform thickness and free from defects.

10.7.7 All taper pins used in any mechanism shall be of the split type.

10.7.8 Surface, which are in contact with oil, shall not be galvanised or cadmium plated.

10.7.9 Labels or plates of non-corrosive material shall be provided for all apparatus such as relays, switches and fuses, contained in any cubicle or marshalling kiosks.

10.7.10 Steel bolts and nuts exposed to atmosphere shall be with suitable finishes like cadmium plated or zinc coated.

10.8. Painting

Interior Painting

10.8.1 Before painting or filling with oil, all ungalvanised parts shall be completely cleaned and freed from rust, scale and greases, and all external surface cavities on castings shall be filled by metal deposition.

10.8.2 The interior of transformer tank and other oil filled chambers and internal structural steel work shall be cleaned off all scale and rust by shot-blasting.

"These surfaces shall be coated with not less than two coats of heat resistant varnish (Hot oil proof)". Un-exposed welds need not be painted.

10.8.3 All interior surfaces of mechanism chambers and kiosks, except those which have received anticorrosion treatment, shall receive three coats of paint, applied to the thoroughly cleaned metal surface. The final coat shall be of a light coloured anti-condensation mixture.

Exterior Painting

10.8.4 Similarly the outer surface shall also be cleaned off all scale and rust by shot blasting, and then the primary coat shall be applied, immediately after cleaning. The second coat shall be of Aluminium paint. Before despatch, the transformer shall be given another final coat of Aluminium paint. Primer paint shall be, ready made zinc chrome as per IS: 2932.

10.8.5 Metal parts not accessible for painting shall be made of corrosion - resistant material.

10.8.6 Marshalling box and drive mechanism box shall also be painted with aluminium paint. The RTCC panel shall be painted with light grey as per shade-631 of IS-5.

10.8.7 **DAMAGED PAINT WORK:**

i) 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 was originally applied.

ii) Any damaged paint work shall be made good as follows:

a) The damaged area, together with an area extending 25mm. around its boundary, shall be cleaned down to bare metal.
b) A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50mm around the perimeter of the original damage.
c) The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

10.8.8 DRY FILM THICKNESS

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

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

iii) Particular attention must be paid to full film thickness at the edges.

10.8.9 TESTS FOR PAINTED SURFACE:

i) The painted surface shall be tested for paint thickness.

ii) The painted surface shall pass the **cross hatch adhesion test and impact test** as acceptance tests and **Salt spray test and Hardness test** as type test as per the relevant ASTM standards.

NOTE: Supplier shall guarantee the painting performance requirement for a period of not less than 5 years.

11.0. CORE

11.1. The core shall be constructed from high grade, cold rolled, non-ageing, high permeability, low loss, grain oriented, silicon steel laminations, known as HI-BI or **MOH** steel trade name. The maximum flux density in any part of the core and yoke at the rated MVA, voltage and frequency shall be such that under 10% continuous over-voltage condition it does not exceed 1.9 Tesla at all tap positions. **This has to be ensured during stage inspection; otherwise the unit will not be accepted.** Core assembly shall employ mitred-interleaved joints. Indian transformer manufacturers shall use core material as per above specification with BIS certification.

11.2. The oxide-silicate coating given on the core steel is adequate. However, laminations can be insulated at least on one side by **hot resistant insulation**, other than paper and varnish, is welcome. The insulation shall be inert to the action of hot transformer oil.

11.3. The design of the magnetic circuit shall be such as to avoid static discharges, development of short circuit paths within itself or to the earthed clamping structure and the production of flux components at right angles to the plane of the lamination which may cause local heating.

11.4. The insulation structure for the core to bolts and core clamp plates shall be such as to withstand a voltage of **2000V DC for one minute without breakdown after the transformer is filled with liquid and insulation resistance should be at least 1 Giga ohm for new transformer.**

. The bolts and clamps, used in the assembly of the core, shall be suitably insulated with **fibre glass tubes** and the **clamping structure** shall be constructed so that eddy current will be minimum.

11.5. All steel sections, used for supporting the core, shall be thoroughly sand blasted or shot-blasted after cutting, drilling and welding.

11.6. Adequate lifting lugs shall be provided to enable the core and windings to be lifted.

11.7. Suitable projecting guides shall be provided on core assembly to facilitate removal of tank, in case Bell type tank construction or the core assembly from the transformer tank

11.8. Core and winding shall be capable of withstanding the shock to which they may be subjected during transport, installation and service. Adequate provision shall be made to prevent movement of the core and winding, relative to the tank, during these conditions.

11.9. The core and winding assembly shall be secured independently, with no connections to the tank cover.

11.10. The supporting frame work of the core shall be so designed, as to avoid the **presence of pockets** which would prevent complete emptying of the tank through the drain valve, or cause trapping of air during filling.

11.11 Oil ducts shall be provided, where necessary, to ensure adequate cooling. The winding structure and major insulation shall not obstruct the free flow of oil through such ducts. Where the magnetic circuit is divided into segments by cooling ducts, parallel to the planes of the laminations or by insulating material above **0.25 mm thick**, tinned copper bridging strips shall be inserted to maintain electrical continuity between segments. The frame work and clamping arrangements shall be earthed as specified separately, herein.

11.12 **The Serial Number of the transformer is to be engraved in the Yoke Plate / Channel of the Transformer.**

12.0.<u>WINDINGS</u>

12.1. The conductor shall be of electrolytic grade copper and windings shall be made in dust proof, humidity controlled environment with positive atmospheric pressure. The supplier shall furnish the facilities available in this regard at his works, along with the tender offer. The maximum current density in **<u>any part of</u>** winding **at Normal Tap** shall not exceed **240 Amp./ sq.cm.**

12.2. The conductors shall be of electrolytic grade copper free from scales and burrs. Oxygen content shall be as per IS 12444.
Epoxy bonded Continuously Transposed Conductor (CTC) shall be used in main winding for rated current of 400 A or more.

12.3 Coils of the windings of identical voltage and ratings shall be interchangeable.

12.3. The star connected winding shall have **graded** insulation. The neutral point of the star connected winding shall be insulated for the voltages specified in **IS:2026.**

12.4. The windings shall be of interleaved continuous disc type designed to reduce the out-of-balance forces in the transformer to a minimum, at all voltage ratios. They shall withstand the impulse and power frequency test voltages as specified in this specification.

12.5 The insulation of transformer windings and connections shall be free from insulating compounds which are liable to soften, ooze out, shrink or collapse and be non-catalytic and chemically in-active in transformer oil during service.

12.6. Coil assembly and insulating spacers shall be so arranged as to ensure free circulation of oil and to reduce the hot spot temperature of the windings.

12.7. **The stacks of windings shall receive adequate shrinkage treatment before final assembly.** Adjustable devices shall be provided for taking up any possible shrinkage of coils in service.

12.8. Coils shall be supported at frequent intervals by means of wedge type insulation spacers permanently secured in place and arranged to ensure proper oil circulation. To ensure permanent tightness of winding assembly, the insulation spacers shall be dried and compressed at high pressure, before use. Interlayer insulation between tap leads shall be wound with crape papers of DP>1200 with adequate thickness.

12.9. **The completed core and coil assembly shall be dried in vacuum, at not more than 0.5 mm of mercury absolute pressure** and shall be immediately impregnated with oil after processing to ensure the elimination of air and moisture within the insulation.

12.10. All threaded connections shall be provided with locking facilities. All leads from the winding to terminal board and bushings shall be framed and fastened rigidly to permallic wood with adequate clearances to prevent injury from vibration. Where applicable, guide tubes shall be used for the leads

12.11. Adequate insulation and clearances between high voltage windings and low voltage windings shall be provided. All clearances of windings and other live parts shall be adequate for the normal voltage of operation **plus 20%**

12.12 The conductors shall be transposed at sufficient intervals in order to minimise eddy current and equalise the distribution of currents and temperature along the windings.

12.13 The connection of all tapping winding segment shall be silver braced. All the winding segment and joints are to be silver braced except where bracing is not possible they may be crimped.

12.14.The strip conductor wound on edge shall not have a **width exceeding six times its thickness.**

12.15. The transformer shall be capable of withstanding the stresses due to short circuits on HV and LV terminals.

12.16.The core coil assembly shall be securely held in position to avoid any movement under short circuit conditions by providing jack bolt or pressure screws.

12.17 **The barrier insulation including spacers shall be made from high density pre-compressed pressboard (1.15 gm/cc minimum for load bearing and 0.95 gm/cc minimum for non-load bearing) to minimize dimensional changes. Kraft insulating paper used on conductor should have density of >0.75 g/cc.**

12.18 Wherever required, electrostatic shield, made from material that will withstand the mechanical forces, will be used to shield the high voltage windings from the magnetic circuit.

12.19 All insulating materials and structures shall be protected from contamination and the effects of humidity during and after fabrication, and after receipt, by storing them in a separate, climate-controlled area. All blocks shall be installed such that the grain is oriented in the horizontal direction, perpendicular to the winding compressive forces.

12.20 Wherever required, electrostatic shield, made from material that will withstand the mechanical forces, will be used to shield the high voltage windings from the magnetic circuit.

12.21 All insulating materials and structures shall be protected from contamination and the effects of humidity during and after fabrication, and after receipt, by storing them in a separate, climate-controlled area.

12.22 All blocks shall be installed such that the grain is oriented in the horizontal direction, perpendicular to the winding compressive forces.

12.23 **Winding paper moisture shall be less than 0.5%.**

12.24 <u>Current carrying connections</u>

The mating faces of bolted connections shall be appropriately finished and prepared for achieving good long lasting, electrically stable and effective contacts. All lugs for crimping shall be of the correct size for the conductors. Connections shall be carefully designed to limit hot spots due to circulating eddy currents.

12.25 <u>Winding Terminations into Bushings</u>

12.25.1 Winding termination interfaces with bushings shall be designed to allow for repeatable and safe connection under site conditions to ensure the integrity of the transformer/reactor in service.

12.25.2 The winding end termination, insulation system and transport fixings shall be so designed that the integrity of the insulation system generally remains intact during repeated work in this area.

12.25.3 Allowances shall be made on the winding ends for accommodating tolerances on the axial dimensions of the set of bushings and also for the fact that bushings may have to be rotated to get oil level inspection gauges to face in a direction for ease of inspection from ground level.

13.0. <u>INSULATING OIL:</u>

13.1. The insulating oil, shall be uninhibited Transformer Oil conforming to IEC-60396-2020. All the tests, specified in the standard, shall be carried out for confirmation of the quality on the oil samples, drawn at the following stages.

i) Prior to filling of the transformer at site
ii) Before carrying out the Heat-Run test
iii) After carrying out the Heat-Run test
iv) Before energising the transformer at site

13.2 Oil shall be filtered and tested for breakdown voltage (BDV) and moisture content before filling. The design and all materials and processes used in the manufacture of the transformer shall be such as to reduce to a minimum the risk of the development of acidity in the oil.

13.3. The insulating oil shall be subjected to testing at the manufacture's works/reputed laboratory before supply, in the presence of Inspecting personnel.

13.4. Sufficient quantity of oil necessary for first filling of all tanks, coolers and radiators, **conservator(s)** shall be supplied in sealed non returnable containers, suitable for out door storage.

13.5. The tenderer shall furnish the following information in his offer to enable the purchaser, to procure, if decided to go for separate procurement.

i) Recommended Technical parameters of the oil.
ii) List of manufacturers of oil, who are preferred by the tenderer for the transformers offered by them.

13.6. Due to limitations in the handling and transport facility, the transformer tank shall be filled with dry Nitrogen or equivalent inert gas from factory to the respective site after final testing at works, and provision of spare nitrogen cylinders fitted to the Main tank. A gas cylinder, with suitable reducer connection and pressure gauge, shall be supplied to monitor the pressure of the gas in the tank during transit and storage at site, till completion of oil filling. These accessories shall become the property of the Purchaser.

13.7. The resistivity of the first filling of transformer oil shall be at least $50x10^{12}$ ohm cm at 90°C.

14.0. TANK AND TANK ACCESSORIES

14.1. Tank Construction

14.1.1. The transformer tank shall be of conventional type construction, with removable top cover. The transformer tank and cover shall be fabricated from good quality, low carbon steel, of adequate thickness and shall be designed to withstand

a) lifting of the complete transformer with the tank completely filled with oil, by crane or jacks and transportation, by road or rail, without overstraining any joints and without causing subsequent leakage of oil.
b) Mechanical shocks, during transportation
c) Vacuum filling of oil

d) Continuous internal pressure of 35 kN/sq.m, over normal hydrostatic pressure of oil.
e) Short circuit forces

14.1.2 The base of each tank shall be so designed that it shall be possible to move the complete unit by skidding on metal plates or rails in any direction without injury.

14.1.3 The minimum thickness of the side and top cover of the tank plate shall be as per ANNEXURE– I. Adequate stiffeners shall be provided, wherever necessary, for general rigidity and these shall be designed to prevent retention of rain water.

Bottom plate thickness of the Tank

Length of tank (m)	Minimum plate thickness (mm)
Over 2.5 m but less than 5m	20
Over 5 m but less than 7.5m	26
Over 7.5 m	32

14.1.4 Wherever possible the transformer tank and its accessories shall be designed without pockets wherein gas may collect. Where pockets cannot be avoided, pipes shall be provided to vent the gas into the main expansion pipes.

14.1.5 Adequate space shall be provided at the bottom of the tank for collection of sediments. Suitable guides shall be provided for positioning the core & coil assembly and other various parts during assembly or dismantling.

14.1.6. Suitable shielding arrangement with a magnetic material of low permeability shall be provided inside the tank to shield off the leakage/stray magnetic fields, entering the tank and causing local heating/temperature rise at the joints. If required, impermeable shields shall be provided at the coil ends. Tank shield shall not resonate when excited at the natural frequency of the equipment. The Tenderer may confirm use of **tank shields** in the schedule of additional information.

14.1.7. All seam and joints, other than those which may have to be opened, shall be welded and wherever possible, double welded. **After completion of construction of tank and before painting, dye penetration test shall be carried out on welded parts of jacking bosses, lifting lugs and all load bearing members**.

14.2. Lifting and Haulage Facilities

Each tank shall be provided with:

(a) Lifting lugs, suitable for lifting the transformer complete with oil.
(b) Pulling eyes shall be provided to facilitate movement of the transformers and they shall be suitably braced in vertical direction, so that bending does not occur when the pull has vertical component.

(c) Lashing lugs.

(d) A minimum of four jacking pads at a **height of about 500 mm** (from the bottom of the tank) to enable the transformers, complete with oil, to be raised or lowered using hydraulic or screw jacks.

14.3. Tank Cover

14.3.1 The detachable top portion of the cover shall be designed for adequate strength. It shall be sloped to prevent collection of water on any part. It must be separate from the core and coil and shall be capable of being lifted separately from the tank for inspecting the core and winding at site. It shall not distort, when lifted.

14.3.2 Inspection openings shall be provided, as necessary to give easy access to bushings, core and windings, OLTC, earth connection, etc. Each inspection opening shall be of ample size for the purpose for which it is provided and at least two openings one at each end of the tank, shall be provided.

14.3.3 All the inspection covers **either on the top or on the sides of transformer** shall be of box type. The box type inspection cover shall be such that to avert trapping of air during oil filling or gas during incipient faults inside the transformers, from entering the Bucholtz relay. **The space under the cover shall be blanked with a solid insulating material, fitted to the cover itself**. Suitable air release plugs shall be provided accordingly. **The inspection covers shall not be of stud mounted type**.

14.3.4 The tank cover and inspection covers shall be provided with suitable lifting arrangements. Unless otherwise approved, inspection covers **shall not weigh more than 25 kg, each.**

14.3.5 The tank cover shall be provided with pockets for the probes/bulbs for oil temperature and winding temperature indicators. Metal sheath protection shall be provided to the capillary tubes of the temperature indicators. It shall be possible to remove these bulbs without lowering the oil in the tank.

14.3.6. The pockets for Temperature indicator shall be fitted with a captive screwed top to prevent ingress of water.

14.3.7 Bushing turrets, covers of inspection openings, thermometer pockets shall not permit ingress of water into or leakage of oil from the tank.

14.3.8 **The Serial Number of the Transformer is to be engraved in the Transformer Tank also.**

15.0. VALVES AND AIR RELEASE PLUGS

15.1. Each tank shall be fitted with the following valves.

i) Oil valves between each cooler and main tank.

ii) **One 100 mm drain valve** with padlocking arrangement, located on the low voltage side of the transformer at the bottom most point of the tank, enabling complete draining of oil.

iii) **Two 50 mm** filter valves, one on the top of the tank and at a diagonally opposite end to that of drain valve and another at the bottom. The bottom valve shall be with padlocking arrangement. These shall have adaptor suitable for 32 mm hose.

iv) Two sampling valves (**size 25 mm)** at top and bottom of the main tank, with provision for fixing PVC pipe.

v) One **15 mm air release plug** on the top cover.

vi) Two plugged pipe outlets for applying vacuum.

15.2 All valves with opening to atmosphere, shall be fitted with blank flanges.

15.3. All valves shall be of gun metal or cast steel bodies with gun metal fittings.

15.4. Valves shall be provided with flanges, having machined faces/screw connection for external piping.

15.5. **Valve for NIFPS Drain and Valve for N2 injection (NIFPS) shall be provided.**

15.6. **All valves in oil line shall be suitable for continuous operation with transformer oil at 115°C.**

16.0 AXLES AND WHEELS

16.1 The transformers are to be provided with bi-directional flanged wheels and axles of suitable dimensions and so supported that under any service condition, they shall not deflect sufficiently to interfere with the movement of the transformer, complete with oil. Suitable locking arrangements shall be provided to prevent the accidental movement of the transformer.

16.2 All wheels should be detachable and shall be provided with suitable bearings which shall be rust and corrosion resistant. Fittings for lubrication shall also be provided. The flanged wheels shall be suitable for use on gauge track and shall be so placed that a pinch bar can be used to move the transformer. Track shall be of **1676 mm** gauge between adjacent rails (inner faces), both on longer and shorter axis. It is noted that rails along shorter axis will be provided.

16.3 The wheels shall be arranged so that they can be turned through an angle of 90 deg. (on both directions) when the tank is jacked up, clear of the rails or floor. Necessary jacking steps shall be provided. Bi directional wheels with swivel movements and without locking shall be provided.

17.0. CONSERVATOR, TANK AND ITS ACCESSORIES

(i) Suitable ladders shall be provided at convenient locations in the conservator so as to reach it easily for inspection.

(ii) Air cell shall be provided in the conservator for the transformers. The conservator shall be provided with **one 50 mm flanged valve for oil filling valve in the top of the conservator shall have a bend pipe extension arrangement attached to the valve flange and blanked to avoid entry of water**

(iii) Main conservator shall have air cell type constant oil pressure to prevent oxidation and contamination of oil due to contact with moisture and shall be fitted with magnetic oil level gauge with low oil electrically insulated alarm contacts.

(iv) OLTC conservator shall have conventional type conservator with prismatic oil level gauge.

17.1.1 The conservator shall have adequate capacity between the highest and the lowest visible levels to meet the requirement of expansion of the total cold oil volume in the transformer and cooling equipment from the minimum ambient temperature to **100ºC or 7.5% of the total volume of oil in the main tank whichever is higher.**

17.1.2. One end of the conservator shall have bolted cover so that it can be removed for cleaning.

17.1.3. The conservator shall be bolted into position so that it can be removed for cleaning purpose.

17.1.4. The conservator shall be fitted in such a position, as not to obstruct the electrical connections to the transformer & lifting of the OLTC units.

17.1.5. The conservator shall be provided with **one 50 mm flanged valve** to completely drain the oil from the conservator.

17.1.6. The conservator shall have provision to receive **one 80mm dia. feed pipe** from the main tank, fitted with Bucholtz relay with two shut off valves on either side of the Bucholtz relay. Of the two valves one shall be on the conservator side, beyond a length of 240mm (3 times the internal diameter of the pipe line) and another on the main tank side beyond a length of 400mm (5 times the internal diameter of the pipe line) from the Bucholtz relay.

The feed pipe shall be free from sharp bends and make an inclination of 3º to 7º to the horizontal.

17.1.7. The feed pipe shall extend inside the conservator for at least 25mm so as to form a sump inside the conservator.

17.2 Oil Preservation equipment

The requirements of air cell type oil sealing system are given below:

17.2.1 Contact of oil with atmosphere is prohibited by using a flexible air cell of nitrile rubber reinforced with nylon cloth air cell.

17.2.2 The temperature of oil is likely to rise up to 100ºC during operation. As such air cell used shall be suitable for operating continuously at 100ºC.

17.2.3 Air cell of conservator shall be able to withstand the vacuum during installation/ maintenance periods. Otherwise provision shall be kept to isolate the conservator from the main tank when the latter is under vacuum by providing a vacuum sealing valve or other suitable means in the pipe connecting main tank with the conservator.

17.2.4 The connection of air cell to the top of the reservoir is by air proof seal preventing entrance of air into the conservator.

17.2.5 **An Air cell failure indicating relay** shall be provided so that in the event of air enters into the conservator as a result of rupture of the air cell, an alarm sounds.

17.3. Magnetic oil level gauge:

17.3.1. The conservator shall be fitted with one magnetic oil level gauge having,

i) Dial with minimum, maximum and normal (at 30^{o} C) oil level markings and a pointer. MOG with reflector type is accepted

ii) Low oil level alarm contacts of 0.5 Amp. 110V / 220V D. C. rating

17.4 Oil sealing system

17.4.1 The Main conservator shall be fitted with **Air cell type oil sealing system** to prevent oxidation and contamination of oil by the atmospheric oxygen/moisture. **3 Nos. of breathers (of identical) in series**, with a valve shall be provided. Separate breathers shall be provided for the main and OLTC portion of the conservator. A separate **2 Nos. of silica gel breathers in series** with its pipe line is to be provided for the OLTC portion of the conservator. Design shall be such that,

(i) The passage of air is through silicagel, **not less than 1 kg for every 3500litres** of oil in the tank.

(ii) The silicagel is isolated from atmosphere by an oil seal.

(iii) The moisture absorption, indicated by a change in colour of the tinted crystals, can be easily seen from a distance.

17.4.2. The Breathers shall be mounted at an approximate **height of 1,400 mm above ground level.**

18.0. i. PRESSURE RELIEF DEVICE

Adequate number of pressure relief devices of sufficient size (atleast two numbers, one on each end) shall be provided at suitable locations for rapid release of any pressure that may be generated inside the tank and which may result in damage to the equipment. They shall be mounted directly on the tank without any pipe for mounting. If mounted on the tank cover, they shall be away from the active parts of the transformer and the openings in the top cover shall be provided with a skirt, extending 25 mm inside the tank and holding a deflector plate, sufficiently away from the opening, so as to avert inadvertent trapping of gas during incipient fault inside the transformer. The device shall operate at a static pressure less than the hydraulic test pressure of transformer tank. Suitable hood shall be provided to prevent ingress of rain in such a way that it shall not hinder the actuation of flag provided in the PRD.

18.2 It is desirable to provide the PRV on the top cover. If there is any constraint in the space on the top cover, in such cases the PRV may be fixed directly on one side of the main tank below the top cover.

18.3. The pressure relief device shall be of safety valve type, capable of resealing after any pressure developed inside the tank is released. It shall be provided with switches for actuating trip contacts, when it acts. The switches shall be able to reset, once the pressure is released, only by manually.

18.0. ii. SUDDEN PRESSURE RELAY/ RAPID PRESSURE RISE RELAY

One number of Sudden Pressure Relay/ Rapid Pressure Rise Relay with trip contact (Terminal connection plug & socket type arrangement) shall be provided on tank of transformer. Operating features and size shall be reviewed during design review.

Suitable canopy shall be provided to prevent ingress of rain water. Pressurised water ingress test for Terminal Box (routine tests) shall be conducted on Sudden Pressure Relay/ Rapid Pressure Rise Relay.

19.0. EARTHING ARRANGEMENTS

19.1. All metal parts of the transformer with exception of the individual core laminations, core bolts and associated individual clamping plates shall be maintained at some fixed potential.

19.2. EARTHING OF CORE CLAMPING STRUCTURE

Main core clamping structure at the top shall be connected to the tank body by a copper strip. The bottom clamping structure shall be earthed by one or more of the following methods.

a) By connecting through vertical tie-rods to the top structure.

b) By direct metal-to -metal contact with the tank base maintained by the weight of the core and winding.
c) By connection to the top structure on the same side of the core as the main earth connection to the tank.

19.3. EARTHING OF MAGNETIC CIRCUIT

a) The magnetic circuit shall be earthed to the clamping structure at one point only through a link placed in an accessible position beneath an inspection opening in the tank cover, the connection to the link shall be on the same side of the core as the main earth connection.
b) Magnetic circuits having an insulated sectional construction shall be provided with a separate link for each individual section. Where oil ducts insulating barriers parallel to the plane the laminations divide the magnetic circuit in to two or more electrically separate parts the ducts or barriers shall be bridged and the magnetic circuit shall not be regarded as being of sectional construction.

19.4. EARTHING OF COIL CLAMPING RINGS

Where coil clamping rings are of metal, each ring shall be connected to the adjacent core clamping structure on the same side of transformer as the main earth connections, so as to maintain at earth potential.

19.5 SIZE OF EARTHING CONNECTION

All earthing connections with the exception of those from the individual coil clamping rings shall have a cross sectional area **of not less than 0.8 sq.cm**. Connections inserted between laminations of different sections of core and shall have a cross sectional area of **not less than 0.2 sq.cm**.

19.6. Two earthing pads, at diagonally opposite external ends of the main tank, at its bottom, capable of carrying the short circuit current for **3 seconds** without injurious heating, shall be provided with clamp type terminal for external connection.

20.0 RATING AND DIAGRAM PLATES

20.1 The following plates, suitable for outdoor use, shall be fixed to the transformer tank, at an average height of about **1750 mm** above ground level.

(a) A rating plate, of not less than **300 X 300 mm** size, bearing the data specified in the appropriate clause of IS 2026. The details of the current transformers and normal operating pressure of PRV may also be indicated.
(b) A diagram plate, showing the internal connections and also the voltage vector relationship of the several windings in accordance with IS 2026 and in addition a plan view of the transformer giving the correct physical relationship of the terminals. No-load voltage shall also be indicated for each tap.

(c) A plate, showing the location and function of all valves and air release cocks or plugs. This plate shall also warn operators to refer to the maintenance instructions before applying the vacuum treatment for drying.

(d) A plate showing the schematic wiring diagram of the respective cubicle may be provided in the cubicle.

(e) **Guarantee period shall be engraved in the name plate.**

(f) The Nameplate details of all Bushing CTs including WTI shall be engraved and fixed on the respective turrets. The details shall not be worn-out during all climatic conditions, in cases where turrets are not provided.

(g) The details of the CTs shall be provided separately along with the main Name plate details.

(h) If the transformer has failed within the guarantee period the date of repair and the subsequent validity of Guarantee period (s) are to be engraved in the Name plate.

(i) The rating diagram and other plates shall be of brass or stainless steel.

(j) **FOR (D) Unit Price of the Transformer shall be engraved in the name plate.**

21.0. JOINTS AND GASKETS

21.1. All gaskets used for making oil tight joints shall be of proven material such as neoprene RC 70 C grade granulated cork bonded gaskets conforming to IS:4253, unless otherwise specified.

21.2 All bolted joints shall be fitted with weather proof, hot oil resistant gaskets in between, for complete oil tightness. Special attention shall be given to the oil tight joints between the tank and the cover and the bushing, the turrets, covers of inspection openings, thermometer pockets etc and the other out-lets to prevent ingress of water into or leakage of oil even under hot condition from the tank. If gasket is compressible, metallic stops shall be provided to prevent over compression.

21.3 One complete set of gaskets shall be supplied with the transformer additionally, for all openings.

22.0. TERMINAL ARRANGEMENT

22.1 **HV (230 KV) and LV (110 KV) bushings shall be RIP Bushings.**
The Neutral Bushings and support insulator Bushings shall be of porcelain Bushings only. The rating of the neutral bushings shall meet the BIL of the neutral point.
The Type Test conducted on HV (230 KV), LV (110 KV) and Neutral Bushings shall be within seven (7) years on the date of tender opening.

22.2 Bushings shall be robust and designed for adequate cantilever strength to meet the requirement of seismic condition, substation layout and movement along with the spare

transformer with bushing erected and provided with proper support from one foundation to another foundation within the substation area. The electrical and mechanical characteristics of bushings shall be in accordance with IS / IEC: 60137. All details of the bushing shall be submitted for approval and design review.

22.3 Oil filled condenser type bushing shall be provided with at least following fittings:
a) Oil level gauge
b) Tap for capacitance and tan delta test. Test taps relying on pressure contacts against the outer earth layer of the bushing is not
c) Oil filling plug & drain valve (if not hermetically sealed)

22.4 Bushing shall be provided **with tap for capacitance and tan delta test**. Test taps relying on pressure contacts against the outer earth layer of the bushing is not acceptable.

22.5 Where current transformers are specified, the bushings shall be removable without disturbing the current transformers.

22.6 Bushings of **identical rating of different makes shall be interchangeable** to optimise the requirement of spares. The standard dimensions for lower portion of the condenser bushings shall be followed.

22.7 **Polymer insulator** shall be seamless sheath of a silicone rubber compound. The housing & weather sheds should have **silicon content of minimum 30% by weight**. It should protect the bushing against environmental influences, external pollution and humidity. The interface between the housing and the core must be uniform and without voids. The strength of the bond shall be greater than the tearing strength of the polymer. The manufacturer shall follow non-destructive technique (N.D.T.) to check the quality of jointing of the housing interface with the core. The technique being followed with detailed procedure and sampling shall be finalized during finalization of MQP.

22.8 The weather sheds of the insulators shall be of alternate shed profile as per IS 16683-3/ IEC 60815-3. The weather sheds shall be vulcanized to the sheath (extrusion process) or moulded as part of the sheath (injection moulding process) and free from imperfections. The vulcanization for extrusion process shall be at high temperature and for injection moulding shall be at high temperature & high pressure.

22.9 Any seams/ burrs protruding axially along the insulator, resulting from the injection moulding process shall be removed completely without causing any damage to the housing. The track resistance of housing and shed material shall be class 1A4.5 according to IS 9947.

22.10 The strength of the weather shed to sheath interface shall be greater than the tearing strength of the polymer. **The polymer insulator shall be capable of high pressure washing.**

22.11 End fittings shall be free from cracks, seams, shrinks, air holes and rough edges. End fittings should be effectively, sealed to prevent moisture ingress, effectiveness of sealing system must be supported by test documents. All surfaces of the metal parts shall be perfectly smooth with the projecting points or irregularities which may cause corona. All load bearing surfaces shall be smooth and uniform so as to distribute the loading stresses uniformly.

22.12 The hollow silicone composite insulators shall comply with the requirements of IEC-61462 and the relevant parts of IEC-62217. The design of the composite insulators shall be tested and verified according to IEC-61462 (Type & Routine test).

22.13 Clamps and fittings shall be of hot dip galvanised/stainless steel.

22.14 Bushing turrets shall be provided with vent pipes, to route any gas collection through the Buchholz relay.

22.15 **No arcing horns** shall be provided on the bushings.

22.16 **Corona shield, wherever required, shall be provided** at bushing terminal (air end) to minimize corona. Stress shield for the bushings shall be considered as an integral part of the bushing- assembly.

22.17 Bushing shall be specially packed to avoid any damage during transit and suitable for long storage, with non-returnable packing wooden boxes with hinged type cover. Without any gap between wooden planks. Packing Box opening cover with nails/screws type packing arrangement shall not be acceptable. Manufacturer shall submit drawing/ documents of packing for approval during detail engineering. Detail method for storage of bushing including accessories shall be brought out in the instruction manual.

22.18 Oil end portion of RIP/RIS type bushings shall be fitted with metal housing with positive dry air pressure and a suitable pressure monitoring device shall be fitted on the metal housing during storage to avoid direct contact with moisture with epoxy. The pressure of dry air need to be maintained in case of leakage.

22.19 **Tan delta measurement at variable frequency (in the range of 20 Hz to 350 Hz) shall be carried out on each condenser type bushing (OIP & RIP/ RIS) at Transformer manufacturing works as routine test before despatch** and the result shall be compared at site during commissioning to verify the healthiness of the bushing.

22.20 **Tan δ value of OIP/RIP/RIS condenser bushing shall be 0.005 (max.) in the temperature range of 10°C to 40°C. If Tan Delta is measured at a temperature beyond above mentioned limit, necessary correction factor as per IEEE shall be applicable.**

22.21 All bushings shall be equipped with suitable terminals and terminal clamps of approved type and size and all external current carrying contact surfaces shall be adequately silver plated. Main terminals shall be solder less.

Flexible connectors shall be made from tinned copper sheets. Size of terminal/ conductor for which the clamp is suitable and the rated current shall be embossed/ punched.

22.22 Each bushing shall be co-ordinated with the insulation class of the winding.

22.23 All porcelain, used in bushings, shall be homogeneous and free from cavities or other flaws. The glazing shall be uniform in colour and free from blisters, burrs and other defects. The glaze shall be brown.

22.24 Specific requirements of bushings and their ratings etc. are given in the Annexure - I. The Bushing Terminals on HV side shall be of outdoor type provided with clamping arrangement (shall be of free end type) and Suitable Bi – metallic sleeves to receive the 3" Aluminum Bus bar.

22.2.TERMINAL CONNECTORS

BUSHING TYPE (OUTDOOR)

i) Bushing terminals on 230 KV sides, shall be out door type provided with clamping arrangement (shall be of free end type) and suitable bi-metallic sleeves to receive 3" Aluminium bus bar.

ii) Bushing terminals on 110 KV side shall be provided with clamping arrangement and suitable bimetallic sleeves to receive 'KUNDAH' conductor. The clamp shall be such that the conductor takes off from the bushings vertically.

iii) The connectors shall be designed for minimum 120% of the maximum current carrying capacity of the conductor and the temperature rise under any condition shall not be more than 50% of that in the main conductor.

iv) All the terminal connectors shall conform to IS:5561 of latest issue.

v) All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

vi) All ferrous parts shall be hot dip galvanised conforming to IS:2633. For bimetallic clamps copper alloy liner of minimum 2 mm thickness shall be cast integral with aluminium body.

vii) Size of the terminal/conductor for which the clamp/connector is suitable shall be embossed/punched on each clamp/connector.

viii) Neutral bushing terminal shall be suitable to receive **2 Nos. 75 x 12 mm** G.I flats placed side by side on insulators up to ground level. Necessary outdoor type porcelain insulators, GI flats and bi-metallic sleeves shall also be supplied.

23.0. BUSHING CURRENT TRANSFORMER

23.1 Bushing current transformers of required ratio PS class may be provided in the bushing turrets of HV, LV and neutral ends of each phase for restricted earth fault protection. The requirement of the bushing current transformers shall be as per ANNEXURE – I.

23.2. The current transformer shall be of low resistance type, complying with I.S 2705, Part-IV of latest issue. The current transformers on HV and LV sides shall have matching characteristics to the extent feasible to have Differential Protection scheme more effective. The bushing current transformers shall be housed in separate turrets and shall not be an in-built unit of the transformer. The housing of current transformers shall be so arranged that bushing can be removed, without disturbing the current transformer. The magnetization characteristic curves, indicating the knee point voltage, excitation current and secondary resistance shall be furnished.

23.3. It shall be possible to remove the current transformers from the tank without removing the tank cover. Necessary precautions shall be taken to minimise the eddy currents and local heat generation in the turret.

23.4. All secondary leads shall be brought into a terminal box near each bushing. The terminals shall be wired up to marshalling box, using separate cables for each core.

23.5 The Nameplate details of all Bushing CTs including WTI shall be engraved and fixed on the respective turrets. The details shall not be worn-out during all climatic conditions, in cases where turrets are not provided the details of the CTs shall be provided separately along with the main Name plate details.

23.6 The secondary termination from the CTs to the terminal blocks shall only be lugged and no eyeing shall be made

24.0. VOLTAGE CONTROL EQUIPMENT (ON LOAD TAP CHANGER)

24.1 The transformer shall be provided with reputed make voltage control equipment of the on-load tap changing type for varying its specified effective transformation ratio as furnished in Annexure-I Sl.No.15, without producing phase displacement and suitable for remote control operation from switch board in the control room, in addition to being capable of local-manual as well as local-electrical operation. The design, manufacture and performance of the OLTC shall comply with the CBIP regulations, other statutes and safety codes and IS 8468 of latest issue. The transformer supplier shall ensure the above.

24.2. a) On Load Tap Changer shall be sourced from reputed manufacturer and it should be type tested as per relevant IEC 60214 and s**hall be within 10 years as on the date of tender opening** and test methods shall be in full conformance to the procedures indicated in IEC 60214.

b) The on-load tap changer shall include the following:

a) An oil immersed divertor switch of transition resistor type.
b) Motor driven mechanism for local as well as remote operation.
c) Control and protective devices.
d) Remote Tap Changer control panel.
e) Annunciation schemes.
f) Local - manual operating device.

24.3. The tap changing switches and mechanism shall be mounted in oil tanks or compartments mounted in an accessible position on the transformer tank. It shall not be possible for the oil in the divertor switch to mix with oil in the transformer tank. The OLTC oil shall be of the same EHV grade oil as used for the main transformer or of higher quality insulating oil and low viscosity is preferred. The oil in the OLTC compartment shall be maintained under conservator head by means of a pipe connection from the highest point of the chamber to the OLTC conservator. This connection shall be controlled by a suitable valve, and shall be arranged so that any gas leaving the chamber will pass into the gas and oil actuated relay. This surge relay shall be of reputed make.

24.4. The OLTC chamber shall have oil filling valve, air release plug, pressure relief device, tap position indicator, oil sampling valve and provision for circulation of oil in the OLTC compartment and equalization of OLTC compartment and main tank during application of vacuum. Necessary pipes, valves, blanking plates etc., for the above purpose shall form part of the accessories.

24.5. The tap changer shall be so mounted that top cover of the transformer can be lifted without removing the connections between the windings and the tap changer.

24.6. It is preferable that the contact be accessible for inspection without lowering oil level in the main tank and the contact tips shall be replaceable. Special tools and tackles if any, required for maintenance of OLTC gear shall be supplied.

24.7. The divertor switch or arcing switch shall be designed so as to ensure that its operation once commenced shall be completed independent of the operation of the control relays or switches, failure of auxiliary supply etc. OLTC shall have a mechanical fuse incorporated in the design to ensure the protection of diverter switch in the event of an undue mechanical stress on the Tap changer.

24.8. Drive mechanism chamber shall be mounted on to the transformer tank, in an accessible position. It shall be adequately ventilated and provided with anti-condensation metal clad heater. All contactors, relay coils or other parts shall be protected against corrosion or deterioration due to condensation, fungi, etc.

i) The Tap selector contacts shall not be of the threaded type to ensure positive, full face and firm contact from Transformer leads to tap changer.

ii) No continuity break shall be allowed during changeover between any two taps. The OLTC shall be tested for the same by ensuing that there is no open circuit showing while changing two taps.

iii) OLTC design should have been seismic tested and qualified.

iv) OLTC manufacturer shall conduct the following routine tests fully in compliance with IEC 60214 on every unit, as given below, before despatch to assure the quality of the products.

S. No.	IEC Reference		Test Description
1.	Cl.5.3.1	-	Mechanical Test
2.	Cl.5.3.2	-	Sequence Test
3.	Cl.5.3.3	-	Auxiliary circuits Insulation Tests
4.	Cl.5.3.4	-	Pressure Test
5.	Cl.5.3.4	-	Vacuum Test

All the relevant test reports shall be submitted along with the test report of transformer for approval.

v) The Tap Changer shall be suitably protected through Oil Surge Relay. This surge relay shall be tested for an Oil flow velocity of 1.20+/- 0.20 m/s.

24.9. The whole of the drive mechanism shall be of robust design and capable of giving satisfactory service and shall not require frequent maintenance under the operating conditions met with, in service.

24.10. A permanently legible lubrication chart shall be fitted within the driving mechanism chamber.

24.11. The OLTC driving mechanism and its associated control equipment shall be mounted in an outdoor, weather-proof and vermin proof housing which shall include

a) Driving motor, operating on 3-phase 415V, 50HZ AC supply.

b) Remote / local electrical and local manual selector switch. It shall control in the following manner.

i) When the selector switch is in LOCAL position, it shall be possible to operate the RAISE / LOWER control switches. Remote control of RAISE/LOWER functions shall be prevented.

ii) When the selector switch is in REMOTE, the RAISE/LOWER switches in the local control cubicle shall become inoperative. Remote control of the RAISE, LOWER functions shall be possible from the remote control panel. The local REMOTE selector switch shall have at least two spare contacts per position which are closed in that position.

c) Motor starting contactor with thermal overload relay, isolating switch and MCB to protect the motor from overloading. All relays, switches, MCBs etc shall be mounted in the drive mechanism chamber and shall be clearly marked for the purpose of identification.

d) Limit switch, to prevent motor over-travel in either direction.

e) Counter (digital type), to indicate the number of operations completed.

f) Electrically interlocked reversing contactors.

g) Space heaters with switches.

h) Master/follower selector switch.

i) Cable termination glands for power and control cables.

j) Interior lighting with door switch.

k) Auxiliary relays.

l) Mechanical tap- position indicator.

m) Manual operating device. This cranking device for manual operation shall be removable and suitable for operation by man at ground level. It shall have mechanical stops to prevent over cranking of the mechanism beyond the extreme tap positions. The mechanism shall have interlock with the motor to block motor-start-up during manual operation.

n) Necessary lamp indications and annunciation schemes of various operations of OLTC gear from RTCC panel.

o) RAISE-LOWER CONTROL SWITCH shall be spring loaded to return to the centre OFF position and shall require movement to the RIGHT, to raise the voltage of the transformer. Movement to LEFT shall lower the voltage of the transformer. This switch shall be operative only when the LOCAL/REMOTE SELECTOR switch is in LOCAL position.

p) In OLTC lugs, terminal numbers should be punched.

24.12. Tap changer control requirements :

1) It shall not be possible for any two controls (ie. MANUAL, LOCAL, ELECTRICAL, REMOTE) to be in operation at the same time.

2) It shall be capable of permitting parallel operation with transformers of the same ratio, say maximum four units.

3) Suitable selector switch shall be provided, so that, any one transformer of the group can at a time be selected as 'Master' 'Follower' or independent.

4) An out-of-step device with timer contacts shall be provided, which shall be arranged to prevent further tap-changing when transformers in a group, operating in 'Parallel control', are one tap out-of-step.

5) The equipment shall be suitable for supervisory control and indication with a "Make before Break" multi-way switch, having one potential free contact for each tap position. This switch shall be provided in addition to any other switch/switches which may be required for the purpose of remote tap position indication. All other components of the supervisory gear, if required, shall be provided separately.

6) Operation from the local or remote control switch shall cause one tap movement only, until the control switch is returned to the 'off' position between successive operations.

7) All electrical control switches and the local operating gear shall be clearly labeled in a suitable manner to indicate the direction of tap-changing.

8) Limit switches to prevent motor 'over-travel' in either direction may be located in the control circuit of the operating motor, provided with a mechanical declutching mechanism.

9) Necessary interlock, blocking the independent controls when the units are in parallel, shall be provided.

10) A time delay relay for INCOMPLETE STEP alarm, consisting of a normally open contact, which closes, if the tap changer fails to make a complete tap change. The alarm shall not operate momentarily for loss of auxiliary supply.

25.0.COOLING EQUIPMENTS

25.1.COOLER:

25.1.1. The cooler shall be supplied with the requisite number of radiators. The wall thickness of radiator shall be not less than 1.2 mm **complying as per IS 513**

25.1.2. Each radiator bank shall have its own cooling fans, oil pumps, oil flow indicators, shutoff valve, lifting lugs, air release plug, a drain valve and thermometer pockets fitted with captive screw cap on the inlet and outlet.

25.1.3. Each radiator shall be designed to withstand the pressure test. When assembled, they shall be accessible for cleaning and painting. Each radiator unit shall be provided with the following:

(a) An 100 mm shut-off valve at each point of connection to the header/ transformer tank
(b) Removable blanking plates to permit blanking-off the oil connection
(c) A drain valve of size 25mm at the lowest point of each radiator
(d) Air release plug of 15 mm dia. at the highest point
(e) Lifting lugs

25.1.4. The clearance between all pipe work and live parts shall be more than the clearance for live parts to earth.

25.1.5. The radiator bank shall be designed for same pressure and vacuum conditions as specified for main tank.

25.1.6 The Manufacturer shall furnish the calculations including the detailed design of the cooling system after awarding of contract to analyze the performance.

25.1.7 **In transformers where separate cooler banks are to be provided, provision shall be made in the transformer tank for interchanging the cooler banks and associated accessories on either side of the main tank**.

25.1.8. The sides on the Main tank which is not utilized shall be blanked suitably by providing valve arrangements.

25.1.9 **For the cooler circuits Two (2) grounding terminals suitable for termination of two (2) Nos. 75x12 mm galvanised steel flats.**

25.2.0. Oil piping and flanges

25.2.1. Necessary oil piping shall be provided for connecting each transformer to the coolers and oil pumps. The oil piping shall be with flanged gasketed joints. Cast iron pipes shall not be used.

25.2.2. A **suitable expansion joints** shall be provided, in each oil pipe connection, between the transformer and the separately mounted oil coolers.

25.2.3. Drain valves/plugs shall be provided in order that each sections of pipe work can be drained independently. The Drain **shall be provided with valves** and shall be provided with blanking plates.

25.2.4. The drilling of all pipe flanges shall comply with IS:3639.

25.3.0. Oil pumps

25.3.1. Each forced oil cooler shall be provided with two 100%, motor driven, oil pumps of the on-line type and of adequate capacity, out of which, one will be connected standby. The oil pump shall be of impeller type to permit oil circulation when the pump is idle.

25.3.2. It shall be possible to remove the pump and motor from the oil circuit without having to lower the level of oil in the transformers or coolers and without having to disturb the pump foundation fixing. Oil pump shall be capable of dealing with the maximum output of transformer and total head which may occur in service and with the varying head due to changes in the viscosity of the oil.

25.3.3. Each pump assembly shall be provided with an oil flow indicator with alarm contacts to indicate normal pump operation and oil flow.

25.3.4. Measures shall be taken to prevent mal-operation of Buchholz relay when all oil pumps are simultaneously put into service. Suitable baffles shall be provided inside the tank at oil inlet points when forced oil circulation is used.

25.4.0. Air blowers/fans

25.4.1. Adequate number of air blowers/fans, for use with oil coolers shall be provided. They shall be suitable for continuous outdoor operation; **Two numbers connected -**

standby air-blowers, one in each cooler bank, shall also be provided additionally.

25.4.2. Air blowers/fans shall be capable of withstanding the stresses, imposed when brought up to speed by the direct application of full line voltage to the motor.

25.4.3. Air blowers/fans shall be complete with all necessary air-ducting and coolers shall be designed so that they operate with a minimum of noise or drumming. They shall not be mounted-on to the radiators and must be physically separate from the radiators. It shall be possible to remove the blower complete with motor, without disturbing or dismantling the cooler structure frame work.

25.4.4. If fans are mounted at a height less than 2.5m, suitably painted wire-mesh guards with a mesh, not greater than 25 mm, shall be provided to prevent accidental contact with the blades. Fans mounted at more than 2.5 m, height, shall be provided with outside guards against birdage. Fans shall be so mounted that hot air shall not get directed towards the transformer.

25.5.0. Motors

25.5.1. Motors shall be of the squirrel cage, totally enclosed, weather proof type and shall comply with IS:325. The motors shall be capable of operating at all loads without undue vibration and with a minimum noise. They shall be suitable for direct starting and for continuous running from 415-440 volts, three phase, 4 wire, 50 Hz supply.

25.5.2. Motors shall also be capable of continuous operation at 85 percent of the nominal voltage, at normal frequency, without injurious overheating. Motors shall be provided with thermal overload and short circuit protection.

25.6.0. Local cooler control cubicle:

25.6.1. Each transformer shall be supplied with outdoor type, vermin and weather proof local cooler control cubicle for accommodating the control gears of the cooling fans and pumps, besides cable termination from remote tap changer control panel and other transformer accessories.

25.6.2. The cooler control cubicle shall be provided with three pole, electrically operated, contactor and with control gears of suitable design, both for starting and stopping the individual oil pumps and groups of cooling fans, manually and also automatically, from the contacts of the Winding Temperature Indicating device. These shall be accommodated in the local cooler control cubicle.

25.6.3. The local control panel shall have all necessary devices meant for cooler control viz.

(a) MCBs of adequate capacity for main supply.
(b) Protection against over load
(c) Protection against single phasing

(d) Selector switch for Manual/Automatic operation of individual pump & groups of cooling fans

(e) Selector switch for Local/Remote operation of individual pumps and groups of cooling fans

(f) Pump control ON/OFF/Test for each pump. (for applicable capacity)

(g) Fan control ON/OFF/Test for each fan.

25.6.4. The following additional terminals shall be provided in the cooler control cubicle for remote indication.

a) Oil flow fail alarm.
b) Cooling fan trip(for each group of fans & standby)
c) Cooler pump trip (for each pumps in service & standby)
d) Cooler supply failure.
e) Low oil level alarm.

25.6.5. The following initiating contacts for lamp indicators shall be provided for local as well as remote indication

(a) Cooling system is on 'Manual' control
(b) Cooling system is on 'Automatic control'.
(c) Selector switch is in 'Auto' or 'Manual'or 'Local'
(d) Pump 'ON', pump 'OFF' for each pump
(e) Fan 'ON' / 'OFF' for each group each group of fan and each pump.
(f) Oil flow failure.

25.6.6 All the fans and pumps are to be properly earthed individually and to be terminated with the main earth suitably

26.0. GAS AND OIL ACTUATED RELAYS (BUCHHOLZ RELAY)

26.1. **Double float, Reed Type** gas detector relay (Buchholz relay) conforming to IS 3637 shall be provided with the following:

a) Two electrically independent ungrounded contacts to cause an alarm and tripping in the event of accumulation of gas and sudden changes in oil pressure.
b) Shut off valve of 80mm on either side of the relay and flange coupling, to permit easy removal , without lowering oil level in the main tank.
c) A drain plug at the bottom most point of the relay-casing.
d) A test cock suitable for a flexible pipe connection for checking its operation and taking gas sample
e) A copper or stainless steel tube shall be connected from the gas collector to a valve located at about 1200 mm above ground level to facilitate sampling, with the transformer in service
f) Locking arrangement during transport.

26.2. The arrangement for mounting this relay, the associated pipe work shall be such that all gas emitted from the transformer shall pass into the relay and mal-operation of the relays shall not take place under normal service conditions.

26.3 **The relay with Mercury switches shall be dispensed with.**

26.4 **The Bucholz relay should be insensitive to vibrations and shocks with acceleration up to 0.5 g.**

26.5 The protection cables to the Bucholz relay and OSR shall be terminated only on the side or in the bottom of the relay.

26.6 The termination Box shall be dust and water resistance proof.

27.0. TEMPERATURE INDICATORS / CONTROLLERS

27.1. Oil temperature indicator (OTI)

The transformer shall be provided with one 150 mm dial type, oil-temperature indicator for indicating top oil temperature. The indicator shall have adjustable, electrically independent ungrounded alarm & trip contacts with micro switches, and maximum reading pointer. The temperature sensing element shall be suitably located in a pocket on the top of the transformer and shall be connected to the oil temperature indicator by means of capillary tubing protected with a metal sheath. The accuracy class of the OTI shall be ± 1.00 %.

27.2. Winding temperature indicator (WTI)

The transformer shall also be provided with a device for indicating the Spot temperature of each winding (HV & LV). It shall comprise the following:

a) Temperature sensing element suitably located on the top cover of the transformer

b) Image coil

c) Auxiliary CTs, if required to match the image coil, shall be mounted in the cooler control cabinet.

d) 150 mm dial, local indicating instrument with maximum reading pointer, mounted in the cooler control cabinet and two adjustable electrically independent, ungrounded contacts with micro switches (besides that required for control of cooling equipment). The tripping contacts shall be adjustable to close between 60^{o}C and 120^{o}C and alarm contacts to close between 50^{o}C and 100^{o}C and both shall re-open when the temperature has fallen by a desired amount between 5^{o}C and 20^{o}C. All contacts shall be adjustable on a scale. They shall be accessible on removal of the cover and it shall be possible to check the operation of the contacts and associated equipments. Connections from the contacts shall be brought down to the terminal BLOCK, placed inside the marshalling Box. The accuracy class of the WTI shall be ±1.00 %.

e) Calibration device

28.0. MARSHALLING BOX

The Marshalling Box shall be tank mounted type and shall not hinder the access to inspection covers, vermin and weather proof marshalling box, shall be provided with a controlled metal-clad heater to accommodate the following:

(a) Temperature indicators/controllers.

(b) Terminal blocks, made up of molded, non inflammable plastic material with adequate size terminals, washers, binding screws/nuts for external wire connections, a white marking strip for circuit identification and a molded plastic cover.

(c) Suitable glands with gland plates for incoming and outgoing cables, meant for oil level alarm, Temperature alarm/Trip, Buchholtz alarm/trip, annunciation and indication provisions for RTCC panel etc.

(d) The internal wiring provided in the marshalling Box shall be of FRLS 1100/650V grade stranded copper conductor, PVC insulated, PVC sheathed, steel wire armoured and PVC jacketed cable of required size as applicable.

(e) Isolator Transformer of adequate capacity shall be provided for the Main AC control supply in Marshalling Box.

(f) Suitable three (3) phase MCB with Neutral (3 phase 4 way MCB) and socket of current rating of 32 Amps shall be provided for AC supply arrangement.

(g) The provision for stand by AC supply to the marshalling box from the control room is to be eliminated.

(h) The terminal Box wiring pertaining to CTs shall be independent and not combined with annunciation and other indication circuits.

(i) The Marshalling Box shall be independent and floor mounted type to prevent vibrations for all capacity of transformers with proper grounding.

(j) The indication lamps provided for fans and pumps in Cooler control Cubicle or in Marshalling box as applicable shall be eliminated.

29.0. AUXILIARY POWER SUPPLY CONTROL PANEL FOR OLTC AND COOLER CONTROL

29.1. Auxiliary power supply shall be provided by the purchaser at one place for OLTC control and cooler control.

29.2. Control cabinet for OLTC control and cooler control shall be of free standing, floor mounting type.

29.3. Control cabinet can be made out of 3mm thick sheet steel or 10mm thick aluminium plate/Aluminium casting. Hinged door shall be provided with padlocking arrangement. Sloping Rain-hood shall be provided to cover all sides. 15mm thick Neoprine or better type of gaskets shall be provided to ensure high degree of protection as per IS2147. The painting shall be as specified earlier.

29.4. Auxiliary electrical equipments to be supplied by the tenderer shall be suitable for operation on the following supply system :

a.	Power devices like drive motors rating 1 KW and above	415V, 3 phase 4 wire 50 Hz, neutral grounded AC supply
b.	Lighting, space heaters and fractional KW motors	240V, single phase, 50 Hz neutral grounded AC supply
c.	Alarm, control and protective devices	220/110V, 2 wire DC supply

29.5. All AC loads shall be fed by one of the two feeders through an electrically interlocked automatic transfer switch housed in any one of the local control cabinets. Design features of the transfer-switch shall include the following:

a) Selection of one of the feeders as normal source and other as stand by
b) Upon failure of normal source, automatic transfer of loads from normal source to the standby source after an adjustable time delay
c) Indication for" failure of normal source" and for transfer to standby Source" and also for "failure to transfer" shall be provided locally and as well as in the remote tap changer control panel.
d) Automatic retransfer to normal source with an adjusted time delay, following re-energisation of the normal sources.
e) The transfer and re-transfer shall not cause paralleling of the two sources at any time.

29.6. Necessary Isolating-switches, MCBs and other components for the above power supply transfer arrangement shall be in the scope of the supply of the supplier.

29.7. Bus bars, if used, shall be tinned copper of adequate cross section to carry the normal current without exceeding the permissible temperature rise over an ambient temperature of 50^{o} C.

29.8. Isolating-switches shall be group operated units (3/4 pole for use on 3 phase supply system and 2 pole for single phase supply system), quick make and break type capable of breaking the rated current of the associated circuit safely. Switch handle shall have provision for locking in both fully opened and fully closed positions.

29.9. Push button shall be rated for not less than 6 Amps, 415 V, AC or 2 Amps, 220/110V DC and shall be flush mounted on the cabinet door and provided with appropriate name plates. Red, Green and Amber indicating lamps shall be flush mounted.

29.10 <u>FOR APPLICABLE CAPACITY OF TRANSFORMERS</u>

(i) For motors up to 5 KW, contactors shall be direct-on-line, air break, single throw type and shall be suitable for making and breaking the stalled current of the associated motor which shall be assumed equal to 6.5 times the full load current of the motor at 0.2 p.f.

(ii) For motors above 5 KW, automatic star-delta type starters shall be provided. 3 pole contactors shall be furnished for 3 phase motors and 2 pole contactors for single phase motors. Reversing contactors shall be provided with electrical interlocks between forward and reverse contactors. If possible, mechanical interlocks shall also be provided. Contactors shall be suitable for uninterrupted duty and shall be of duty category class AC4 as defined in IS:2959. The main contacts of the

contactors shall be silver plated and the insulation class for the coils shall be class E or better. The dropout voltage of the contactors shall not exceed 70% of the rated voltage.

(iii) Contactors shall be provided with a three element, positive acting, ambient temperature compensated, time lagged, hand reset type thermal overload relay with adjustable setting, hand reset button shall be flush with the front door of the cabinet and suitable for resetting with starter compartment door closed.

29.11. Single phasing preventer relay shall be provided for 3 phase motors to provide positive protection against single phasing.

29.12. Mini starters shall be provided with No-volt coils whenever required.

29.13. Purchaser's power cable shall be **FRLS** 1100/650V grade stranded copper conductor, PVC insulated, PVC sheathed, steel wire armoured and PVC jacketed cable. All cable terminating accessories such as brass cable glands, lugs etc. shall be included in the scope of supply.

29.14 Separate Terminal-Blocks shall be provided for circuits of various voltage classes.

29.15. The terminal blocks shall be 1100V grade and have 10 Amps continuous rating. They shall be fully enclosed with removable slip-on/clip-on covers and made of molded non-inflammable plastic material with block and barrier molded integrally. Such blocks shall have non-disconnecting stud type terminals, washers, nuts and lock nuts. All terminals shall be clearly marked with identification numbers or letters to facilitate connection to external wiring. No live metal shall be exposed at the back of the terminal blocks.

29.16. In all terminal blocks at least 20% spare terminals shall be provided uniformly.

29.17 The terminal blocks meant for control circuits shall be suitable for connecting minimum of 2 numbers of 2.5 sq.mm. Copper cable. Terminals meant for CT circuits shall be capable of accommodating at least 2 numbers of 4 sq.mm. copper cable.

29.18. The terminal boards shall be mounted obliquely towards the rear doors to be easily accessed to termination and to enable ferrule numbers to be read without difficulty. The terminal boards shall be placed at least above a distance of 250mm from the cable gland so as to permit satisfactory arrangement of multi core cable tiles.

29.19.Terminal board rows should be spaced not less than 150mm apart to permit convenient access to wires and terminations.

29.20. Control cabinet shall be provided with a 230V **LED** lamp operated by a door switch.

29.21. The cabinet shall be provided with a 240V, single phase, 5 amps, 3 pin socket for hand lamp.

29.22. Strip heaters shall be provided inside the cabinet with thermostat (preferably differential type) to prevent moisture condensation. The heaters shall be controlled by suitably rated double pole miniature circuit breakers.

29.23. Signal lamps provided shall be of neon, screw type, with wire & resistors enclosed in bakelite body. Each signal lamp shall be provided with a fuse integrally mounted in the lamp body. If separate fuse units are used they shall be of the cartridge type. Fuses shall be labeled.

29.24. Electric measuring instruments shall be of moving iron type. Ammeters for measuring currents upto 30 amps shall be directly connected while those for measuring above 30 amps shall be connected through suitable CT's. Ammeter and Voltmeters shall be provided with selector switches.

29.25 The terminal Box wiring pertaining to CTs shall be independent and not combined with annunciation and other indication circuits.

30.0. REMOTE TAP-CHANGER CONTROL PANEL

The Remote In-door Tap Changer control cubicle of height 2312 mm with sufficient inner working space for easy access to the instruments, wherever necessary, shall house the following:

30.1. Controls :

a) Push button switch to Raise/Lower the tap.
b) Tap position indicator (digital type).
c) Selector switch for Local/Remote operation.
d) Four position Selector switch for Independent/OFF/Master/Follower.
e) Emergency 'supply - off ' push button.
f) Relays, Heater, illumination lamps,MCBs etc.
g) Control selector switch for thé fans of the cooler

30.2. LAMP INDICATIONS for the following (ON: Red indication; OFF: Green indication)

a) Cooling pump ON/OFF (Group)
b) Cooling fans ON/OFF (Group).
c) OLTC supply HEALTHY.
d) Cooler control on AUTOMATIC/MANUAL.
e) Tap change IN-PROGRESS.
f) Selector switch on `AUTO' or `MANUAL' or `LOCAL' for each fan groups.

30.3. Facia type annunciation scheme for the following trip, non-trip & alarm INDICATIONS, suitable for 220V/110V DC operation.

a) Pressure Relief Device -trip
b) Bucholtz Relay - alarm

c) Bucholtz Relay - trip
d) Winding Temperature Indicator – alarm
e) Winding Temperature Indicator - Trip
f) Oil Temperature Indicator - alarm
g) Oil Temperature Indicator – trip
h) Tap Changer Surge Relay - trip
i) Tap Changer Drive Motor – trip
j) Tap Changer Out of Step - alarm
k) Tap change delay - indication
l) OLTC supply failure relay- alarm
m) Cooling Fan – trip (For each group of fans & standby)
n) Cooling Pump – trip (For pumps in service & standby)
o) Cooler supply failure indication
p)Oil flow fail – alarm
q)Low oil level – alarm
r) Air cell failure indicating relay – alarm
s) Spare contactors- 4Nos.

31.0 FITTINGS AND ACCESSORIES

The fittings and accessories, mentioned in this specification, are only indicative and any other fittings which are generally required for satisfactory operation of the transformer are deemed to be included.

32.0. CENTRE OF GRAVITY

The centre of gravity of the assembled transformer shall be low and as near the vertical centre line as possible. The transformer shall be stable with or without oil. If the centre of Gravity is eccentric, relative to track either with or without oil, its location shall be shown in the "Outline" drawing.

33.0. CONTROL WIRING, TERMINAL BOARDS, FUSES ETC.

33.1. All wiring connections, terminal boards, fuses and links shall be suitable for tropical atmosphere. Any wiring liable to be in contact with oil shall have oil resisting insulation and the Board ends of stranded wire shall be sweated together to prevent creepage of oil along the wire.

33.2. There shall be no possibility of oil entering into the connection boxes, used for cables or wiring.

33.3. Panel connections shall be neatly and squarely fixed to the panel. All instruments and panel wiring shall be run in PVC or non-rusting metal cleats of the limited compression type. All wiring to a panel shall be taken from suitable terminal boards.

33.4. Where conduits are used, the runs shall be laid with suitable falls, and the lowest parts of the run shall be external to the boxes. All conduit runs shall be adequately drained and ventilated. Conduits shall not be run at or below ground level.

33.5. When 415 Volt connections are taken through junction boxes or marshalling boxes they shall be adequately screened and "415 volts Danger" notices must be affixed to the outside of the junction boxes or marshalling boxes.

33.6. All box wiring shall be in accordance with relevant IS. **All wiring shall be of stranded copper of 1100 grade and size not less than 4.00 sq.mm. for CT leads and not less than 2.5 sq.mm. for other connections.**

33.7. All wires on panels and all multicore cables shall have ferrules which bear the same number at both ends.

33.8. At those points of interconnection between the wiring carried out by separate contractors, where a change of number cannot be avoided, double ferrule shall be shown on the appropriate diagram of the equipment.

33.9. The same ferrule numbers shall not be used on wires in different circuits on the same panels.

33.10. Ferrule shall be of yellow insulating material and shall be provided with glossy finish to prevent the adhesion of dirt. They shall be clearly and durably marked in black and shall not be affected by damp or oil.

33.11. Stranded wires shall be terminated with tinned Ross countney terminals, claw washers or crimped tubular lugs. Separate washers shall be used for each wire. The size of the washers shall be suitable to the size of the wire terminated. Wiring shall, in general, be accommodated on the sides of the box and the wires for each circuit shall be separately grouped. Back of panel wiring shall be arranged so that access to the connecting stems of relays and other apparatus is not impeded.

33.12. Wires shall not be jointed or tied between terminal points.

33.13. Wherever practicable, all circuits in which the voltage exceeds 125 Volts, shall be kept physically separated from the remaining wiring. The function of each circuit shall be marked on the associated terminal boards.

33.14. Where apparatus is mounted on panels, all metal cases shall be separately earthed by means of copper wire or strip having a cross section of not less than 2.0 sq.mm. where strip is used, the joint shall be sweated.

33.15. All wiring diagram for control and relay panel shall preferably be drawn as viewed from the back and shall show the terminal boards arranged as in service. All diagrams shall show, which view is employed.

33.16. Multicore cable tails shall be so bound that each wire may be traced without difficulty to its cable.

33.17. The screens or screen pairs of multicore cable shall be earthed at one end of the cable only. The position of earthing connections shall be shown clearly on the diagrams.

33.18. All terminal boards shall be mounted obliquely towards the rear doors to give easy access to terminations and to enable ferrule numbers to be read without difficulty.

33.19. Terminal board rows should be spaced adequately, not less than 100 mm apart, to permit convenient access to wires and terminations.

33.20. Terminal boards shall be so placed with respect to the cable gland (at a minimum distance of 200 mm), as to permit satisfactory arrangement of multicore cable tails.

33.21. Terminal boards shall have pairs of terminals of incoming and outgoing wires. Insulating barriers shall be provided between adjacent connections. The height of the barriers and the spacing between terminals shall be such as to give adequate protection while allowing easy access to terminals. The terminals shall be adequately protected with insulating dust-proof covers.

33.22. No live metal shall be exposed at the back of the terminal boards.

33.23. All fuses shall be of the cartridge type.

33.24. Fuses and links shall be labeled.

34.0. QUALITY PLAN AND INSPECTION

34.1. The tenderer shall furnish the programme of manufacturing works well in advance.

34.2. The purchaser or the accredited representative of the purchaser shall have access to the contractor or sub-contractor's works at any time during working hours for the purpose of inspection of manufacture and selection of samples of the materials going into the equipment and testing. The contractor shall provide necessary facilities for such inspection or test.

34.3. Documents like invoice or receipted chalans, detailing the source of supply of raw materials and their specification, shall be shown by the supplier on demand either during the manufacturing process or at the time of inspection of the transformer .

34.4. The core and coil assembly, shall be offered for inspection and to verify the guaranteed technical parameters prior to connections and tanking. The readiness for such inspection shall be intimated at least 15 days in advance. Further process of manufacture of core and coil assembly, shall be taken up only after our approval in this regard.

34.5. The transformers shall be completely assembled arrange for conducting all the TYPE/SPECIAL/ROUTINE tests as per IS 2026 of latest issue at manufacturers work or at the accredited laboratories, in the presence of purchaser or the accredited representative of the purchaser. The readiness of the transformer with all its accessories for testing/inspection shall be intimated at least 15 days in advance. The transformer shall be despatched only after the approval of the test certificates by the purchaser.

34.6 QUALITY ASSURANCE

A. A quality assurance programme shall generally cover the following:

1. Organization structure for the management and implementation of the proposed quality assurance programme
2. Document control system
3. Qualification data for bidder's key personnel
4. The procedure for purchases of materials, parts, components and selection of Sub-contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases, etc.,
5. System of shop manufacturing and siteerection controls including process controls and fabrication and assembly control
6. Control of non-conforming items and system for corrective actions
7. Inspection and test procedure both for manufacture and field activities
8. Control of calibration and testing of measuring instruments and field activities
9. System for indication and appraisal of inspection status
10. System for quality audits
11. System for authorising release of manufacture product to the Purchaser
12. System for maintenance of records
13. System for handling storage and delivery
14. The manufacturing quality plan detailing out the specific quality control measures and procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered.
15. A field quality Plan covering field activities.

B. The manufacturing & Field quality Plans shall be mutually discussed and approved by the Purchaser after incorporating necessary corrections by the Supplier as may be required.

C. The Purchaser or his duly authorised representative reserves the right to carryout quality audit and quality surveillance of the system and procedure of the Purchaser / his vendor's quality management and control activities

D. The Bidder would be required to submit all the Quality Assurance documents as stipulated in the quality Plan at the time of Purchaser's Inspection of equipment/ material.

34.7 The supplier shall ensure that pre-dispatch inspection for materials are intimated only when the material is completely ready for inspection. On due date of inspection, if it is found that materials are not ready in required quantities or the inspection could not be carried out due to non-availability of requisite calibrated certificate of instruments with manufacturer, closing of works on scheduled date of inspection, non-availability of sufficient testing/material handling staff at manufacturer works etc, all expenditures incurred on deployment of various inspecting officials along with a fine of Rs. 25,000/- shall be recovered from the bills of the supplier and re-inspection shall be carried out on expense of supplier.

35.0 TESTING:

35.1 TYPE TEST:

(a) All the TYPE Tests validity **should be within FIVE (5)**years as on the date of tender opening as per IS 2026 / IEC 60076 and latest issue of IS/IEC:

(b) All the TYPE Tests as per IS 2026 / IEC 60076 and latest issue of IS/IEC are to be carried out at **Suppliers Cost** on the 1st unit or any one of the designated unit at the discretion of TANTRANSCO at NABL accredited CPRI / ERDA / International Accredited Laboratory/ any other Government approved / Government recognized laboratory or in the presence of Purchaser's representatives or by third party agency (ERDA/CPRI/ International Accredited Laboratory) tested with the testing instruments / equipment having valid calibration certificate issued from third party agency (ERDA/CPRI / International Accredited Laboratory).

The **Type test reports** which could not be re-validated due to lock down in the country since 23rd March 2020 shall be treated as valid upto 30th September 2022.

The above extension is a one time measure and shall not be extended further. The tenderers are advised to get such equipment **Type Tested** before 30th September 2022.

35.2 SPECIAL TEST:

The bidder should furnish Dynamic Short Circuit test report with validity within five (5) years as on the original date of Technical bid opening from Government/ Government recognized laboratories / International Accredited Laboratory conforming with latest IS / IEC for 100 MVA or above capacity of 220 or 230KV or above Voltage Class transformer.

Note: If validity of Short Circuit Test is not available an undertaking that the supplier will carry out S. C. Test at Government/ Government recognized laboratories / International Accredited Laboratory conforming with latest IS / IEC for 100 MVA, 230/110KV Auto Transformer at Supplier cost with no cost implication to TANTRANSCO.

35.3 ROUTINE TEST:

All the ordered quantity as per IS 2026 of latest issue / IEC 60076 shall be carried out at suppliers COST in the presence of purchaser or purchaser's representative or by the third party agency (ERDA/CPRI) **with the testing instruments / equipment having valid calibration certificate issued from third party agency (ERDA/CPRI)**.

35.4 The supplier shall ensure that the testing instruments and equipment used for testing/measurements have calibration certificates issued by a Government recognized /Government laboratory or **the testing instruments / equipment have calibration certificate issued from third party agency (ERDA/CPRI)** not earlier than one year from the date of testing used for testing/measurements.

35.5 The correction for the errors of measuring instruments / testing transformers and resistance of test connections shall be applied, as specified in IEC before coming to the conclusion on the test results.

35.6 i) One unit of out of the ordered quantity will be selected at the discretion of TANTRANSCO shall be tested for measuring No-load and load losses concurrently by **at NABL accredited** CPRI / ERDA / **any other Government approved /** Government recognized High Voltage testing laboratory and tested **with the testing instruments / equipment having valid calibration certificate issued from third party agency (ERDA/CPRI)** as decided by TANTRANSCO. The

arrangements connected towards testing shall be made by the supplier and recouped from TANTRANSCO on actuals, if the losses are proved to be within the guaranteed limits.

ii)If the losses are found to be higher than the guaranteed values, necessary compensation charges (for excess over losses) shall be levied as per the formula specficed in the Volume-II of the bid Document.

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

35.8 The Purchaser at its discretion may re-test the same Transformer or any other Transformer (s) at a Govt./or Govt. Recognized laboratory of his choice for reconfirmation of the test results, particularly no load losses, load losses and percentage impedance, which will be taken as the final and binding as per the clause 35.6 mentioned above.

36.0. <u>Type / Special / Routine Tests :</u>

36.1. i) The following Type /special tests as per IS 2026 of latest issue shall be carried out on the first unit or any other unit at the discretion of TANTRANSCO at Supplier's cost in the presence of TANTRANSCO's representative.

(a) <u>Oil Leakage Test</u>

All tanks and oil filled compartments shall be completely filled with air or oil of a viscosity not greater than that of insulating oil conforming to IEC 60296 at the ambient temperature and subjected to a pressure equal to normal head of oil plus 35 kN/sq.m (5 psi) measured at the base of the tank. This pressure shall be maintained for a period of not less than 12 hours for oil and 1 hour for air during which no leakage shall occur.

(b) <u>Vacuum test on the transformer tank</u>: The transformer tank shall be tested at an internal pressure of 3.33 KN/sq.m. (25 torr) for one hour. The permanent deflection of flat plates, after the vacuum has been released, shall not exceed the values below and the performance of the transformer shall not be affected in any way.

Horizontal length of Flat Plate (mm)		Permanent deflection (mm)
Upto and including 750	-	5
751- 1250	-	6.5
1251 to 1750	-	8.0
1751 to 2000	-	9.0
2001 to 2250	-	11.0
2251 to 2500	-	12.5
2501 to 3000	-	16.0
Above 3000	-	19.0

(c) Pressure test: The transformer tank shall be subjected to a pressure corresponding to twice the normal head of oil or to normal pressure plus 35 KN/sq.m. whichever is lower. The applied pressure shall be measured at the base of the tank and maintained for **Eight hours**. The equivalent air pressure corresponding to oil pressure calculated at the base of the tank to be considered for Air Pressure test. The permanent deflection of flat plates, after the excess pressure has been released, shall not exceed the values specified under the caption 'Vacuum test'.

(d) Temperature rise test at the lowest tap.

(e) Full wave lightning Impulse voltage withstand test on all three phases including chopped impulses on principle tap and extreme taps. (This test shall precede power frequency high voltage tests).

(f) Capacitance and Tan-delta measurement

(g) Zero sequence impedance test.

(h) Noise Level Test.

(i) Measurement of harmonic voltages

(j) Measurement of transformer oil required for first filling for entire transformer including radiators, coolers, conservator, etc.

36.2 STAGE & FINAL INSPECTION

The supplier shall offer the core, windings and tank of each transformer for inspection by the purchaser's representative(s). During stage Inspection, all the measurements like diameter, window height, leg centre, stack width, stack thickness, thickness of laminations etc. for core assembly, conductor size, Insulation thickness, winding height, major and minor insulations for both H.V and L.V windings, length, breadth, height and thickness of plates of Transformer tank, the quality of fittings and accessories will be taken / determined.

The supplier can offer for final inspection of the transformers subject to clearance of the stage Inspection report by the purchaser.

The proforma for Stage & Final inspection is furnished in Annex. VIII & IX.

The manufacturer shall offer the core for stage inspection and get approval from purchaser during manufacturing stage. The BIS certified prime core materials are only to be used. The manufacturer has to produce following documents at the time of stage inspection for confirmation of use of prime core materials.

a) Invoice of supplier
b) Mills approved test certificates
c) Packing list
d) Bill of lading
e) Bill of entry certificate by custom.
f) Description of material, electrical analysis, physical inspection, certificate for surface defects, chemical composition certificate, thickness and width of the materials
g) Place of cutting of core materials

36.3 ROUTINE TESTS (for Acceptance):

The following Routine tests as per IS 2026 of latest issue and special tests shall also be carried out on all the transformers, at supplier's cost.

(a) Measurement of winding resistance on all taps.
(b) Measurement of voltage ratio on all taps and check of voltage vector relationship.
(c) Measurement of impedance voltage/short circuit impedance, load-loss & spill current at principal and extreme taps. The test shall be repeated at 415 volts for comparison during pre-commissioning tests at site.
(d) Measurement of No-load loss and current corresponding to normal & extreme taps at 100%, 90% and 110% of rated voltage.
(e) Measurement of insulation resistance.
(f) Dielectric Tests (Short duration Power frequency withstand voltage test and Induced over voltage withstand test with line/leakage current measured)
(g) Oil leakage test on transformer tank: The tank and oil filled compartments shall be tested for oil tightness by completely filling with air/oil of viscosity not greater than that of insulating oil, conforming to IS:335 1983/'87 at the ambient temperature and applying a pressure, equal to the normal pressure plus 35 KN/sq.m. measured at the base of the tank. This pressure shall be maintained for a period of not less than 12 Hours for oil and 1 Hour for air during which time no leakage shall occur.
(h) Magnetic balance test.
(i) Measurement of No-load current with 415 Volts supply.
(j) Check of polarity and ratio, tests for knee point voltage, and magnetizing current for Bushing current transformer.
(k) Tests on On- load tap changer (fully assembled on transformer) as per Clause 10.8 of IEC: 60076-1 as referred in Clause 5.3 of IEC:60214/2003.
(l) Measurement of neutral unbalance current which shall not exceed 2% of the full rated current of the transformer
(m) **Sweep Frequency Response Analysis Test (SFRA Test) shall also be conducted at works.**
(n) **Full wave lightning Impulse voltage withstand test on all three phases including chopped impulses on principle tap and extreme taps.(This test shall precede power frequency high voltage tests).**
(o) Capacitance and Tan-delta measurement

The test sequence shall be:- Tests on transformer tank, Heat run test, Oil leakage test on the assembled transformer, Impulse test, Routine tests and Special tests.

36.4 FURTHER TESTS

i) The purchaser reserves the right of having other reasonable tests carried out at his own expense either before transport or at site, to ensure that the transformer complies with the requirements of our specification.

ii) It may also be noted that the purchaser reserves the right to conduct **Short Circuit Test, Temperature rise test and Impulse Voltage Withstand Test** in accordance with the IS, afresh on each ordered rating at Purchaser's cost as and when required, even if the transformers of the same rating and similar design are already tested. This test shall be carried out on **any no. of transformer either** offered for inspection or randomly from supply already made at site and under erection. **The finding and conclusion of these tests shall be binding on the supplier.**

36.5. TEST CERTIFICATES

36.5.1. Six copies of the test certificates on the above type tests/ special tests/ routine tests with the endorsement of the inspecting officer shall be furnished to the Superintending Engineer / TR.II / 5th Floor, Northern Wing, TANTRANSCO Building, 144, Anna Salai, Chennai -2.

36.5.2. The test report shall contain the following information.

i) Complete identification data, including serial No. of the transformer.
ii) Method of application where applied, duration, and interpretation of results in each test.
iii) Details of Temperature rise corrected to 75 ^{o} C .

36.5.3.The equipment will be rejected if test results are not in conformity with the Guaranteed Technical particulars.

36.5.4. Besides the above test certificates, manufacturer's test certificates in respect of the following accessories shall also be furnished in sixtuplicate.

a) Bushings (HV, IV, LV & Neutral).
b) Buchholtz relay and surge relay.
c) Magnetic oil level gauge.
d) Winding Temperature Indicator.
e) Oil Temperature Indicator.
f) Radiators.
g) Transformer oil(including Dissolved Gas Analysis tests)
h) OLTC

36.5.5. TYPE TEST FOR BOUGHT OUT COMPONENTS:

Tenderers are requested to furnish along with tender copy of type test certificates for the bought out components in full shape as conforming to relevant IS/IEC standards of latest issue obtained from a Government / Government Recognized Laboratory. The above test certificates should accompany the drawings of the material/equipments, duly signed under seal by the institution who has issued the type test certificate.

Otherwise the above type test certificates shall be furnished before the offer of inspection for the first lot of materials/ equipments at no extra cost to TANTRANSCO and no relaxation to TANTRANSCO's Delivery clause will be given on this accounts.

The above type test should have been conducted not earlier than five years (5 Years) as on the date of tender opening. Non submission of above type test certificates within the stipulated time will entail cancellation of Purchase Order without any further reference to supplier.

The original type test certificate shall be furnished for verification on request. The details of type test if already conducted should be furnished in the Schedules II.

36.5.6. The supplier shall also furnish test certificates to the effect that the withstand capability of the insulation between the core and all core bolts, side plates & structural frame has been tested with 2000 Volts AC for one minute after assembling the core and prior to the despatch of the transformer.

36.6. TESTS AT SITE :

36.6.1. After erection at site and prior to commissioning, the transformer shall be subjected to the following tests by the purchaser in the presence of the supplier at TANTRANSCO'S cost.

(a) Insulation resistance test.
(b) Ratio and polarity test on all taps.
(c) All relevant tests on oil.
(d) Open circuit and short circuit test.
(e) Tests on the operation of OLTC.
(f) Tests on the protective devices and interlocks.
(g) Measurement of winding resistance at all taps.
(h) Vector group verification
(i) Capacitance and Tan-delta measurement on windings and bushings
(j) Dissolved gas analysis on transformer.(The test figures will form the base values for comparison in future.).
(k) SFRA (Sweep Frequency Analysis) Test.
(l) Other tests that may be required to ensure that the transformer complies with the requirements of the specification.
(m) Dissolved gas analysis on transformer. (The test figures will form the base values for comparison in future.)

36.6.2 After erection at site and prior to commissioning, the Transformer shall be subjected to the following tests by the ***Purchaser in the presence of the supplier at supplier's cost at TANTRANSCO / TANGEDCO Laboratory.***

(a) All relevant tests on oil.

(b) Dissolved Gas Analysis on Transformer (The test figures will form the base values for comparison in future).

(c)**Oil Samples shall be taken from the <u>Main Tank as well as from the OLTC and to be got tested separately</u>**

37.0. <u>FIRE PREVENTION SYSTEM BY INJECTING NITROGEN GAS :</u>

1.0 All the transformers shall be provided with fire prevention system by injecting Nitrogen gas.

2.0 Technical specification

2.1. The fire prevention system shall protect the oil filled auto transformer against explosion fire that may emanate internally (during internal fault etc) and /or externally (such as failure of condenser bushing of the transformer under subject, other source of equipment etc).

2.2. The system may be an integral part of the transformer and of leak proof.

2.3. The system shall be of automatic operation in sensing and taking Prevention measures in protecting the transformer whenever internal/external fire risk arises.

2.4. The fire fighting equipment/ system shall operate normally on automatic mode. Additional facilities for remote/local control and manual operation shall also be provided with separate annunciation and indication in control room.

2.5. The tenderer shall indicate the maintenance and testing schedules required. Practically maintenance free system is preferred.

2.6. Inter locks shall be provided to prevent mal-operation.

2.7. The scope of this specification is for complete design, engineering, shop testing, supply and installation and commissioning of system for prevention of fire & explosion of Auto Transformers as indicated by TANTRANSCO.

2.8. The materials shall be manufactured as per Indian/ International Standards as applicable.

2.9. The tenderer may furnish the detailed working of the system offered meeting the requirement of national / international requirement for fire prevention. Necessary literatures, pamphlets, broachers etc required may also be enclosed along with tender offer.

2.10. Any modifications required in the transformer must be minimal and other related civil works may be indicated and this shall also be under the scope of installation.

2.11. The design, material, construction, manufacture, inspection, testing, commissioning and performance of equipment supplied shall comply with all currently applicable statues, regulations and safety codes. Deviations, if any, from the specification/ standards shall clearly be explained.

2.12. The scope of supply shall include all apparatus such as control boxes, piping, cabling, detectors, values, control, necessary cabinets etc., to make it fully operational.

2.13 Control box to be fixed in control room, with monitoring and mechanical releasing devices for automatic control/local operation with alarms, indication lights, switches, push buttons, audio signals suitable for tripping and signaling shall operate on 230 V AC supply. The control box must be installed in the control room of the substation as indicated by TRANTRANSCO based on control room lay out and feasibility. Necessary

cables, cable laying, marshaling cabinets in control room, cabinets for fixation of control boxes etc are under the scope of tenderer.

2.14. The tenderer must demonstrate the system commissioned is totally leak proof (Nitrogen and oil).Necessary visual indications must be provided.

3.0. **BRAND NAMES:**

The specific reference in these specifications and documents to any material by trade name, make or catalogue number shall be construed as establishing standard of quality and performance and not as limiting competition. However, bidders may offer similar equipment provided it meets specified design standards and performance requirements and the purchaser's approval.

4.0. **Schematic of the System.**

The Transformer Explosive and Fire Prevention System shall be a stand alone dedicated system for oil filled transformer. It shall have a fire extinguishing Cabinet placed on a plinth near the transformer. The Cabinet shall be connected to the transformer oil tank (near its top) and to the oil pit (of capacity approx. equal to 10% for transformer oil tank) from its bottom through oil pipes with gate valves and properly routed considering safety aspect.

The Cabinet shall house a pressurized nitrogen cylinder connected to the transformer oil tank (near its bottom). Cable connections are to be provided from the signal box placed on the transformer to the control box in the control room and from the control box to the Cabinet.

Heat detecting / Fire detecting system placed in transformer is to be connected in parallel to the signal box. The signal box shall be connected to a Shutter valve fitted between the conservator tank and Buchholz relay. Control box is also to be connected to the relay panel in the control room for system activation signals.

5.0**. Operation**

On receipt of all activating signals, the drain of a pre-determined quantity of oil commences thus removing high temperature top oil layer. After a time gap depending on the scenario, the nitrogen is injected inside the tank at a pre-fixed rate from the storage cylinder, stirring the oil thus bringing the temperature of oil down. Nitrogen occupies the top space created by oil drained out and acts as an insulting layer between the tank oil & fire, if any on top cover. Shutter valve blocks oil flow from conservator tank thus fully isolating transformer and preventing aggravation of fire.

6.0 **Performance Requirement of the System**

The system for prevention of fire and explosion of Auto Transformers shall act as fire preventer by preventing transformer oil tank explosion and possible fire in case of internal faults. In the event of fire by external causes such as bushing fires, OLTC fires fire from surrounding equipment etc., it shall act as a fast & effective fire fighter. The

Drain and Stir system shall accomplish its role as fire preventer using nitrogen and extinguisher without employing water and or carbon dioxide.

7.0. **Activation**

Mal-functioning of fire prevention / extinguishing system is their major shortcoming which leads to interruption in power supply. The supplier shall ensure that the chances of malfunctioning and leak of the Drain and Stir system is practically nil. To achieve this objective, the supplier shall work out his scheme of activating signals which will preventing mal-operation, should not be too rigorous to make the operation of the Drain and Stir system impracticable in case of actual need. Following electrical signals shall be provided in series for activating the system.

7.1 **Auto Mode:**

The system should activate upon reception of the following signals.

a) For prevention of Fire :1) Differential Relay Operation
2) Pressure Relief valve or RPRR (Rapid Pressure Release Relay)
3) Tripping of all connected breakers (As a Pre-requisite for initiation of system activation).

b) For Extinguishing of Fire:1) Linear Heat / Fire Detector
2) Buchholz Relay paralleled with Pressure Relief valve or RPRR (Rapid Pressure Release Relay)
3) Tripping of all connected breakers (As a Pre-requisite for initiation of system activation).

7.2. **Manual Mode** : Tripping of all connected breakers is a Pre-requisite for initiation of system activation.

In this mode, the Drain & Stir system should work in manual mode. The activation must be operated from the Control Box by switching the key from "automatic mode" to "manual mode", selecting a dedicated button to the manual activation. This leads to the opening of the Quick Depressurization Valve and injection of nitrogen 20 seconds later.

8.0. **Cabinet:**

It shall be made of 3 mm thick steel frame, painted darn red from inside and outside with hinged split doors fitted with high quality tamper proof lock. The protection of the cabinet should be IP55. The cabinet shall be complete with the base frame and the following:

Multiplication of connections
Oil drain pipe with mechanical quick drain valve
Electro mechanical 220VDC control equipment for oil drain with (protection IP20)

Pre-determined regulated nitrogen flow reducer to release the Nitrogen
Limit switches and monitoring for the system
Flanges on top panel for connecting oil drain and nitrogen injection pipes for transformer
Panel lighting (CFL / LED Type)
Oil Drain pipe extension of suitable sizes for connecting pipes of oil pit
Antisesmic mechanical protection
All electrical cables inside panel must be routed and channeled with cover.

9.0. **Cylinder:**

The Nitrogen gas cylinder should be of 50 / 60 Liters capacity and should be filled at a pressure of 200 / 150 Bars with falling pressure electrical contact manometer. Such cylinder with such capacity should have been already handled and delivered successfully by the supplier.

Additionally:

The Nitrogen Cylinder valve shall be of IP 67 protection

The Nitrogen shall be contained within the cylinder and released from the Cylinder Valve only upon activation of the Drain and Stir system (to avoid any possible leakage due to a multiplication of non IP 67 connections)

Nitrogen purity shall be equal or above 99,99%

Proper approvals and certificates should be available with the cylinder

10. **Draining valve:**

The Depressurization / Draining operation should be conducted (release of constrained oil through the butterfly valve) in no more than 0.2 seconds (time to have the Depressurization valve released totally) so as to allow an efficient depressurization process at the required moment.

11. **Control Box**

Control Box to be fixed in control room of substation as indicated by TANTRANSCO based on control room lay out and feasibility, for monitoring system operation, automatic control and remote operation, with following alarms indication, light switches, push buttons, audio signal, suitable for tripping and signaling on 220 V DC supply

System on
Conservator shutter valve open
Oil drain valve closed
Gas inlet valve closed
Shutter valve closed

Fire Detector / Linear heat detector Trip
Fire Detector/heat detector faulty
Oil drain valve open
Extinction Mode activated
Cylinder pressure low
Deferential relay trip
PRV/RPRR trip
Transformer trip
System Out of service
Auto/Manual/ Off lamp test
Visual / Audio Alarm

12. **Shutter Valve**

Shutter valve is to be fitted in the conservator pipe line between conservator & Buchholz relay. It shall have the proximity switch for remote alarm, indication and with visual position indicator.

13. **Fire Detectors / Linear Heat Detectors**

The System shall be provided with (Water Proof/Weather Proof) Heat Detector /Fire detector across the transformer oil tank & OLTC. The heat/fire detectors shall be rated for 138°C/141C for sensing. The Heat/Fire Detector should have been tested by the supplier and the performance should have been certified by a proper Agency accredited in India. A proper certificate and report should have been issued.

14. **Signal Box**

It shall be fitted on the transformer with cable connections from Shutter & fire detectors and for further connection to the control box.

15. **Cables**

All the cables are under the scope of tenderer. Fire survival cables, able to withstand 750°C, 4core x 1.5 Sq.mm for connection of fire detectors in parallel shall be used.

Fire retardant low smoke (FRLS) cable 10 core x 1.5 mm Sq. for connection between transformer signal box/marshalling box to control box and control box to fire extinguishing cubicle shall be used. Fire retardant low smoke (FRLS) cable 4 core x 1.5 Sq.mm for connection between the Control box to DC supply source and fire extinguishing cubicle to AC supply source, signal box/ marshalling box to pre-stressed Shutter valve connection on transformer shall be used.

16. **Pipes**

Pipes, complete with connections, flanges, bend tees etc., Shall be supplied by tenderer along with the system.

17. **Other items**

Oil drain and nitrogen injection openings with gate valves on transformer tank at suitable locations.

Heat/ fire detectors brackets on transformer top cover.

Pipe connections between transformer to fire extinguishing cubicle and fire extinguishing cubicle to oil pit.
Cabling on transformer top cover for fire/heat detectors to be connected in parallel and inter cabling between signal box to control box and control box to fire extinguishing cubicle.

Gate valves on oil drain pipe & nitrogen injection pipe should be able to withstand full vacuum. A non-return valve shall also be fitted on nitrogen injection pipe between transformers & gate valve.

The cabinet shall be painted with post office red color (Shade 538 of IS-5). All the exposed parts i.e., pipes, supports, signal box etc. shall be painted with enameled paint.

18. **Mandatory Spares**

The following mandatory spares may be supplied along with recommended mandatory spares if any, for the entire system at free cost:

1 No. filled nitrogen cylinder
1 set of hose pipes with fittings.25 meters.
Of linear heat detector/ 6nos. fire detectors

19. **Interlocks.**

It shall be ensured that once the system gets activated, all the connected breakers shall not close until the system is actually put in OFF mode.

20. **Technical Particulars**

20.1 **Fire Extinction Period**

On commencement of Nitrogen Injection	: Maximum 20 seconds
From the moment of system activation to Complete cooling.	: Maximum 30-45 minutes
"Linear Heat Detector" / Fire Detector heat sensing temp	: 138°C / 141°C
Shutter valve setting for operation	: Minimum 60ltr. Per minute
Capacity of Nitrogen Cylinder	: 50 /60 litres water capacity and shall hold minimum 10 cubic meter gas at200/150 bar pressure.
Control Box	: 220V DC
Fire extinguishing cubicle for lighting	: 230 V AC

The supplier shall furnish three copies of erection, operation & maintenance manual clearly incorporating the following, in addition to others as required:-

a) The maintenance and testing schedule of NIFPES.

b) All the steps required to be undertaken for restarting the transformer and connected equipment after operation and maloperation (if any) of the NIFPES.

c) The process of venting nitrogen in case nitrogen pressure in the cylinder exceeds the stipulated maximum value.

20.2. Codes and Standards:

The design and installation of complete fire protection system shall comply with the latest applicable Indian standards / codes**.**

20.3 Tests:

Type Tests

The test reports including that for detectors along with declared response time as per TAC's letter shall be submitted along with the drawings for approval.

Certificates of the test on the system carried out by national / international testing bodies and TAC's approval, if any, shall also be submitted with the drawings for approval.

Factory Test

Tests will be carried out on individual equipment of the system, as applicable and the total system in the supplier's workshop in presence of purchaser's representative.

Performance Test:

Performance test of the complete system shall be carried out after complete erection at site by the supplier representative. These tests shall include simulation and verification of the response of the complete system without injection of the Nitrogen gas**.**

Drawing and Manuals:

Detailed layout drawings along with the equipment drawing & control circuit drawing shall be given by the supplier along with complete bill of material. After awarding of contract detailed dimensional drawing of the system complete bill of material shall be submitted for approval.

38.0. DRAWING,TECHNICAL LITERATURE AND GUARANTEED TECHNICAL PARTICULARS

38.1 (a) General out line drawing, showing front side elevations and plan views of the transformer and all accessories and external features with detailed dimensions, weights, crane lift for un-tanking and for erection/removal of bushings, size of lifting lugs and pulling eyes, HV and LV terminal clearances, live terminal to ground clearance, quantity of insulating oil, dimensional details for foundation etc with list of fittings and accessories.

(b) Assembly drawings of HV, LV /cable box and Neutral bushings

(c) Mounting arrangement for cooling pipes, radiators, fans etc.

(d) Schematic control and wiring drawing and drawings showing temperature indicator/ recorder circuits, and control system for cooling equipment.

(e) Drawing, showing construction and mounting details of marshalling boxes.

(f) Drawing, giving details of name plate, terminal marking and connection diagram.

(g) Drawing on OLTC gear assembly.

(h) Remote Tap Changer control panel.

(i) Remote Tap Changer control circuit.

(j) Drawing on Terminal Clamps.

The responsibility rests with the supplier in case of any corrections or modification on scrutiny of the drawings.

38.2 Six complete sets of final drawings shall be supplied for the transformer, sufficiently before the actual despatch of the equipment.

38.3. Six copies of all bulletins, complete instruction manuals for the erection, operation and maintenance of the transformer are to be supplied, before they are despatched.

38.4. Any approval given to the detailed drawings by the purchaser shall not relieve the contractor of the responsibility for correctness of the design, completeness of the equipment supplied and in the execution of the works in accordance with the terms of specification.

39.0. REJECTION

39.1. The transformer may be rejected if any of the following conditions arise during the tests or while in service.

(a) No -load loss exceeds the guaranteed value.
(b) Load loss exceeds the guaranteed value.
(c) Percentage impedance values exceed by the guaranteed figure.
(d) Temperature rise of oil and or windings exceed the specified values
(e) Transformer fails during impulse test.
(f) Transformer fails during power frequency voltage withstand test.
(g) If either of the test results conducted at factory and site (during pre-commissioning test) are not satisfactory.
(h) Transformer has not been manufactured in accordance with the specification and approved drawings.

40.0 SPARES:

3 Nos. of One litre capacity Oil Sampling Flask (Stainless Steel) shall be provided when order is placed on successful tenderer(s).

41.0 DESIGN REVIEW:

41.1 The transformer shall be designed, manufactured and tested in accordance with the best international engineering practices under strict quality control to meet the requirement

stipulated in the technical specification. Adequate safety margin w.r.t. Thermal, Mechanical, Dielectric and Electrical Stress etc., shall be maintained during design, selection of raw material, manufacturing process etc. in order to achieve long life of transformer with least maintenance.

41.2 Design reviews will be conducted by TANTRANSCO or by an appointed consultant during the procurement process; however, the entire responsibility of design shall be with the manufacturer. TANTRANSCO may also visit the manufacturers works to inspect design, manufacturing and test facilities.

41.3 The design review shall be finalised before commencement of manufacturing activity and shall be conducted generally following the "CIGRE TB 529: Guidelines for conducting design reviews for power transformers".

41.4 The manufacturer shall provide all necessary information and calculations to demonstrate that the transformer meets the requirements of mechanical strength and inrush current.

41.5 The manufacturer will be required to demonstrate the use of adequate safety margins for Thermal, Mechanical, Dielectric and Vibration etc., in design to take into account the uncertainties of his design and manufacturing processes. The scope of such design review shall include but not limited to the requirement mentioned.

41.6 Each page of the design review document shall be duly signed by the authorised representatives of manufacturer and purchaser and shall be provided to the purchaser for record and reference before commencement of manufacturing.

42. PACKING, FORWARDING AND ERECTION:

42.1 The equipment and all its accessories shall be securely packed and dispatched, freight paid, duly insured, at supplier's risk and cost. The packing may be in accordance with the manufacturer's standard practice. The supplier is responsible for ascertaining the facilities that exist for Road Transport to site. Each package shall be clearly marked and contain detailed packing list, such as gross weight, net weight etc. The supplier is solely responsible for any loss or damage during transport. The dispatch of materials shall be made only after the approval of test certificates by the TANTRANSCO.

42.2 The scope shall include:

i) Supply of the transformer at our substation including unloading the transformer on the plinth or if the plinth is not ready the transformer shall be unloaded adjacent to plinth/any other site as decided by the Site Engineer. The accessories shall be unloaded at site.

ii) Erection of the transformer at the substation site and assisting in testing and commissioning. Testing will be done by the purchaser in the presence of the supplier at TANTRANSCO's cost.

iii) Erection of the Transformer at Substation site by supplying, laying all the control cable required for all the protection/ necessary schemes for the successful testing and commissioning,

iv) Supply, lay, erect and weld the M.S. flat and M.S. Channels for earthing the transformer with the earth pit and shall be present during testing and commissioning.

42.3 The dispatch of materials shall be made only after the approval of test certificates by the TANTRANSCO for the materials concerned.

42.4 The supplier shall be responsible for any damage to the equipment during transit due to improper and inadequate packing.

42.5 Only packages constructed out of sound material and of dimensions proportional to the size and weight of contents shall be used.

42.6 Loose materials eg. Bolts, Nuts etc., shall be packed in gunny bags and sealed in airtight bags with proper tagging.

42.7 Components containing glass fragile materials shall be carefully covered with shock absorbing protective material

42.8 All openings in the equipment shall be tightly covered, plugged or capped to prevent foreign material from entering.

42.9 In the case of large and bulk equipment, the vendor shall be responsible for ascertaining transport limitations and supply the equipment in the minimum number of components or sub-assemblies, within the frame work of transport limitations.

42.10 Wherever necessary, proper arrangements for attaching slings for lifting shall be provided.

4.11 The contents of the packages shall be sealed in thick **water proof** sheets and all the inside walls of the packages shall be lined with waterproof paper to protect the equipment from damage due to dust and moisture.

42.12 All equipment shall be protected for the entire period of Dispatch, storage and erection against corrosion, incidental damage due to vermin, sunlight, rain, high temperature, humid atmosphere, rough handling in transit and storage in the open including possible delays in transit.

42.13 Silicagel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.

42.14 Adequate provision of skids or pellets shall be made to keep the packages above the collecting drainage. Crates and other large containers should have drain holes in the bottom to prevent collection of water within the packing.

42.15 Each crate or package shall contain a packing list, in a waterproof envelope. Copies of the packing list, in triplicate, shall be forwarded to the consignee prior to dispatch. All items of material shall be clearly marked for easy identification against the packing list.

42.16 All spare parts shall be packed and treated for long storage conditions at site.

42.17 Any material found short inside the intact packing cases shall be supplied by the SUPPLIER at no extra cost to the PURCHASER, including transportation upto stores/site.

42.18 All packing cover and packing material shall become the property of the PURCHASER.

42.19 All packages shall be clearly, legibly and durably marked with uniform block letters (preferably with waterproof paint) on at least three sides with:

i) Destination address as communicated.
ii) Purchase order reference
iii) Dimensions
iv) Net and Gross Weights
v) Sign showing `Side Up'
vi) Sign showing `fragile' marks in case of delicate equipment.
vii) Sign showing slinging and sling position.
viii) Any handling and unpacking instructions, if considered necessary.

43.0 The supplier should give a schedule of dispatches one month prior to the actual date of dispatch and should dispatch only after getting approval from the consignee for such dispatches. The dispatch instruction will be issued by the Chief Engineer/ Transmission/ Chennai.

43.1 The supplier should dispatch only after getting dispatch instruction. If the supplier dispatches the materials without the prior approval of the purchaser, then the purchaser shall not be responsible for any demurrage or wharfage or both and only the supplier should bear any expenditure arising out of such unapproved dispatches.

43.2. If there is any short supply or supply of defective materials is found, then only on completion of supply/rectification of defective supply, the first bill will be admitted by SE/GCC.

43.4 Equipment will be deemed to have been delivered only when all its component parts and its accessories are also delivered. If certain components and accessories are not delivered in time, the whole equipment will be considered as delayed unless the missing parts are delivered.

43.5 TANTRANSCO reserves the right to accept or reject the delayed supplies without assigning any reason there for and take action

44.0 DELIVERY :

44.1 The scope of the delivery shall cover the following:

(i) Delivering the complete equipment and accessories from the date of receipt of purchase order upto delivering at our substation site including un-loading on the plinth or nearer to the plinth if plinth is not ready, as decided by the field Engineer.

(ii) The erection of the transformer from the date of handing over of site/plinth upto intimation for readiness for testing, by the contractor.

44.2 The delivery schedule is as follows:

(A) SUPPLY:

i) Commencement :

To commence with **one unit** within **Eight (8)** months from the date of receipt of Purchase Order.

ii) Balance Quantities:

The indents for the balance quantity will be given by the Chief Engineer/Transmission at least 60 days in advance, duly indicating the due date of delivery.

iii) The vendor shall indicate the minimum and maximum number of units that can be supplied by them every month.

(B) ERECTION:

The erection work shall be completed for each transformer supplied within one month from the date of handing over of site/plinth.

44.3 It is the responsibility of the supplier to give advance information on inspection, despatch of materials and other obligations under the terms and conditions of this specification in order to deliver the unit within the contractual delivery period.

44.4 The delivery period will not normally be extended. Hence all efforts shall be taken to deliver the materials within contractual delivery period.

44.5 The above delivery shall be guaranteed under liquidated damages clause .

44.6 The date of receipt of **last component of the main equipment** will be reckoned **as the date of delivery for the purpose of calculation of liquidated damages for delay in delivery**, when the main equipment and accessories are received in piece-meal.

45 INSURANCE:

Contracting firms shall arrange insurance for the equipment and all its accessories being supplied by them, through any of the Nationalised Insurance Companies. The equipment shall be insured to cover transport (from Warehouse) and 90 days storage risk at site.

The damages, if any, during transit will be reported within 30 days of receipt of materials. It will be the responsibility of the supplier to replace the defective/damaged materials and make good the shortages and other losses in transit, free of cost, lodge and recover claim from Insurance, Under-writers/Carriers.

46.LOSS OR DAMAGE:

46.1 External damages and/or shortages that are prima facie, the results of rough handling in transit or due to defective packing will be intimated within one month from the date of receipt of the materials at site. Internal defects, damages or shortages of integral parts which cannot ordinarily be detected on a superficial visual examination, though due to bad handling in transit or defective packing, would be intimated within 2 months from the date of receipt of materials. In either case, the defective materials shall be replaced/rectified by the supplier, free of cost as per Clause 48.

46.2 If during the period of supply, it is found that goods already supplied are defective in material or workmanship or do not conform to specification or are unsuitable for the purpose for which they are purchased, then it will be open to the purchaser either to reject the goods or repudiate the entire contract and claim such loss that the purchaser may suffer on that account or require the supplier to replace the defective goods, free of cost.

46.3 Similarly, if during the guarantee period any of the goods found to be defective in materials or workmanship or do not conform to specification, it will be open to the purchaser either to repudiate the entire contract and claim damages or accept such parts of the goods that are satisfactory and require the supplier to replace the balance or to claim compensation for the entire loss sustained by the purchaser on that account.

46.4 In the event of supplies being received damaged or any shortages at the destination stations, the cost of such materials, GST (if payable) and other charges payable thereof will be paid only proportionate to the value of materials received in good condition, unless the damaged goods or short supplies are made good free of cost by the suppliers.

46.5 For all legal purposes, the materials shall be deemed to pass into the TANTRANSCO's ownership at the destination Substation, where they are to be delivered and accepted.

46.6 The supplier is responsible for any theft damage etc. for the materials from the date of receipt of materials at site upto commissioning.

47.0 GUARANTEE:

47.1 The entire equipment should be guaranteed for satisfactory operation, free of defects **for a period of 60 months from the date of successful commissioning of Auto Transformer**.

47.2 Any defects /failure noticed during this guarantee period shall be rectified, free of cost, within 3 months from the date of intimation of defect/failure. Irrespective of number of failures and repairs within the guarantee period, the suppliers are responsible for free replacement/repair of the defective materials. The guarantee period for such repaired/replaced equipment shall be **THREE years from the date of re-commissioning for the entire transformer (or) the original guarantee period of 60 months from the date of first commissioning, (excluding the time taken for rectification (ie) from the date of the transformer is isolated from service due to fault to the date of putting the transformer back into service), whichever is later.**

47.3 In case the major active parts such as HV winding, LV winding and OLTC, failed within the guarantee period, the Guarantee Period has to be extended for another three years from the date of re-commissioning for the whole Transformer only.

47.4 In respect of accessories such as Buchholz relay, PRD relay, OSR, MOG, WTI, OTI, TIMERS, CONTACTOR, OL RELAY and Differential relay (wherever applicable) the guarantee period will be for the respective items only.

47.5 The incidental expenses, charges towards dismantling and re-erectionof failed unit/defective part, transport and freight charges for the replacement of defective materials within the guarantee period shall be borne by the supplier.

47.6 The tenderers shall guarantee among other things, the following:

i) Quality and strength of materials used.

ii) Safe electrical and mechanical stresses on all parts of the equipment under all specified conditions.

iii) Performance figures given by the tenderers in the Schedule of Guaranteed technical particulars.

48.0 REPLACEMENT OF DEFECTIVE / DAMAGED MATERIALS:

48.1 Notwithstanding anything contained in the above liquidated damages clause when the whole or part of the materials supplied by the supplier are found to be defective/damaged or are not in conformity with the specification, such defects or damages in the materials supplied shall be rectified within three months from the date of intimation of defect/damage at the supplier's works, at the cost of supplier, against furnishing of Indemnity Bond for the cost of the defective equipment valid till date of satisfactory commissioning of the rectified equipments. In the alternative, at the point of destination, the defective or damaged materials shall be replaced free of cost within three months from the date of receipt of the intimation from the purchaser of such defects or damages. If the defects or damages are not rectified or replaced within this period, the supplier shall pay a sum towards liquidated damages as per liquidated damages clause given above, for the delay in rectification/replacement of the defects or

damages. The charges towards loading, to and fro transport (anywhere in Tamilnadu), un-loading and re-erection shall be borne by the supplier.

48.2 If even after such rectification or replacement of the damaged or defective part, if the equipment ordered is not giving the satisfactory performance as per the contract, then it will be open to the purchaser to reject the goods and recover the entire cost of such goods and also claim such loss sustained by the TANTRANSCO.

48.3 Notwithstanding any other remedies available, the purchaser shall be entitled to dispose of the defective/damaged materials in 'as is where is condition' without further notice, if the contractor/supplier fails to rectify the defect and/or replace the damaged materials within such period as may be notified by the purchaser through notice and the sale proceeds of such disposal shall be appropriated towards the dues to the Board such as Liquidated Damages, ground, rent, etc. as may be determined by the purchaser.

48.4 Similarly, if during the guarantee period stipulated under guarantee clause subsequent to the date of receipt of goods, any of the goods be found defective in materials or workmanship, or do not conform to the specification or unsuitable for the purpose for which they are purchased, then it will be open to the TANTRANSCO either to repudiate the entire contract and claim damages or accept such part of the goods that are satisfactory and require the supplier to replace the balance or pay compensation to the extent of the loss sustained by the TANTRANSCO on that account.

49.0 RAW MATERIALS:

It is the responsibility of the tenderer to make their own arrangement to procure the necessary raw materials required for the manufacture.

50.0 RESPONSIBILITY:

50.1 The tenderer is responsible for safe delivery of the materials with all its accessories at the destination site. The tenderer should include and provide for packing and secured protection of the materials with all its accessories so as to avoid damages or loss in transit.

50.2 The supplier is responsible to make sure about the facilities that exist for Road and Rail transport to site, the maximum packages which can be conveyed by the railways and crane lift available at the destination railway station. The supplier is also responsible for any loss or damage during transport and storage for 90 days.

50.3 Each case or package should be clearly marked and should contain detailed packing list. Equipment will be deemed to have been delivered only when all its components parts and its accessories are also delivered.

51.0 **INSPECTION:**

51.1 The authorized representatives of the purchaser shall have access to the supplier's or sub-vendor's works at any time during working hours, for the purpose of inspecting the availability of infrastructure facilities for manufacturing and also during manufacture of the materials and for testing the selected samples from the materials covered by this specification. The supplier or the sub-vendor shall provide facilities for the above.

51.2 Tenderers are requested to furnish in their tenders the exact location of their factory with detailed address to enable inspection by TANTRANSCO if considered necessary.

51.3 Not less than 15 days advance intimation shall be given about the quantity of materials that will be ready for inspection by the TANTRANSCO's Officers/Third Agency authorized by the TANTRANSCO. The arrangement for inspection shall be made by supplies in such a way that the delivery schedule is kept up. The materials shall not be dispatched without instruction from TANTRANSCO.

51.4 The supplier should give a schedule of dispatches one month prior to the actual date of dispatch and should dispatch only after getting approval from the consignee for such dispatches. The dispatch instruction will be issued by the Chief Engineer/ Transmission/ Chennai.

51.5 The supplier should dispatch only after getting dispatch instruction. If the supplier dispatches the materials without the prior approval of the purchaser, then the purchaser shall not be responsible for any demurrage or wharfage or both and only the supplier should bear any expenditure arising out of such unapproved dispatches.

52.0 MATERIALS AND WORKMANSHIP:

52.1 All materials, equipments and spare parts thereof shall be new, unused and originally coming from manufacturer's plant to the destination stores.Those including used, rebuilt or overhauled materials/equipment will not be accepted.

52.2 All the materials shall be of best class and capable of satisfactory operation in the tropics with humid atmospheric condition. Unless otherwise specified, they shall conform to the requirements of appropriate Indian Standards. Where these are not available, IEC and American/British Standards shall be followed.

52.3 The equipments should be designed to facilitate inspection and repair and to ensure satisfactory operation under atmospheric conditions prevailing at site and under sudden variations of load and voltages as may be met with under working conditions in the system including those due to faulty synchronizing and short circuits within the rating of the apparatus.

52.4 The design shall incorporate every reasonable precautions and provisions for the safety of all those concerned in the operation and maintenance of equipment.

52.5 All the equipments should operate without undue vibration and with the least practicable amount of noise.

53.0 PAST PERFORMANCE:

53.1 The intending tenderers shall furnish the documentary evidence with details of various Purchase Orders/placed on them during the last **TEN** years as on the date of Tendering in the proforma enclosed to the Tender Specification and also proof for having manufactured the tendered item and for their satisfactory performance from State utilities.

53.2 a) The Bidders shall furnish the attested copies of Balance Sheet, Profit and Loss Account and Turn-Over certificate duly certified by the Auditor for the years mentioned in the BQR.

b) In case last financial year accounts mentioned in the BQR are not finalized, the Bidders shall furnish Annual Turnover Statement for the respective financial year, certified by Auditor.

53.3 The Bidders shall furnish documentary evidence for the constitution of the firm such as Memorandum and Articles of Association, Attested copy of Registered Partnership Deed with details of Name, Address, Telephone, Electricity Board Service Connection No. of the manufacturing plants.

53.4 The details furnished by the tenderers shall be in complete shape and if it is found that any information is found omitted, suppressed, incomplete or incorrect, the same will be taken note of while dealing with the Tenderers in future.

54.0 PATENT RIGHTS ETC. :

The supplier shall indemnify the purchaser against all claims, actions, suits and proceedings for the infringement or alleged infringement of any patent, design or copy right protected either in the country of origin or in India by the use of any equipment supplied by the supplier other than for the purpose indicated by or reasonably to be inferred from the specification.

55.0 INTERCHANGEABILITY:

All similar parts and removable parts of similar items shall be interchangeable with each other.

56.0 ELECTRICITY RULES:

All works shall be carried out in accordance with the latest provisions of the Indian Electricity Act/Electricity Supply Act and the Indian Electricity Rules there-under unless modified by this specification.

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SECTION-II
ERECTION

1.0 GENERAL:

1.1. Unless otherwise stated the work shall be carried out as per Section-K of CBIP guidelines

1.2. The following shall supplement the conditions already contained in the other parts of these specifications and documents and shall govern that portion of the work on this Contract to be performed at site.

1.3 The Contractor, shall nominate a responsible person as its representative at site suitably designated for the purpose of overall responsibility and co-ordination of the works to be performed at site.

2.0 SCOPE OF WORK

2.1 The scope of work shall be to make the transformer ready for testing and Commissioning and include the following

a) Placing of the transformer on the plinth and fixing of wheels and carrying out stop block welding including moving the transformer to the plinth, where the transformer is supplied and unloaded near the plinth.

b) The Contractor has to supply, lay, erect and weld M.S.Channel, Flat of the **75x 12 mm.** sizes, including green painting and providing with adequate bolts and nuts as applicable.

75x 12 mm. Flat with suitable M.S.Channel for earthing with neutral bushing at two different earth points of existing earth pit, Transformer tank, Cooler fan and pumps. D.M.box RTCC panel & other accessories body earthing with required standards. **No of joints should be a max of one (1) joint only for Neutral Earth.**

(c) Erection of the following, wherever applicable:

(i) HV bushing with turrets
(ii) LV and neutral bushing with turrets.
(iii) Cable boxes
(iv) Bushing current transformers
(v) Conservators
(vi) Valves
(vii) Radiators
(viii) Fans/Pumps
(ix) Buchholz relay
(x) Surge relay
(xi) Gaskets
(xii) Temperature indicators
(xiii) Others wherever stated

d) Erection of the Drive Mechanism Box, Marshalling at site with equipment and RTCC Panel in the Control room after removing the existing panel, if any.

e) First Filling of transformer oil in the transformer and OLTC under hot oil circulation, vacuum drying wherever applicable/necessary to the required level and circulation of oil till satisfactory results are obtained before commissioning.

(Power supply for hot oil circulation will be provided by TANTRANSCO/ TANGEDCO).

The oil samples shall be tested at TANTRANSCO/TANGEDCO Laboratory for BDV, IFT, Resistibility, Water content, Acidity, TAN Delta and DGA for the 1st lot of oil filling in the Transformer at the supplier's cost.

f) i) The Contractor scope of work shall include all the control cables of minimum 7 strands required for the successful commissioning of Auto/Power Transformers including supply, laying, providing suitable glands ferrules, lugs, termination etc., but not limited to the above mentioned for successful commissioning of the transformer as per standard requirement.

1 Protection schemes of Auto/Power Transformer including Differential Protection cable.
2 Indication/Annunciation scheme for cooler fan and pumps.
3 OLTC Remote operation
4 OLTC fan, pump, D.M. power supply cable
5 DC cable from control room to Transformer
6 SCADA scheme for Remote/Automation operation
7 CTs cable from CT secondaries to Marshalling Box and Marshalling box to LV panel/RTCC panels
8 Any other control cable with required site for successful commissioning of the transformer
9 Interconnection of cables for AC/DC panels to RTCC/LV panels
10 Each and every Fans and Pumps are to be suitably earthed
11 DM Box, Cooler Circuit Control Panel, Marshalling Box, NIFS panels and RTCC panels are to be suitably earthed,

ii) All CT cables shall be 4 sq.mm. (minimum) and shall be FRLS, copper, armoured cables. The other cables that are to be provided shall be FRLS, 2.5 sq.mm. (minimum), **copper multi-strand (minimum of 7 strands)** and armoured cables, separate cables for AC and DC are to be used. The AC supply cables shall be sufficient to cater the load of pumps, fans and the load of pumps, fans and the loads of transformer for the AC panel around in the transformer end. **The LT cable shall comply as per IS 1554 –Part-I Standard.**

iii) Additional adequate quantity of cable length shall be provided at the Transformer end and at the RTCC/LV panels ends in case of shifting of panels/ Transformers. All the cables shall be laid end to end without any joints and it should be ensured that the cables so provided shall comply with TANTRANSCO control cable specification and should be strictly adhered. All the control cables shall be neatly laid /buried in control cable duct/trench by suitable dressing.

iv) However any additional work and in the schedule of cables shall be discussed with the site Engineers/ TANTRANSCO Engineers before laying of cables and necessary approval shall be obtained before connection to the panels/ Transformer ends.

g) Painting as required will be carried out so as to maintain the finish of the surface of the transformer and accessories prior to the erection of the same at site.

h) Required assistance for testing and commissioning

i) Civil work related to Cooler Banks, and other panels related to the transformers shall be provided by the transformer supplier/erection contractor.

Any other works not covered in items (a) to (i) but required for satisfactory commissioning of the power transformer shall also to be carried out by the contractor free of cost.

2.2. The supplier shall prepare a schedule of the works to be carried out with specific periods for each item of work involved. All assembly and erection drawing shall be made available at site.

2.3. If the commissioning of the transformer is delayed due to incompletion of erection works, the TRANTRANSCO has the right to recover an estimated amount for such pending erection works from the contractor besides Levy of L.D. clause.

3.0. REGULATION OF LOCAL AUTHORITIES AND STATUTES

The Contractor shall comply with all the rules and regulations of local authorities during the performance of its field activities. The Contractor shall also comply with the Minimum Wages Act, 1948 and the payment of Wages Act (both of the Government of India) and the rules made there under in respect of any employee or workman employed or engaged by it or its Sub-Contractor.

4.0. OWNER'S LIEN ON EQUIPMENT

The Owner shall have lien on all equipment including those of the Contractor, brought to the Site for the purpose of erection, testing and commissioning of the plant. The Owner shall continue to hold the lien on all such equipment throughout the period of Contract. No material brought to the site shall be removed from the site by the Contractor and/or its Sub-contractors without prior written approval of the Site Engineer.

5.0. INSPECTION, TESTING AND INSPECTION CERTIFICATES

The provisions of the clause entitled inspection, Testing and Inspection Certificates under Technical Specification applicable to the erection portion of the Works. The Site Engineer shall have the right to re-inspect any equipment, even though the same may have been previously inspected and approved by him at the Contractor's works, before and after the same are erected at Site. If by the above inspection, the Site Engineer rejects any equipment, the Contractor shall make good such rejected equipment etc., either by replacement or modification/repairs as may be necessary to

the satisfaction of the Site Engineer. Such re-placements will also include the replacements or re-execution of such of those works of other Contractors and/or agencies, which might have got damaged or affected by the replacements or re-work done to the Contractor's work.

6.0. ACCESS TO SITES AND WORKS ON SITE

6.1 The works so far as it is carried out on the Owner's premises, shall be carried out at such time as the Owner may approve and the Owner shall give the Contractor reasonable facilities for carrying-out the works.

6.2 In the execution of the works, no person other than the Contractor or its duly appointed representative, Sub-Contractor and workmen, shall be allowed to do work on the site except by the special permission, in writing of the Site Engineer or his representative.

7.0. CO-OPERATION WITH OTHER CONTRACTORS

7.1 The Contractor shall co-operate with all other Contractors or tradesmen / representative(s) of the Owner, who may be performing other works on behalf of the Owner and the workmen who may be employed by the Owner and doing work in the vicinity of the works under the Contract. The Contractor shall also so arrange to perform its work as to minimise, to the maximum extent possible, interference with the work of other Contractors and their work-men. Any injury or damage that may be sustained by the employee(s) of the other Contractors and the Owner, due to the Contractor's work shall promptly be made good by the Contractor at its own expense. The site Engineer shall determine the resolution of any difference or conflict that may arise between the Contractor and other Contractors or between the Contractor and the workmen of the Owner in regard to their work. If the work of the Contractor is delayed because of any acts of omission of another Contractor, the Contractor shall have no claim against the Owner on that account other than an extension of time for completing its works.

7.2. The Site Engineer shall be notified promptly by the Contractor of any defects in the other Contractor's works that could affect the Contractor's works. The Site Engineer shall determine the corrective measures, if any, required to rectify this situation after inspection of the works and such decisions by the Site Engineer shall be binding on the Contractor.

8.0. DISCIPLINE OF WORKMEN

The Contractor shall adhere to the disciplinary procedure set by the Site Engineer in respect of its/its Sub-Contractor's employees and workmen at site. The Site Engineer shall be at liberty to object to the presence of any representative or employee of the Contractor/ its Sub-Contractor at the site, if in the opinion of the Site Engineer such representative/ employee has misconduct himself or is incompetent or negligent or other-wise undesirable. The Contractor shall remove such person(s) objected to, and provide competent replacement in his place.

9.0. PROTECTION OF WORK

The Contractor shall have total responsibility for protecting its works till it is finally taken over by the Site Engineer. No claim will be entertained by the Owner or by the Site Engineer for any damage or loss to the Contractor's works and the Contractor shall be responsible for complete restoration of the damaged works to original conditions, to comply with the specification(s) and drawings. Should any such damage to the Contractor's works occur because of any other party not being under its supervision or control, the Contractor shall make its claim directly to the party concerned without involving the Owner. If disagreement or conflict or dispute develops between the Contractor and the other party or parties concerned regarding the responsibility for damage to the Contractor's works the same shall be resolved as per the provisions of Clause 6.0 above titled co-operation with other Contractors. The Contractor shall not cause any delay in the repair of such damaged works because of any delay in the resolution of such disputes. The Contractor shall proceed to repair the work immediately and no cause thereof will be assigned pending resolution of such disputes.

10.0. EMPLOYMENT OF LABOUR

10.1 The Contractor will be expected to employ on the work only its regular skilled employees with experience in the particular type of work. No female labour shall be employed after darkness. No person below the age of eighteen years shall be employed.

10.2 All traveling expenses including provisions of all necessary transport to and from site, lodging allowances and other payments to the Contractor's employees shall be the sole responsibility of the Contractor.

10.3 The hours of work on the site shall be decided by the Owner and the Contractor shall adhere to it. Working hours will normally be eight (8) hours per day-Monday through Saturday.

10.4 Contractor's employees shall wear identification badges while on work at Site.

10.5 In case the contractor becomes liable to pay any wages or dues to the labour or any Government agency under any of the provisions of the Minimum Wages Act, Workmen Compensation Act, Contract Labour Regulation Abolition Act or any other law due to act of omission of the Contractor, the Owner may make such payments and shall recover the same from the Contractor's bills.

10.6 The Contractor shall be provided with free supply of electricity for the purposes of the Contract only, at one point in the project Site. The Contractor, at its own cost shall make its own further distribution arrangement. All temporary wiring shall comply with local regulations and will be subject to Site Engineer's inspection and approval before connection to supply.

11.0. FACILITIES TO BE PROVIDED BY THE CONTRACTOR

11.0 Tools, tackle and scaffolding.

11.1.2 The Contractor shall bring to site all the construction/erection equipment tools, tackle, scaffolding etc required for pre-assembly, erection of the equipment covered under the contract. The contractor shall submit a list of all such materials to the Site Engineer before the commencement of pre- assembly at Site.

11.1.3 The following items are generally required:

1) Lifting equipment:
   a) Derrick or mobile crane of adequate capacity.
   b) Wire ropes.
   c) Pulley blocks.
   d) Chain blocks.
   e)Manila ropes.
   f) Shackles.
   g) Sleepers.
2) Oil purifier with heating and vacuum facilities and hot oil resistant hose pipes.
3) Vacuum pump.
4) Oil storage tank.

11.1.4 The Owner shall have a lien on such goods for any sum or sums which may at any time be due or owing to it by the Contractor.

11.1.5 After the completion of the Works, the Contractor shall not remove from the Site, the materials such as construction equipment, erection tools and tackle, scaffolding etc., without permission of the Site Engineer.

12.0 FIRST – AID

The Contractor shall provide necessary first-aid facilities for all its employees, representatives and workmen working at the site. Adequate number of Contractor's personnel shall be trained in administering first-aid.

13.0. CLEANLINESS

13.1. The Contractor shall be responsible for keeping the entire allotted area clean and free from rubbish, debris etc. during the period of Contract.

13.2. Waste oil shall be disposed off in a manner acceptable to the Owner. Under no circumstances shall waste oil be dumped into uncontrolled drains.

14.0 FIRE PROTECTION

14.1. All the Contractor's supervisory personnel and sufficient number of workers shall be trained for fire-fighting and shall be assigned specific fire protection duties. Enough of such trained personnel shall be available at the Site during the entire period of the Contract.

14.2. The Contractor shall provide enough fire protection equipment of the types and number for the ware-house, office, temporary structures, labour colony area etc. Access to such fire protection equipment, shall be easy and kept open at all times.

15.0. SECURITY

The Contractor shall have total responsibility for all equipment and materials in its custody, stored, loose, semi-assembled and/or erected by it at Site. The Contractor shall make suitable security arrangements including employment of security personnel to ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loss. All materials of the Contractor shall enter and leave the work site only with the written permission of the Site Engineer in the prescribed manner.

16.0 MATERIALS HANDLING AND STORAGE

16.1 All the equipment furnished under the Contract and arriving at Site shall be promptly received, unloaded and transported and stored in the storage by the Contractor.

16.2. The Contractor shall be responsible for examining all the consignment and shall notify the Site Engineer immediately of any damage, shortage, discrepancy etc. for the purpose of Site Engineer's information only. However, the Contractor shall be solely responsible for any shortages or damage in transit, handling and/or in storage and erection of the equipment at site as well as for preferring all claims with the underwriter(s). Any demurrage, wharfage and other such charges claimed by the transporters, railways etc., shall be to the account of the Contractor.

16.3.The Contractor shall maintain an accurate and exhaustive record detailing out the list of all equipment received by it for the purpose of erection and keep all such record open for the inspection of the Site Engineer.

16.4. All equipment shall be handled very carefully to prevent any damage or loss. No bare wire ropes, slings, etc. shall be used for unloading and/or handling of the equipment without the specific written permission of the Site Engineer. The equipment stored shall be properly protected to prevent damage either to the equipment or to the floor where they are stored.

16.5. The Contractor shall ensure that all the packing materials and protection devices used for the various equipment during transit and storages are removed before the equipment is installed.

16.6. All the materials stored in the open or dusty location(s) shall be covered with suitable weather-proof and flameproof covering material, wherever applicable.

16.7. The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipment which requires indoor storage. Normally, all the electrical equipment such as motors, control gears and consumables shall be stored in the closed storage space.

17.0. CONSTRUCTION MANAGEMENT

17.1. The field activities of the Contractor's working at site, will be co-ordinated by the Site Engineer and the Site Engineer's decision shall be final in resolving any dispute or conflict between the Contractor and other contractors and tradesmen of the Owner regarding scheduling and co-ordination of work. Such decision by the Site Engineer shall not be a cause for extra compensation or extension of time for the Contractor.

17.2. Time is the essence of the Contract and the Contractor shall be responsible for performance of its works in accordance with the specified construction schedule.

18.0. PROTECTION OF PROPERTY AND CONTRACTOR`S LIABILITY

The Contractor shall be responsible for any damage resulting from its operations. It shall also be responsible for protection of all persons including members of public and employees of the owner and the employees of other Contractors and Sub-Contractors and all public and private property including structures, building, other plants and equipment and utilities either above or below the ground.

19.0. INSURANCE:

19.1 In addition to the conditions covered under the Clause, titled Insurance the followingprovisions will also apply to the portion of works to be done beyond the Contractor's own or its Sub-Contractor's manufacturing Works.

19.2 **Workmen's Compensation Insurance:**

This insurance shall protect the Contractor against all claims applicable under the Workmen's Compensation Act, 1948 (Government of India). This policy shall also cover the Contactor against claims for injury, disability disease or death of its or its Sub-Contractor's employees, which for any reason are not covered under the Workmen's Compensation Act, 1948. The liabilities shall not be less that

Workmen's Compensation	:	As per statutory Provisions
Employee's liability	:	As per statutory Provisions

"All statutory provisions in respect of labour engaged viz ESI,EPF etc are to becomplied by the bidder and the corresponding liabilities are to be borne by thebidder".

19.3 **Comprehensive Automobile Insurance:**

This insurance shall be in such form to protect the Contractor against all claims for injuries, disability, disease and death to members of public including the Owner's men and damage to the property of other arising from the use of motor vehicles during on or off the Site operations, irrespective of the owner-ship of such vehicles. The minimum liability covered shall be as herein indicated:

Fatal Injury	:	Rs. 1,00,000 each person
	:	Rs. 2,00,000 each occurrence
Property Damage	:	Rs. 1,00,000 each occurrence

19.4 **Comprehensive General Liability Insurance:**

19.4.1 The insurance shall protect the Contractor against all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others, due to any act or omission on the part of the Contractor, its agents, its employees, its representatives and Sub Contractors or from riots, strikes and civil commotion. This insurance shall also cover all the liabilities of the Contractor.

19.4.2 Thehazards to be covered will pertain to all the works and areas where the Contractor, its Sub-Contractors, its agents and employees have to perform work pursuant to the Contract.

19.5 The above are only illustrative list of insurance covers normally required and it will be the responsibility of the Contractor to maintain all necessary insurance coverage to the extent both in time and amount to take care of all its liabilities either direct or indirect, in pursuance of the Contract.

20.0 <u>WORK & SAFETY REGULATIONS</u>:

20.1 The Contractor shall ensure proper safety of all the workmen, materials plant and equipment belonging to it or to the others, working at the site. The Contractor shall also be responsible for provision of all safety notices and safety equipment required by the relevant legislations and deemed necessary by the Site Engineer.

20.2 All equipment used in construction and erection by Contractor shall meet Indian/International Standards and where such standards do not exist, the Contractor shall ensure these to be absolutely safe. All equipment shall be strictly operated and maintained by the Contractor in accordance with manufacturer's operation manual and safety instructions and as per Guidelines/Rules in this regard.

20.3 Periodical examinations and all tests for all lifting/hoisting equipment & tackle shall be carried-out in accordance with the relevant provisions of Factories Act 1948, Indian Electricity Act and associated Laws/Rules in force from time to time. A register of such examinations and tests shall be properly maintained by the Contractor and will be promptly produced as and when desired by Site Engineer or by the persons authorized by him.

20.4 No electric cable in use by the Contractor/Owner will be disturbed without prior permission.

20.5 No repair work shall be carried out on any live equipment. The equipment must be declared safe by the Site Engineer and a permit to work shall be issued by the Site Engineer before any repair work is carried out by the Contractor. While working on electric lines/equipment whether live or dead, suitable type and sufficient quantity of tools will have to be provided by Contractor to electricians/workmen/officers.

20.6 The Contractor shall employ necessary number of qualified, full time electricians/electrical supervisors to maintain its temporary electrical installations.

20.7 In case any accident occurs during the construction/ erection or other associated activities undertaken by the Contractor, thereby causing any minor or major or fatal injury to its employees due to any reason whatsoever, it shall be the responsibility of the Contractor to promptly inform the same to the Site Engineer in prescribed form and also to all the authorities envisaged under the applicable laws.

20.8 The Site Engineer shall have the right at its sole discretion to stop the work, if in its opinion the work is being carried out in such a way as may cause accidents and endanger the safety of the persons and/or property, and/or equipment.In such cases, the Contractor shall be informed in writing about the nature of hazards and possible injury/accident and he shall comply to remove short-comings promptly. The Contractor, after stopping the specific work, can, if felt necessary, appeal against the order of stoppage of work to the Site Engineer within 3 days of such stoppage of work and the decision of the Site Engineer in this respect shall be conclusive and binding on the Contractor.

20.9 The Contractor shall not be entitled for any damages/compensation for stoppage of work due to safety reasons as provided above and the period of such stoppage of work will not be taken as an extension of time for completion of work and will not be the ground for waiver of levy of liquidated damages.

20.10 The Contractor shall follow and comply with all Safety Rules, relevant provisions of applicable laws pertaining to the safety of workmen, employees plant and equipment as may be prescribed from time to time without any demur, protest or contest or reservation. In case of any unconformity between statutory requirement and Safety Rules referred above, the latter shall be binding on the Contractor unless the statutory provisions are more stringent.

20.11 If the Contractor does not take all safety precautions and/or fails to comply with the Safety Rules as prescribed by the Owner or as prescribed under the applicable law for the safety of the equipment, plant and personnel and the Contractor does not prevent hazardous conditions which may cause injury to its own employees or employees of other Contractors, or Owner or any other person at Site or adjacent thereto, the Contractor shall be responsible for payment of compensation to the Owner as per the following schedule :-

a)Fatal injury or accident causing death :Rs. 1,00,000/-(per person)
These are applicable for death injury
to any person whosoever.

b) Major injuries or Accident causing 25%
or more (or) permanent disability to
work men or employees : Rs. 20,000/-(per person)

Permanent disability shall have the same meaning as indicated inWorkmen's Compensation Act. The compensation mentioned above shall be in addition to the compensation payable to the workmen/employees under the relevant provisions of the Workmen's Compensation Act and rules framed there under or any other applicable law as applicable from time to time. In case the Owner is made to pay such compensation,

the Contractor will be liable to reimburse the Owner such amount(s) in addition to the compensation indicated above.

21.0 CODE REQUIREMENTS

The erection requirements and procedures to be followed during the installation of the equipment shall be in accordance with the relevant ASME codes, accepted good engineering practice, the Engineer's Drawings and other applicable Indian codes and laws and regulations of the Government of India.

22.0. CHECK OUT OF CONTROL SYSTEMS

After completion of wiring and cabling the Contractor shall check out the operation of all control systems for the equipment furnished and installed under these specifications and documents.

23.0. CABLING

23.1 All cables shall be supported by conduits or cable tray run in air or in cable channels. These shall be installed in exposed runs parallel or perpendicular to dominant surfaces with right angle turn made of symmetrical bends for fittings. When cables are run on cable trays, they shall be clamped at a minimum intervals of 2000 mm or otherwise as directed by the Site Engineer.

23.2. Each cable, whether power or control, shall be provided with a metallic or plastic tag of an approved type, bearing a cable reference number indicated in the cable and conduit list (prepared by the Contractor), at every 5 meter run or part thereof and at both ends of the cable adjacent to the terminations. Cable routing is to be done in such a way that cables are accessible for any maintenance and for easy identification.

23.3. Sharp bending and kinking of cables shall be avoided. The minimum radii for PVC insulted cables 1100 V grade shall be 15 D where D is the overall diameter of the cable. Installation of other cables like high voltage, coaxial, screened, compensating, mineral insulated shall be in accordance with the cable manufacturer's recommendations. Wherever cables cross roads and water, oil, sewage or gaslines, special care should be taken for the protection of the cables in designing the cable channels.

23.4. In each cable run some extra length shall be kept at a suitable point to enable one or two straight through joints to be made, should the cable develop fault at a later date.

23.5. Control cable terminations shall be made in accordance with wiring diagrams, using identifying codes subject to Site Engineer's approval. Multicore control cable jackets shall be removed as required to train and terminate the conductors. The cable jacket shall be left on the cable as far as possible to the point of the first conductor branch. The insulated conductors from which the jacket is removed shall be neatly twined in bundles and terminated. The bundles shall be firmly but not tightly tied utilising plastic

or nylon ties or specifically treated fungus protected cord made for this purpose. Control cable conductor insulation shall be securely and evenly out.

23.6. The connectors for control cables shall be covered with a transparent insulating sleeve so as to prevent accidental contact with ground or adjacent terminals and shall preferably terminate in Elmex terminals and washers. The insulating sleeve shall be fire resistant and shall be long enough to over pass the conductor insulation. All control cables shall be fanned out and connection made to terminal blocks and test equipment for proper operation before cables are corded together.

24.0 GOODS AND SERVICES TAX [GST]:

GST Registration Number: TANTRANSCO is **33AADCT4780AFZA**. The details are also posted in TANTRANSCO web portal.

25.0 INCOME TAX:

(i)Income Tax will be recovered from the contractors every running bill at the prevailing rate of tax in force with amendments issued from time to time as per the Income Tax Act.

26.0 GENERAL CONDITIONS (STATUTORY COMPLIANCES)

1. The Contractor shall employ labour in sufficient numbers to maintain the required rate of progress and of quality to ensure workmanship of the degree specified in the Contract and to the satisfaction of the Engineer-in-Charge. The Contractor shall not employ in connection with the Works any person who has not completed his eighteen years of age.

2) The Contractor shall pay to labour employed by him either directly or through digital transfer. The wages should not be less than fair wages as defined in the current PWD Schedule rates (or) Minimum Wages Act (if applicable).

3) The Contractor shall in respect of labour employed by him comply with or cause to be complied with the Contract Labour Regulations in regard to all matters provided therein.

4) The Contractor shall comply with the provisions of the payment of Wages Act, 1936, Minimum Wages Act, 1948, Employers' Liability Act, 1938, Workmen's Compensation Act, 1923, Industrial Disputes Act, 1947, Maternity Benefit Act, 1961, Employees Provident Fund & Miscellaneous Provisions Act, 1952, Employees State Insurance Act, 1948, Payment of Bonus Act, 1965 and Mines Act, 1952, Contract Labour Regulation & Abolition Act, 1970 or any modifications thereof or any other law relating thereto and rules made thereunder from time to time.

5) The Engineer-in-Charge shall on a report having been made by an Inspecting Officer as defined in the Contractors Labour Regulations have the power to deduct from the moneys due to the Contractor any sum required or estimated to be required for making good the loss suffered by a worker or workers by reason of non-fulfillment of the Conditions of the Contract for the benefit of workers, nonpayment of wages or of deductions made from his or their wages which are not justified by the terms of the Contract or non-observance of the said Contractors Labour Regulations.

6) The Contractor shall indemnify the Corporation against any payments to be made under and for observance of the Regulations afore said without prejudice to his right to claim indemnity from his sub- contractors. (if permitted)

7) In the event of the Contractor committing a default or breach of any of the provisions of the aforesaid Contractors Labour Regulations as amended from time to time or furnishing any information or submitting or filling any Form/ Register/Slip under the provisions of these Regulations which is materially incorrect then on the Report of the Inspecting Officers as defined in the Contractors Labour Regulations the Contractor shall without prejudice to any other liability pay to the Corporation a sum not exceeding Rs. 50.00 as liquidated damages for every default, breach or furnishing, making, submitting, filling materially incorrect statement as may be fixed by the Engineer-in-Charge and in the event of the Contractor's default continuing in this respect, the liquidated damages may be enhanced to Rs. 50.00 per day for each day of default subject to a maximum of ten percent of the estimated cost of the Works put to tender. The Engineer-in-Charge shall deduct such amount from bills or security deposit of the Contractor and credit the same to the Welfare Fund constituted under Regulations. The decision of the Engineer-in-Charge in this respect shall be final and binding.

27.0 1.0 CONTRACT LABOUR REGULATIONS :

(i) Notice of commencement: The Contractor shall, within SEVEN days of commencement of the work, furnish in writing to the Inspecting Officer of the area concerned the following information :

(a) Name and situation of the work.
(b) Contractor's name and address
(c) Particulars of the Department for which the work is undertaken,
(d) Name and address of sub-contractors as and when they are appointed.
(e) Commencement and probable duration of the work.
(f) Number of workers employed and likely to be employed.
(g) 'fair wages' for different categories of workers.
(h) Number of hours of work which shall constitute a normal working day:-

(i) The number of hours which shall constitute a normal working day for an adult shall be NINE hours. The working day of an adult worker shall be so arranged that inclusive of intervals, if any, for rest it shall not spread over more than twelve hours on any day, when an adult worker is made to work for more than NINE hours on any day or for more than FORTY EIGHT hours in any week he shall, in respect of overtime work, be paid wages at double the ordinary rate of wages.

(ii) Weekly day of rest : Every worker shall be given a weekly day of rest which shall be fixed and notified at least TEN days in advance. A worker shall not be required or allowed to work on the weekly rest day unless he has or will have a substituted rest day, on one of the five days immediately before or after the rest day. Provided that no substitution shall be made which will result in the worker working for more than ten days consecutively without a rest day for a whole day.

(a) Where in accordance with the foregoing provisions a worker works on the rest day and has been given a substituted rest day he shall be paid wages for the work done on the weekly rest day at the overtime rate of wages.
(b) Note: The expression 'ordinary rate of wages' means the fair wage the worker is entitled to.

(c) Display of notice regarding Wages, Weekly Day of Rest etc. The Contractor shall before he commences his work on contract, display and correctly maintain and continue to display and correctly maintain in a clean and legible condition in conspicuous places on the works, notice in English and in the local Indian Language, spoken by majority of workers, giving the rate of fair wages, the hours of work for which such wages are payable, the weekly rest days workers are entitled to and name and address of the Inspecting Officer. The Contractor shall send a copy each of such notices to the Inspecting Officers.

(iii) Register of Workmen: A register of workmen shall be maintained in the Form appended to these regulations and kept at the work site or as near to it as possible, and the relevant particulars of every workman shall be entered therein within THREE days of his employment.

(iv)Employment Card : The contractor shall issue an employment card in the Form appended to these regulations to each worker on the day of work or entry into his employment. If a worker already has any such card with him issued by the previous employer, the contractor shall merely endorse that Employment Card with relevant entries. On termination of employment the Employment Card shall again be endorsed by the Contractor and returned to the worker.

(v)Register of Wages etc. : A Register of Wages-Cum-Muster Roll in the Form appended to these regulations shall be maintained and kept at the work site or as near to it as possible.

(vi) Fines and deductions : Wages of a worker shall be paid to him without any deductions of any kind except the deduction for damage to or loss of goods expressly entrusted to the employed person for custody, or for loss of money which he is required to account for, where such damage or loss is directly attributable to his neglect or default;

(a) No fine shall be imposed on a worker and no deductions for damage or loss shall be made from his wages until the worker has been given an opportunity of showing cause against such fines or deductions.

(b) The Contractor shall maintain a register of fines and the register of deductions for damage or loss in the Forms appended to these regulations which should be kept at the place of work.

(vii) Register of Accidents : The Contractor shall maintain a register of accidents in such form as may be convenient at the work place but the same shall include the following particulars:--

(a) Full particulars of the labourers who met with accident.

(b) Rate of Wages.

(c) Sex.

(d) Age.

(e) EPF UAN number
(f) ESI number
(g) Aadhaar number
(h) Nature of accident and cause of accident.
(i) Time and date of accident.
(j) Date and time when admitted in hospital.
(k) Date of discharge from the hospital.
(l) Period of treatment and result of treatment.
(m) Percentage of loss of earning capacity and disability as assessed by Medical Officer.
(n) Claim required to be paid under Workmen's Compensation Act.
(o) Date of payment of compensation.
(p) Amount paid with details of the person to whom the same was paid.
(q) Authority by whom the compensation was assessed.
(r) Remarks. [Note: k,l,m,n for the workmen not covered under the ESI provisions]

(viii) Preservation of Registers : The Register of workmen and the Register of Wages-cum-Muster Roll required to be maintained under these Regulations shall be preserved for 3 years after the date on which the last entry is made therein.

(ix) Enforcement: The Inspecting Officer shall either on his own motion or on a complaint received by him carry out investigations, and send a report to the Engineer-in-Charge specifying the amounts representing Workers' dues and amount of penalty to be imposed on the Contractor for breach of these Regulations, that have to be recovered from the Contractor, indicating full details of the recoveries proposed and the reasons there for. It shall be obligatory on the part of the Engineer-inCharge on receipt of such a report to deduct such amounts from payments due to the Contractor.

(x) Disposal of amounts recovered from the Contractor : The Engineer-inCharge shall arrange payment to workers concerned within FORTY FIVE days from receipt of a report from the Inspecting Officer except in cases where the Contractor had made an appeal under Regulation 16 of these Regulations. In cases where there is an appeal, payment of workers dues would be arranged by the Engineer-in-Charge, wherever such payments arise, within THIRTY days from the date of receipt of the decision of the competent authority.

(xi) Welfare Fund : All moneys that are recovered by the Engineer-inCharge by way of workers dues which could not be disbursed to workers within the time limit prescribed above, due to reasons such as whereabouts of workers not being known, death of a worker etc. and also amounts recovered as penalty, shall

be credited to a Fund to be kept under the custody of the Corporation for such benefit and welfare of workmen employed by Contractors.

(xii)Appeal against decision of Inspecting Officer : Any person aggrieved by a decision of the Inspecting Officer may appeal against such decision to the competent authority concerned within THIRTY days time stipulated from the date of the decision, forwarding simultaneously a copy of his appeal to the Engineer-in-Charge. The decision of the competent authority shall be final and binding upon the Contractor and the workmen.

(xiii) Inspection of Books and other Documents : The Contractor shall allow inspection of the Registers and other documents prescribed under these Regulations by Inspecting Officers and the Engineer-in- Charge or his authorized representative at any time and by the worker or his agent on receipt of due notice at a convenient time.

(xiv) Interpretation, etc.: On any question as to the application interpretation or effect of these Regulations, the decision of the Commissioner of Labour (or) Director/ Industrial Safety and Health shall be final and binding.

(xv) Amendments: Government may, from time to time, add to or amend these Regulation and issue such directions as it may consider necessary for the proper implementation of these Regulations or for the purpose of removing any difficulty which may arise in the administration thereof

2.0 <u>Compliance of EPF& MP Act, 1952</u>:

(a) The Contractor who take up works contract for TANGEDCO/TANTRANSCO is required to comply with all the relevant provisions stipulated in the EPF & MP Act;

(b) The Contractor should have a separate EPF main code number.

(c) The Contractor should be responsible for the payment of necessary EPF contributions both Employer's and Employee's contribution as per the provisions of the EPF Act in respect of the actual workers engaged for the specified works.

(d) The contractor should submit necessary returns to EPF Organisation within the stipulated time as required under the said EPF & MP Act.

(e) The Contractor should produce the proof of payment of contribution – both Employer's and Employee's contributions made to EPF Organisation in order to claim the Bills for the respective works.

(f) The contractor should be fully liable to meet and fulfill all the relevant provisions of the EPF act in the respect of the execution of the Tendered work.

(g) In case the Contractor fails to fulfill any of the statutory provisions of the EPF & MP Act and consequently it happens that TANGEDCO/TANTRANSCO Ltd has to meet such requirements of the said Act or Statutory provisions in the capacity of Principal Employer, TANGEDCO/TANTRANSCO shall make good such requirements out of the money due and payable to the said Contractor and further the performance of the said Contractor in this regard will be noted for all future Contracts of TANGEDCO/TANTRANSCO.

2.1 In respect of the category of employee for whom the wages are fixed at the rate of Rs.500/- and above in the current PWD Schedule rates (or) say the monthly wages of Rs.15,000/- above. The EPF employer contribution will be restricted upto Rs.15,000/- only.

3.0 <u>Compliance of ESI Act 1948 :</u>

(a) The contractor who take up the works contract for TANGEDCO & TANTRANSCO is required to comply with all the provisions stipulated to ESI Act 1948.

(b) The contractor should have a separate ESI main code number.

(c) The contractor should be responsible for the payment of necessary ESI contributions – both Employer's and Employee's contributions as per the provisions of the ESI Act in respect of the actual workers engaged for the specified works.

(d) The contractor should submit necessary returns to the ESI Organization within the stipulated time as required under the said ESI Act.

(e) The contractor should produce the proof of payment of contributions - both Employer's and Employee's contributions made to ESI Organization in order to claim the Bills for the respective work.

(f) The contractor should be fully liable to meet and fulfill all the relevant provisions of the ESI Act in respect of the execution of the Tendered work.

(g) In case the Contractor fails to fulfill any of the statutory provisions of the ESI Act and consequently it happens that TANGEDCO & TANTRANSCO has to meet such requirements of the said Act or Statutory provisions in the capacity of Principal Employer, TANGEDCO & TANTRANSCO shall make good such requirements out of money due and payable to the said Contractor and further the performance of the said Contractor in this regard will be noted for all future Contracts of TANGEDCO & TANTRANSCO.

(h) (i) The contractor who claims exemption under the ESI Act should produce the exemption order obtained from the Government/ESI organization.

(ii) The contractor who claims exemption for those areas that are not covered under the purview of the ESI Act, necessary evidences should be submitted by the contractor to ensure that the revenue village where the work is being carried out has not been covered under the implemented area of ESI.

(iii) The category of employees (Technical Assistant II Grade) and above for whom the wages are fixed at the rate of Rs. 700/- and above in the PWD Schedule rates (or) the monthly wages of Rs.21,000/- above. Such employees will not be covered under the ESI Act. In all such conditions, the Contractor has "to ensure the medical benefits for the Workers engaged by the Contractors for the works and has to take relevant group insurance policies with the applicability for giving compensation to the workers" under the Employee's Compensation Act.

4.0 Statutory Compliance Clearance Certificate:-

(a) The Contractor executing the works contract in TANGEDCO/TANTRANSCO should obtain the Statutory Compliance Clearance Certification from the Online Compliance Service Providers engaged by TANGEDCO/ TANTRANSCO, the required documents should be submitted by the contractors to the respective Online Compliance Service Providers.

(b) The charges for Statutory Compliance Clearance Certification will be at the rate of Rs.2.00/- per man day per month with minimum charges of Rs.400/- and maximum charges of Rs. 3200/- and Rs.300/- for re-audit due to reasons attributable to the contractor. The charges should be paid by the respective contractors to the service provider through online.

5.0 The Building and Other construction Workers Act:-

(other than the circle/station registered under the Factories Act)

(a) The contractor should obtain the Registration certificate under the Building and Other construction Workers (Regulation of Employment and Condition of Service) Act, 1996 from the Competent Authority (the Joint Director/Industrial Safety and Health (BOCW)).

(b) The contractor should comply all the provisions of the Building and Other construction Workers (Regulation of Employment and Condition of Service) Act, 1996.

6.0 The Contract Labour (Regulation & Abolition) Act 1970 & Rules 1975 and Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979 & Rules 1983.

(a) The Contractor who take up works contract for TANGEDCO/TANTRANSCO should deploy sufficient number of workmen for the work and the contractor should deploy 20 or more workmen on a day of emergency (or) in necessity.

(b) The Contractors should comply with all the provisions of the Contract Labour (Regulation & Abolition) Act, 1970 and Tamilnadu Contract Labour (Regulation & Abolition) Rules 1975 as modified from time to time and shall also indemnify TANGEDCO/TANTRANSCO from all and against any claims under the aforesaid Act and the Rules. The contractors should also submit the copy of the labour licence before executing the works.

(c) The Contractors who desires to engage the migrant workmen (workmen from other states) for the works contracts of TANGEDCO/TANTRANSCO is required to comply with all the provisions of the Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979 and Tamilnadu rules, 1983 as modified from time to time and shall also indemnify TANGEDCO/TANTRANSCO from all and against any claims under the aforesaid Act and the Rules The contractors should also submit the copy of the migrant labour licence before executing the works.

(d) The contractors should maintain the following records as per section 78 of Contract Labour (Regulation & Abolition) central rules 1971.

(i) Muster Roll in Form – XVI.

(ii) Register of Wages in Form – XVII.

(iii) Register of overtime in Form – XVIII.

(iv) The contractor shall issue an photo identity card to his employees.

7.0 <u>Wages:-</u>

(a) The Wages prescribed for the contractor/ industry/ establishment as per rates of Minimum Wages notified by the Government of Tamilnadu under the Minimum Wages Act, 1948 or the current PWD rates of wages, whichever is higher is to be paid by the contractor to their employees.

(b) The contractor should pay the wages before the expiry of seventh day as per section 65 and shall issue wage slip in Form – XXVIII to the workmen as per section 78(b) of The Tamil Nadu Contract Labour Rules, 1973. The copies of the wage slip so issued to the workmen should be maintained by the contractor and produced as when called for.

8.0 EPF Documents to be Produced for Claiming Bills:-

(a) The EPF contribution should be remitted separately (by separate Challan) for each and every work. The acceptance order/ formal order reference number should be entered in the remarks column of the ECR Challan (Electronic Challan Cum Return) and the same should be submitted.

(b) The payment confirmation receipt should be submitted (the payment confirmation date is mandatory)

(c) The combined Challan of Account No. 1,2,10,21 & 22 should be submitted.

(d) All the documents should duly signed with seal by the contractor.

9.0 ESI Documents for While Claiming Bills:-

(a) The Monthly Contribution Challan Form should be submitted (Transaction status field – completed successfully is mandatory).

(b) The contribution history of the respective months should be submitted.

(c) The month wise statement should be submitted showing the details of the employees utilized by the contractors for the specific work and the contribution remitted as per the below format.

S.No	IP.No	IP.Name	No. of days	Wages	IP Contributions

(d) All the documents should duly signed with seal by the contractor.

10.0 Tamil Nadu Rationlisation of Forms and Reports under Certain Labour Laws Rules, 2020.

The contractor should comply/ maintain the applicable new combined forms introduced vide the following Acts/ Rules.

(a) The Tamil Nadu Contract Labour (Regulation and Abolition) Rules, 1975.

(b) The Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) (Tamil Nadu) Rules, 1983.

(c) The Tamil Nadu Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Rules, 2006.

The contractor should comply/ maintain the applicable new combined forms introduced vide the following Acts/ Rules.

(a) The Tamil Nadu Contract Labour (Regulation and Abolition) Rules, 1975.

(b) The Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) (Tamil Nadu) Rules, 1983.

(c) The Tamil Nadu Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Rules, 2006.

New Forms:

FORM I	Certificate of Registration of Principal Employer/Employer (under 3 Rules)
FORM II	Application for Licence/ Renewal of Licence (under CLRA and ISMW Rules)
FORM III	Form of Certificate by Principal Employer (under CLRA and ISMW Rules)
FORM IV	Certificate of Initial and Periodical Test and Examination of Various Appliances (under BOCW Rules)
FORM V	Application for Adjustment of Security Deposit (under CLRA and ISMW Rules)
FORM VI	Licence and Renewal (under CLRA and ISMW Rules)
FORM VII	Notice of commencement/ completion of work (under CLRA and BOCW Rules)
FORM VIII	Service Certificate (under 3 Rules)
FORM IX	Certificate of Medical Examination (under BOCW Rules)
FORM X	Report on recruitment and employment of migrant workmen and cessation of employment of migrant workmen (under ISMW Rules)
FORM XI	Report of Poisoning or Occupational Notifiable Diseases/ Accidents and Dangerous Occurrences (under BOCW Rules)
FORM XII	Application for Registration of Establishments Employing Contract Labour or Migrant Workmen or Building Workers

11.0 Agreement and Undertaking to be furnished by the contractors in respect of the Statutory Provisions:-

(a) An undertaking as specified in Annexure-A should also be obtained from the contractors to ensure the remittance of EPF & ESI, Employee

and Employer contribution for the respective works while claiming the bills.

(b) The TNEB (TANGEDCO/ TANTRANSCO) registered contractor, who wants to execute the works in a circle shall be instructed to execute an agreement [Annexure-I] with respective Superintending Engineer's of the circle.

12.0 <u>SAFETY CONDITION:-</u>

(i) All the relevant personal protective equipments like safety helmets, safety shoes, safety belt, goggles, nose mask, face mask, dust respirator, asbestos sult, apron, leg guards, rubber gloves, face shield hand sleeves, ear plug, ear muff, fiber helmet, fall net etc., should be supplied by the contractors to their workmen and ensure for proper usage by their workers without fail.

(ii) Proper welding machines with accessories, good and sound construction of hand tools, power tools such as grinding machines, cutting machines, chipping tools, scaffolding materials, etc., should be used. Proper earthing to be provided wherever necessary.

(iii) The contractor shall not allow his workmen to wear loose garments, like lingoes, dhotis, watches, loose jewels and bangles, etc., while at work and smoke cigarettes, beedies etc., inside the power house premises.

(iv) The contractor shall ensure that his workmen to wear tight full or half pant while at work inside the powerhouse premises.

(v) Technically skilled and also safety-oriented supervisor should supervise the work at all time.

(vi) If any accident occurs, it should be informed to the concerned officer of TANGEDCO in writing by the concerned contractor immediately.

(vii) For any safety violation and non-compliance of the statutory provisions and rules the contractor is sole responsible and the contractor is liable for any prosecution and imposition of penalty as per the rules in force.

(a) Every opening in floor of a building or in a working platform shall be provided with suitable means to prevent fall of persons or materials by providing suitable fencing or railing with a minimum height of 1 meter.

(b) All practical steps shall be taken to prevent danger to persons employed, from risk or fire or explosion, or flooding. No floor, roof, or other part of a building shall be so overloaded with debris or materials as to render it unsafe.

All necessary personal safety equipment as considered adequate by the Engineer-in-Charge shall be available for use of persons employed on the Site and maintained in a condition suitable for immediate use; and the Contractor shall take adequate steps to ensure proper use of equipment by those concerned.

(i) When workers are employed in sewers and manholes, which are in use the Contractor shall ensure that manhole covers are opened and manholes are ventilated at least for an hour before workers are allowed to get into them. Manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent accident to public.

(a) No paint containing lead or lead products shall be used except in the form of paste or readymade paint.

(b) Suitable face masks shall be supplied for use by workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.

(ii) Use of hoisting machines and tackle including their attachments, anchorage and supports shall conform to the following :–

(a) These shall be of good mechanical construction, sound material and adequate strength and free from patent defects and shall be kept in good working order and properly maintained.

(b) Every rope used in hoisting or lowering materials or as a means of suspension shall be of durable quality and adequate strength, and free from patent defects.

(iii) The Contractor shall at his own expense arrange for the safety provisions as appended to these conditions or as required by the Engineer-in-Charge, in respect of all labour directly employed for performance of the works and shall provide all facilities in connection therewith. In case the Contractor fails

to make arrangements and provide necessary facilities as aforesaid, the Engineer-in-Charge shall be entitled to do so and recover the cost thereof from the Contractor.

(iv) Failure to comply with Safety Code shall make the Contractor liable to pay to the Corporation as liquidated damages an amount not exceeding Rs. 50.00 for each default or materially incorrect statement. The decision of the Engineer-in-Charge in such matters based on reports from the Inspecting Officers as defined in the Contract Labour Regulation as appended to these conditions shall be final and binding and deductions for recovery of such liquidated damages may be made from any amount payable to the Contractor.

(a) All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in a safe condition and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities shall be provided at or near places of work.

(b) These safety provisions shall be brought to the notice of all concerned by display on a notice board at a prominent place at the work spot. Persons responsible for ensuring compliance with the Safety Code shall be named therein by the Contractor.

(c) To ensure effective enforcement of the rules and regulations relating to safety precautions, arrangements made by the Contractor shall be open to inspection by the Engineer-in-Charge or his representatives and the Inspecting Officers as defined in the Acts/Rules applicable.

(d) The Contractor is not exempted from the operation of any other Act or Rule in force.

28.0 TDS under GST is applicable for this tender and will be deducted @ 2% on each and every invoice of the contract as per section 51 of CGST Act 2017 notified by the Central Government Notification No.:50/2018 dt.13.09.18.
TANTRANSCO's GST Registration No. for**TDS** is **33CHET12024F1DI**.

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"CONSERVATION OF ENERGY IS SERVICE TO NATION"

SECTION-III
FORMATS
SCHEDULE - I

STATEMENT OF SUPPLY ORDERS EXECUTED/UNDER EXECUTION DURING THE LAST TEN YEARS AS ON THE DATE OF TENDER.

Sl. No.	Name and address of the organization	Name of material	P.O.NO. & Date	Qty.	Value of order in Rs. in Lakhs	Scheduled date of completion of order	Actual date of completion of order
1	2	3	4	5	6	7	8

COMPANY SEAL:

SIGNATURE :

DESIGNATION :

COMPANY :

DATE :

SCHEDULE-II
STATEMENT OF TYPE TEST PARTICULARS

SL. NO.	NAME OF THE TEST	NAME OF LAB	DATE OF TEST
	TYPE TEST:		
1.	IMPULSE VOLTAGE TEST		
2.	TEMPERATURE RISE TEST		

NOTE: All the TYPE Tests validity **should be within FIVE (5)**years as on the date of tender opening as per IS 2026 / IEC 60076 and latest issue of IS/IEC:

All the TYPE Tests as per IS 2026 / IEC 60076 and latest issue of IS/IEC are to be carried out at Suppliers Cost on the 1st unit or any one of the designated unit at the discretion of TANTRANSCO at NABL accredited CPRI / ERDA / International Accredited Laboratory/ any other Government approved / Government recognized laboratory or in the presence of Purchaser's representatives or by third party agency (ERDA/CPRI/ International Accredited Laboratory) tested with the testing instruments / equipment having valid calibration certificate issued from third party agency (ERDA/CPRI / International Accredited Laboratory).

COMPANY SEAL:

SIGNATURE :

DESIGNATION :

COMPANY :

DATE :

SCHEDULE-III

STATEMENT OF SPECIAL TEST PARTICULARS

S. NO.	NAME OF THE TEST	NAME OF LAB	DATE OF TEST
1.	**SPECIAL TEST**: SHORT CIRCUIT TEST		

Note: The bidder should furnish Dynamic Short Circuit test report with validity within five (5) years as on the original date of Technical bid opening from Government/ Government recognized laboratories / International Accredited Laboratory conforming with latest IS / IEC for 100 MVA or above capacity of 220 or 230KV or above Voltage Class transformer.
If validity of Short Circuit Test is not available an undertaking that the supplier will carry out S.C.Test at Government/ Government recognized laboratories / International Accredited Laboratory conforming with latest IS / IEC for 100 MVA, 230/110 KV Auto Tranformer at Supplier cost with no cost implication to TANTRANSCO.

DATE:

COMPANY SEAL:

SIGNATURE :

DESIGNATION:

COMPANY :

SCHEDULE-IV

UNDERTAKING TOWARDS INPUT TAX CREDIT

(Declaration to be submitted by the bidders in Non-Judicial Stamp paper of value

not less than Rs.100/-)

To

The Chief Engineer/Transmission,
TANTRANSCO,
4th floor, Southern Wing,
TANTRANSCO Building,
144, Anna Salai,
Chennai – 600 002.

We hereby declare and confirm that we are registered vendor under GST Act having GSTIN in State of …….. . Our applicable GST% for the above reference job is …… % under HSN code ……..... (or) ……. % under SAC code ……

We hereby declare and confirm that we are unregistered vendor under GST Act being turnover is less than Rs. ……Lakhs (being threshold limit) per annum. (For unregistered vendor, the vendor has to submit an affidavit in the enclosed format).

We hereby declare and confirm that we are registered vendor under composite scheme having GSTIN …….. .

We are aware that as per sec 171 of CGST Act, any reduction in rate of tax on any supply of goods or services or the benefit of input tax credit should be passedon to TANTRANSCO by way of commensurate reduction in prices and as such whereby declare that we are extending Rs. ……../- of ……..% as rebate in my awarded price against input tax credit benefit.

We hereby declare that we do not have any input tax credit benefit on account of GST applicable against this job. If it is established that we have availed input tax credit benefit against this job, the differential tax benefit will be returned to TANTRANSCO failing which TANTRANSCO may take appropriate action

Signature of bidder
with Company Seal.

Witness with address:
1)

2)

Note: Bidder may strike out the para not applicable.

SCHEDULE-V
UNDERTAKING IN LIEU OF TYPE TEST

(To be furnished in non-judicial stamp paper of value not less than Rs.100/-)

We hereby confirm and undertake that we will conduct and submit Type Test Reports for the offered Transformer (whose Type Test Reports could not re-validated due to lock down in the country since 23rd March 2020) at free of cost to TANTRANSCO as per Specification .

SIGNATURE :

NAME IN BLOCK LETTERS :

SEAL OF THE COMPANY :

In the presence of Witnesses:

1. Signature
   Name & Address

2. Signature
   Name & Address

ANNEXURE – I
TYPE, RATING AND TECHNICAL REQUIREMENTS

Sl.No	DESCRIPTION	REQUIREMENT
1.	Maximum continuous rating (MVA)	
	(a) HV	100
	(b) LV	100
2.	Maximum continuous rating and cooling	
	(a) ONAN	60%
	(b) ONAF / ONAF 1	80%
	(c) ONAF 2 / ODAF / OFAF	100%
3.	Type of cooling	(a) ONAN / ONAF / OFAF **or** (b) ONAN / ONAF / ODAF **or** (c) ONAN / ONAF1 / ONAF2
		(b) 1x100% or separately 2x50% cooler bank (c) 2 X 100% cooling pumps out of which one is connected stand-by (d) 2 fans as stand-by one for each cooler bank.
4.	Max. Temperature rise over ambient temperature of 50 deg. C	
	(a) Winding	55 deg. C
	(b) Oil	50 deg. C
	(c)Limit of hot spot temperature with yearly weighted average ambient temperature of 32ºC	98 deg. C
	(d)Maximum hot spot temperature	140 deg C
5.	Maximum flux density at normal voltage and frequency	1.72 Tesla
6.	(i) Rated voltage (KV) (a) H.V. winding (b) L.V. winding	 230 110
	(ii) Variation in the system voltage	$\pm$ 10%
7.	Number of phases	3
8.	Rated frequency	50 $\pm$ 5%
9.	Voltage Ratio (KV)	230/110 KV
10.	(i) Type of connection	
	(a) H.V.	Star
	(b) L.V.	Star
	(ii) Vector group	**YNaO**
	(iii) Neutral	Effectively earthed
11.	Type of winding	
	(a) H.V.	Disc Winding
	(b) L.V.	Disc Winding
12.	Max. current density of winding	**240 A/cm^2**

Sl. No.	DESCRIPTION	REQUIREMENT		
13.	Insulation levels	HV	LV	Neutral
	(1) Winding voltage KV (rms)	230	110	--
	(2) Highest system voltage KV (rms)	245	145	36
	(3) Lightning impulse withstand voltage(KVp)	950	550	95
	(4) Power frequency rated short duration withstand voltage (KV rms)	38	38	38
	(5) Induced over voltage withstood (KV rms)	395	230	--
14.	Duration of short circuit withstand capacity	2 seconds.		
15.	(a) Tap changer	OLTC with remote control panel		
	(b) Tapping range	On HV winding for HV variation of +10% to – 10% in steps of 1.25% (16 steps)		
16.	D.C. voltage for relays etc.	110/220 Volts		
17.	Percentage impedance +10% tolerance (Negative tolerance is not accepted)	Principal Tap		
	HV – LV	12.5		
18.	Cooling medium / insulating oil	Uninhibited Transformer Oil conforming to IEC-60396-2020		
19.	Maximum Losses			
	(a) No-load loss	28 KW		
	(b) I^2R loss	125 KW		
	(c) Load loss	170 KW		
	(d) Auxiliary loss	5 KW		
20.	Termination arrangement	HV side with free end clamp with bi-metallic strip suitable for 3 inch Al. Bus bar Bushing type suitable for outdoor operation.		
21.	Terminal bushings	HV	LV	Neutral
	(a) Voltage rating (KV rms)	245	145	36
	(b) Current rating (Amps)	800	800	2000
	(c) Impulse withstand voltage (KV Peak)	1050	650	170
22.	Bushing Current transformers:			
	a) C.T. Ratio	600/1 for restricted earth fault protection		
	b) Accuracy class	PS		
	c) VA Burden	30	30	
	d) Knee point voltage	Shall be more than 40*I* (Rct+Ra) where Rct = secondary resistance of the current transformer Ra = lead resistance (2 ohms)		
	e) Magnetizing current	Shall be less than 30 milli amperes at half the knee point voltage.		

23.	Tank:		
	(i) Type	Bell/Conventional	
	(ii) Thickness (mm) (a) Bottom (b) Sides (c) Top (iii) Pressure release device (a) Type (b) Number (iv) Sudden Pressure Relief device (a) Number	 Refer Section VII – Technical – cl.14.13 10 12 Safety valve type spring operated 2 1	
24.	Clearances (mm)	230KV	110KV
	(a) Phase to Phase	2388	1200
	(b) Phase to Earth	2150	1050
25.	Noise level	Less than **80 db**	
26.	Oil preservation Main Conservator OLTC Conservator	Air cell type with 3 Nos. breathers in Series associated with oil seal with a valve. 2 Nos. Breathers in series with oil seal.	
27.	Expected life period of the transformer	25 Years.	

ANNEXURE – II (A)
To be filled in by the tenderer
SCHEDULE OF GUARANTEED PERFORMANCE AND OTHER PARTICULARS OF TRANSFORMER

Sheet – 1/10.

Sl No.	ITEM	VALUES
1.	Name of the manufacturer and address	
2.	Applicable standards.	
3. (a)	Continuous ratings under conditions specified in I.S:2026(Part-I) 1977 Clause-3 Type of cooling	(a) ONAN / ONAF / OFAF **or** (b) ONAN / ONAF / ODAF **or** (c) ONAN / ONAF1 / ONAF2
(b)	Rating in (MVA) -Total load on HV/LV under any combination of loading shall not exceed 100 MVA (i) With ONAN cooling (ii) With ONAF cooling (iii) With ODAF / OFAF/ ONAF 2 cooling	HV LV
(c)	Rated Voltage. (i) HV (KV) (ii) LV (KV)	
(d)	Voltage variation	
(e)	Rated frequency (Hz)	
(f)	Frequency variation	
(g)	Number of phases.	
(h)	Current at rated load and voltage on principal tap (i) HV amps. (ii) LV amps.	
4.	Connections: (i) HV, (ii) LV	
5.	Connection Symbol.	
6 (a)	Maximum Temperature rise (above peak ambient. Temperature rise of oil. (By thermometer) (ºC) (i) At full ONAN rating (ii) At full ONAF rating (iii) At full ODAF OFAF/ ONAF 2 rating	
(b)	Temperature rise of winding (By resistance method) (ºC) (i) At full ONAN rating (ii) At full ONAF rating (iii) At full ODAF OFAF/ ONAF 2 rating	

		Sheet – 2/10.
(c) (d) (e)	Temperature gradient between winding and oil (ºC) Limit of hot spot temperature for which the transformer is designed (ºC) Time in minutes for which the transformer can be run at full load without exceeding the max. permissible temperature at reference ambient temperature when, (i) Supply of fan is cut off but oil pumps are working (ii) Supply of oil pump is cut off but fans are working (iii) When supply of both fans and pumps are cut off (iv) Ambient peak temperature specified Deg.C	
7. (a) (b)	Tappings on windings on HV side. Number of steps Range of tappings for variation	
8. (a) (b) (c) (d)	Losses (KW-MAX) No-load losses at rated voltage and Frequency at principal tap. Load-losses at rated output rated Frequency and corrected for 75 ºC Auxiliary losses at rated output, normal ratio, rated voltage, rated frequency and ambient temperature (KW) Total losses at normal ratio inclusive of auxiliary equipment losses (KW) corrected to 75ºC.	
9. (a) (b)	Resistance per phase (ohms) H.V.winding. L.V. winding	
10. (a) (b) (c	Positive sequence impedance on rated MVA base at rated current and frequency at 75 ºC winding temperature at, Principal tap percent. (normal voltage) Highest voltage tap percent. Lowest voltage tap percent	
11	Zero Sequence impedance at reference temperature of 75ºC at principal tap percent .	

12	Noise level in decibles when energised at normal voltage and normal frequency at No-Load.	
13.	% Reactance at rated MVA base at rated Current and frequency	
14.	% Regulation at full load and 75ºC Winding temperature expressed as a percentage of normal voltage (i) At unity power factor (ii) At 0.8 p.f. (lagging)	
15.	% Efficiency at 75 ºC winding temperature as derived from guaranteed loss figures and at UPF (a) Full load percent (b) 3/4 load (c) 1/2 load	
16.	Short time rating for 2 seconds of (a) HV winding (b) L V winding	
17.	Permissible over loading (a) HV winding (b) L V winding	
18(a)	Over load capacity of transformer duration for the following over loads starting with transformer unexcited (i) 10 % (ii) 20 % (iii) 30 % (iv) 50 % (v) 75 % (vi) 100 %	
(b)	Overload capacity of transformer duration For the following overloads, starting with Transformer after continuous running on Open circuit. (i) 10 % (ii) 20 % (iii) 30 % (iv) 50 % (v) 75 % (vi) 100 %	

		Sheet – 4/10.
(c)	Permissible emergency short time, loading of the transformer immediately following full load run (i) 2 seconds. (ii) 5 seconds. (iii) 10 seconds. (iv) 30 seconds. (v) 1 minute . (vi) 5 minutes.	
19.	Terminal arrangement (i) High voltage (HV) Free end clamp with bi-metalic strip suitable for 3 inch Al. bus bar (ii) Intermediate Voltage (IV) (iii) Low voltage (LV) (iv) Neutral	
20.	Insulating and cooling medium	
21.	Test Voltage **(i)** Lightning impulse withstand voltage (KVp) **(ii)** Power frequency withstand test voltage (dry and wet) (kV rms) **(iii)** Induced over voltage withstand voltage (kV rms) **(iv)** Voltage to earth for which star points of the transformer LV windings will be insulated.	HV LV
22.	External short circuit withstand capacity (MVA) and duration (seconds)	
23.	Over flux withstand capacity of the transformer.	

	ADDITIONAL TECHNICAL PARTICULARS	
1.	Details of core	
(a)	Type of core construction	
(b)	Type of core joints	
(c)	Flux density at rated voltage and frequency and at principal tap Tesla i) at rated voltage. ii) at 110% rated voltage. iii) at 90% rated voltage	
(d)	Magnetising current on HV side at normal ratio at and frequency and at (i) 85 % of rated voltage (ii) 100 % of rated voltage (iii) 110 % of rated voltage	
(e)	Power factor of magnetising current at normal voltage ratio and frequency	
(f)	(i) Material of core laminations (CRGO) (ii) Thickness of core laminations (mm) (iii) Specific loss of the core material watts per kg at working flux density	
(g)	(i) Whether core construction is without core bolts (ii) Insulation of core bolt (iii) Insulation of core bolt washers (iv) Insulation between core lamination (v) Core insulation withstand voltage for 1 minute(kV rms)	
(h)	Insulation of clamping plate	
(i)	Describe location / Method of core grounding	
(j)	Details of oil ducts in core – along plane of laminations	
2.	Method of making joints carrying current	
3.	Details of winding	HV LV
(a)	Type of winding	
(b)	Material of winding conductor :-	
(c)	Maximum current density of windings (at rated current) and conductor area (i) H.V. (ii) L.V. (iii) Regulating	
(d)	Whether HV windings are interleaved	
(e)	Whether windings are preshrunk	
(f)	Whether adjustable coil clamps are provided for HV and LV windings	
(g)	Whether steel rings used for the windings if so, whether they are split	
(h)	Whether electro static shields are provided to obtain uniform voltage	

(i)	Insulating material used for (I) HV winding (ii) LV winding (iii) Regulating winding	
(j)	Insulating material used between (I) HV winding (ii) LV winding (iii) Regulating winding	
(k)	Type of axial coil supports (i) H.V. Winding (ii) L.V. Winding	
(l)	Type of radial coil supports (i) H.V. winding (ii) L.V. winding (iii) Regulating winding	
(m)	Maximum allowable torque on coil clamping bolts	
4. (a) (b) (c) (d) (e) (f) (g) (h) (i) (j) (k) (l)	Bushings: Make and type (i) Rated Voltage class KV (ii) Rated current (Amps) Lightning impulse withstand test voltage (1.2x50 micro second (KV peak) Switching surge withstand test voltage (KV peak) Power frequency withstand test voltage (i) Wet for 1 minute (KV rms) (ii) Dry for 1 minute (KV rms) Visible corona discharge voltage (KV rms) Partial discharge level Creepage distance in mm Creepage distance (protected) Whether test tap is provided Quantity of oil in bushing and specification of oil used (Kg) Weight of assembled bushing (Kg) Min. clearance height for removal of bushing (mm)	HV LV & Neutral
5. (a) (b) (c) (d) (e) (f) (g)	Details of bushing current transformers Type and Make. Ratio. Class of Accuracy as per IS:2705 Part IV of latest issue. V.A.Burden. Knee point voltage. Magnetising current at knee point voltage. Lead resistance.	HV, LV & Neutral

6.	Minimum clearance (mm): In oil / In air Betn. Phases / Ph. to Gnd. / Betn. Phases / Ph. to Gnd. HV - LV -	
7.	Approximate weight.	
(a)	Core steel kg:	
(b)	Coil with insulation kg:	
(c)	Core and winding kg:	
(d)	Oil required for first filling kg:	
(e)	Fittings & accessories kg:	
(f)	Tank and fittings with Accessories kg:	
(g)	Un tanking weight kg:	
(h)	Total weight with oil and fittings kg:	
8.	Details of Tank	
(a)	Type of tank	
(b)	Approximate thickness of sheet (i) Sides (mm) (ii) Bottom (mm) (iii) Cover (mm) (iv)Cooling tubes/Radiators (mm)	
(c)	Materials of tank and construction	
(d)	Vacuum to be maintained during oil filling in transformer tank (torr)	
(e)	Vacuum to which the tank can be subjected without distortion (torr)	
(f)	No of bi-directional wheels provided	
(g)	Track gauge required for the wheels	Transverse Axis / Longitudinal Axis
(h)	Size of rail recommended for the track	
(i)	Type and quantity of Pressure Relief Device, Sudden Pressure Relief Device and pressure at which it operates	
(j)	Whether tank shields provided if so, details	
(k)	Details of painting at works and site	
9.	Conservator	
(a)	Total volume (Liters)	
(b)	Volume between the highest and lowest visible oil levels (Liters)	
10.	Oil	
(a)	Governing Standard	
(b)	Specific resistance at (i) 27 ºC (ohms-cms) (ii) 90 ºC (ohms-cms) shall be at least 50x 10^{12} ohm cm at 90°C.	
(c)	Tan delta	
(d)	Water content	
(e)	Dielectric strength (Break down voltage)(KV)	

(f)	Characteristic of oil after ageing test as per ASTM D - 1934 (i) Specific resistance at 27 ºC (ii) Tan delta (iii) Sludge content (iv) Neutralisation number		
(g)	Details oil preserving equipment offered		
11.	Radiator		
(a)	No. of banks attached whether attached/separate		
(b)	Overall dimensions (lxbxh) (mm)		
(c)	Total weight with oil (kg)		
(d)	Total weight without oil (kg)		
(e)	Thickness of radiator tube (mm)		
(f)	Type of mounting		
(g)	Vacuum withstand capability		
12.	Cooling System	**Fan**	Pump
(a)	Make and type		
(b)	No. of connected units		
(c)	No. of stand by units		
(d)	Rated power input		
(e)	Capacity (cu.m/min) or (litres/min)		
(f)	Rated voltage (volts)		
(g)	Locked rotor current (Amps)		
(h)	Efficiency of motor at full load (percent)		
(i)	Estimated time constant in hours for (i) Natural cooling (ii) Forced air cooling Temperature rise of motor at full load (ºC)		
(j)	BHP of driven equipment		
(k)	Temperature range over which control is		
(l)	adjustable(ºC)		
(m)	Whether the fans suitable for continuous operation at 85 percent of their rated voltage		
13.	Gas and oil operated relay – Make & type		
14.	Magnetic oil level gauge – Make & type		
15	Temperature controllers (i) Make and Type (ii) Permissible setting ranges for alarm and trip (iii) Number of contacts (iv) Current rating of each contact (v) Diameter of the dial	Oil	Winding
16	(i) Minimum clearance height for lifting core and winding from tank cover :mm: (ii) Minimum clearance height for lifting tank cover: mm:		

17. (a) (b)	Shipping details Approximate weight of heaviest package :kg Approximate dimension of largest package : l x b x h	
18.	Transformer will be transported with oil / gas	
19. (a) (b) (c) (d) (e) (f) (g) (h) (i) (j) (k) (l) (m) (n) (o) (p)	Tap-changing equipment Make Type Power flow-unidirectional /bi-directional/ restricted bi-directional Rated voltage to earth (KV) Rated Current (Amps) Step Voltage (Volts) Number of steps Control-Manual/Local electrical/Remote electrical Line drop compensation provided/not provided. Parallel operation Protective devices Auxiliary supply details Approximate overall dimensions of tap changer Approximate overall weight Approximate mass of oil Details of the OLTC control panel for installation in the control room (1)Tap change delay (2)Tap change out of step (3)Tap change drive motor trip (4)Oil temperature alarm (5)Winding temperature alarm (6)Winding temperature trip (7)Buchholz alarm (8)Buchholz trip (9)Tap changer surge relay trip (10)Tap changer out of step alarm. (11)Oil flow fail alarm (12)Cooling fan trip(for each group of fans and standby)	
	(13)Cooling Pump Trip(for working and standby pump) (14) Pressure relief device acted (15) Sudden Pressure Relief acted (16) Cooler supply failure (17) OLTC buchholz alarm (18) Low oil level alarm	

20.	Driving mechanism box (i) Make and Type (ii) Details of apparatus proposed to Be housed in the box.	
21.	Weight of copper used (kg)	HV LV
22	Weight of core steel used (Kg)	
23.	Quantity of transformer oil used (K.litres) (including cooling system, OLTC & conservator)	
24.	Type of gaskets used in the transformer	
25. (a) (b) (c)	Overall Dimensions. Length (mm) Breadth (mm) Height (mm)	
26.	Expected life of transformer	

ANNEXURE II(B)
TECHNICAL DATA—WINDING

Sl.No.	PARTICULARS	100 MVA, 230/110 KV TRANSFORMER HV / LV / TAP
1	Phase Current	
2	Cross sectional Area(A)	
3	Current density	
4	a)Type of oil	
	b)ID-mm	
	c)OD-mm	
	d)Mean dia (Dm)	
	e)Size of conductor including parallels	
5	No. of turns/phase (T)	
6	No. of spacers per circle	
7	Winding radial Duct	
8	Oil duct	
9	Length of mean turn(Lmt)=Dm*T	
10	Wt. of copper (kg) $=Lmt \times A \times 8.89 \times 10^{-3}$	
11	Per phase resistance of winding (Ohms) $=\frac{0.0211 \times Lmt}{A}$	
12	$I^2 R$ Loss (Kw)	
13	Eddy Current & Stray loss (Kw)	
14	Total copper loss	
15	Guaranteed loss at 75 degree cent.	
16	Source of receipt including details of import of following:	
	(a) EC grade copper	
	(b) Paper Insulation	
	(c) Press board & other insulating materials	

Note: The Tenderers may please note that all data as per Sl.No. 1 to 16 are to be brought out separately for each winding i.e. HV, LV and tap. Also it may be noted that the loss figures against Sl.No. 12,13,14,15 are to be indicated at $75^{o}C$.

SIGNATURE
WITH SEAL OF TENDERER

ANNEXURE (II) (C)
TECHNICAL DATA—CORE

Sl.No.	PARTICULARS	100 MVA, 230/110 KV TRANSFORMER
1	Core material	
2	(a) No. of steps of core	
	(b) Thickness of steps	
	© No. of limbs	
3	Gross core area	
4	Stacking factor	
5	Net core area (A)	
6	Core circle dia.(D)	
7	Height of window (H) Width of window	
8	Centre to centre distance of limb ('C)	
9	Voltage per turn (V/t)	
10	Weight of core in kg. = (2.1xD +3H+4C) x A x 0.00765	
11	Working flux density (B in tesla) $= \frac{(V/t) \times 10^4}{4.44 f A}$	
12	Core loss in watt per kg. from graph for grade of core material and selected flux density	
13	Building factor	
14	No. Load Loss in Watts = Core wt. x watts per kg. x Building factor	
15	Guaranteed No load Loss (W)	
16	Source of receipt with proof of import	

SIGNATURE
WITH SEAL OF TENDERER

ANNEXURE – III

FITTING AND ACCESSORIES TO BE SUPPLIED ALONG WITH EACH UNIT

1. Conservator with partition for main transformer and OLTC:

   (1) For Main transformer:
   (a) 50 mm oil filling valve.
   (b) 25 mm drain cum sampling valve with dummy plug.
   (c) 50 mm filter valve with dummy plug.
   (d) Lifting hooks.
   (e) Ladder

   (2) For OLTC conservator.
   (a) 50 mm oil filling valve.
   (b) 25 mm drain cum sampling valve with dummy plug.
   (c) 25 mm shut-off valve.
   (d) Prismatic oil level gauge.
   (e) Surge relay.

2. Magnetic type oil gauge with low oil level alarm contacts.
3. **3 Nos. Silica gel breather in Serie**s associated with oil seal with a valve for main conservator and **2 Nos. Silica gel breather in Series** associated with oil seal for OLTC conservator.

4. Buchholz relay double float with alarm and trip contacts with shut off valves on either side of the relay of size 80 mm.

5. Pressure Relief Device (safety valve type) and Sudden Pressure Relief Device with trip contacts.
6. Pockets for thermometer on tank cover.
7. Oil temperature controller with maximum pointer and two sets of contacts, with micro switches.

8. Winding temperature controllers with maximum pointer and four sets of contacts with micro switches with calibration device.

9. Valves.
   (i) Between cooler and tank.
   (ii) One 100 mm drain valve with padlocking arrangement, located on the low voltage side.
   (iii) Two 50 mm filter valves at diagonally opposite corners with padlocking arrangement for the bottom valve.
   (iv) Two sampling valves of 25 mm with provision for fixing PVC pipe.
   (v) One 15 mm air release plug.
   (vi) Valves for NIFS as required

10. 2 Nos. earthing terminals.

11. Rating, diagram, terminal marking, schematic wiring, guarantee period and valve position plates, (stainless steel) of not less than 300 x 300 mm.

12. Inspection cover.

13. Bi-directional rollers with greasing duct and nipple.

14. Wiring upto marshalling box with PVC stranded, FRLS, Copper Cables of 1100 V grade from various points.

15. Lifting and hauling facilities.

    (i) Lifting lugs.
    (ii) Pulling eyes.
    (iii) Jacking pads at a height of 500 mm.
    (iv) Latching lugs.
    (v) Lifting eyes for the tank cover.
    (vi) Fixed ladder with anti clamping device.

16. Weather-proof marshalling boxes for housing control equipment and terminal connections.

17. OLTC gear with remote control panel comprising, among other things,

    a) Necessary valves for filling drain and sampling of oil.
    b) Conservator for OLTC.
    c) Equaliser pipe with valve between divertor and main tank.
    d) Drive mechanism box.
    e) Local control panel with necessary wiring and with the following:
        (i) Remote/Local selector switch.
        (ii) Push button switch; Raise/off/lower.
        (iii) Limit witch to prevent motor over-travel in either direction.
        (iv) Counter.
        (v) Electrically interlocked reversing contractors.
        (vi) Heaters with switch and HRC fuse.
        (vii) Master/follower selector switch.
        (viii) Interior lighting
        (ix) Auxiliary relays.
        (x) Manual operating device.
    (f) Remote control panel.
        (i) Control push button switch: Raise/off/lower.
        (ii) Independent/Off/Master/follower selector switch.
        (iii) Lamp indications and initiating contacts as specified.
        (iv) Remote top position indicator. (digital type)
        (v) Alarm annunciation scheme for trip and non-trip alarm as specified.
        (vi) Local/remote selector switch for OLTC.
        (vii) Provision with dummy plate for fixing differential relay in the panel.

18. Cooling accessories:
    (1) Requisite number of radiators with shut-off valves at top and bottom, air release plug, drain plug and lifting eyes.

    (2) Fans and pumps.

    (3) Cooler control cubicle with necessary wiring and with the following:

    (a) Lamp indications as specified.
    (b) Initiating contacts.
    (c) Selector switch for Local/Auto/Remote control
    (d) Fan control switch for ON/OFF/Test.
    (e) Pump control switch for ON/OFF/Test.

    (4) Transformer oil required for first filling at site including wastage in pre-commissioning process.

19. RIP Bushings for 230 KV and 110 KV and Porcelain Bushings for neutral.

20. Terminal clamps for HV, LV and Neutral.

21. One set of spare gaskets for assembling at site.

22. **3 Nos**.of One litre capacity Oil Sampling Flask (Stainless Steel) shall be provided when order is placed on successful tenderer(s)

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ANNEXURE – IV

PROFORMA FOR STAGE INSPECTION OF AUTO TRANSFORMERS

(A) GENERAL INFORMATION:

1.	Name of firm	:	
2.	Order No. and date	:	
3.	Voltage rating available	:	
4.	Details of offer		
	a) Capacity	:	
	b) Quantity	:	
	c) Serial Nos.	:	
5.	Details of last stage inspected lot	:	
	a) Total quantity inspected	:	
	b) Serial Nos.	:	
	c) Date of stage inspection	:	
	d) Quantity offered for final	:	
	Inspection of (a) above with	:	
	Date		
(B)	Availability of material for offered quantity:		
	Details to be filled in	:	
(C)	Position of manufacturing stage of the offered quantity		
	a) Complete tanked assembly	:	
	b) Core and coil assembly ready	:	
	c) Core assembled	:	
	d) Coils ready for assembly	:	
	(i) HV coils	:	
	(ii) LV coils	:	
	(iii) IV coils		

S. No.	**Particulars**	**As per P.O.**	**As observed**	**Deviation & Remarks**
(D)	**Inspection of Core**			
	(I) Core material			
	(1) Manufacturer's characteristic			
	Certificate in respect of grade of			
	Lamination used (Please furnish			
	Test certificate)			
	(2) Remarks regarding Rusting			
	& smoothness of core			
	(3) Whether laminations used for top and bottom yoke are in one Lot			

	(II) Core construction:												
	(1) No. of steps												
	(2) Dimension of steps												
	Step No.	1	2	3	4	5	6	7	8	9	10	11	12
	As offered:												
	W mm												
	T mm												
	As found:												
	W mm												
	T mm												
	(3) Core dia. (mm)												
	(4) Total cross sectional area of core												
	(5) Effective cross sectional area of core												
	(6) Clamping arrangement												
	(i) Channel size												
	(ii) Bolt size and no.												
	(iii) Tie rods size and no.												
	(iv) Painting												
	(a) Channels												
	(b) Tie Rods												
	(c) Bolts												
	(7) Thickness of insulation provided between core base and support channel												
	(8) Core length (leg center to leg center)												
	(9) Window height												
	(10) Core height												
	(11) Core weight only (without channels etc.)												
	(12) Core/Yoke bolt												
	(a) Insulation provided												
	(b) No. of core/yoke bolts												
	(c)Insulation checked for 2KV												
(E)	**INSPECTION OF WINDING**												
	(I) Winding material												
	(1) Material used for												
	(a) HV winding												

	(b) LV winding			
	(c) Tapping winding			
	(2) Grade of material for			
	(a) HV winding			
	(b) LV & IV winding			
	(c) Tapping winding			
	(3) Test certificate of manufacturer (enclose copy) for winding material of			
	(a) HV winding			
	(b) LV & IV winding			
	(c) Tapping winding			
	(II) Constructional details			
	(1) Size of cross sectional area of conductor for:			
	(a) HV winding			
	(b) LV winding			
	(c) Tapping winding			
	(2) Type of insulation for conductor of			
	(a) HV winding			
	(b) LV & IV winding			
	(c) Tapping winding			
	(3) Diameter of wire used for delta formation (mm)			
	(4) Diameter of coils in			
	(a) LV winding			
	i) Internal dia. (mm)			
	ii) Outer dia. (mm)			
	(b) IV winding			
	i) Internal dia. (mm)			
	ii) Outer dia. (mm)			
	(c) HV winding			
	i) Internal dia. (mm)			
	ii) Outer dia. (mm)			
	(5) Current density of winding material used for			
	(a) HV			
	(b) LV			
	(c) IV			
	(6) No. of taps			
	(7) Method of HV coil joints			
	(8) Total weight of coils of			
	a) LV winding (Kg.) b) HV winding (Kg.)			

(F)	**INSULATION MATERIALS**			
	(I) Material			
	1) Craft paper			
	a) Make			
	b) Thickness (mm)			
	c) Test certificate of manufacturer (enclose copy)			
	(2) Press Board			
	a) Make			
	b) Thickness (mm)			
	c) Test certificate of manufacturer (enclose copy)			
	(3) Material used for top and bottom yoke and insulation			
	(II) Type and thickness of material used (mm)			
	a) Between core and LV			
	b) Spacers			
	c) Interlayer			
	d) Between HV & IV and IV & LV winding			
	e) Between phases			
	f) End insulation			
(G)	**TANK**			
	(I) Constructional details			
	1) Thickness of side wall (mm)			
	2) Thickness of top &bottom plate (mm)			
	3) Tank internal dimensions(mm)			
	a) Length			
	b) Breadth			
	c) Height			
	(i) On HV side			
	(ii) On LV side			
	(II) General details			
	1) Inside painted by oil corrosion resistant paint (please specify which type of coating done)			
	2) Gasket between top cover and tank			
	i) Material			
	ii) Thickness (mm)			
	iii) Jointing over laps (mm)			
	3) Reinforcement of welded			

	angle (specify size and no. of angle provided) on side walls of tank			
	4) Provision of lifting lugs			
	a) Numbers			
	b) Whether lugs provided			
	5) Provision of air release plugs			
	6) Deformation of lengthwise side wall of tank when subject to			
	a) Vacuum of 3.33 KN/sq.m (25 torr) for 1 hour			
	b) Pressure in KN/sq.m			
(H)	**Radiators**			
	1) Fin Radiators of 1.2mm thick sheet			
	a) Dimension of each fin (LXBXT)			
	b) Fins per radiator			
	c) Total no. of radiators			
	2) Verification of manufacturer's test certificate regarding heat dissipation (excluding top and bottom) in w/sq.m.			
(I)	**Conservator**			
	1. Dimensions (LXD) in mm.			
	2. Volume (m^3)			
	3. Inside dia. Of Conservator tank pipe			
	4. Whether drain valves and filling hole with cover is provided			
(J)	**Bushings**			
	1. Whether HV bushings mounted on side walls			
	2. Position of mounting of LV bushings			
	a) LV to earth			
	b) HV to earth			
	c) Between LV bushings			
	d) Between HV bushings			
	3. Neutral bushing			
	4. Neutral channels support			

	insulator			
(K)	**Tank Base Channel/Rollers**			
	1. Size of channel (mm)			
	2. Whether channels welded across the length of the tank			
	3. Size and type of Roller (mm)			
	4. Whether rail gauge bi-directional wheels provided			
	5. Whether jacking pads provided			
(L)	**No. of Valves:**			
	i) Tank			
	ii) Conservator			
	iii) OLTC			
	iv) Radiators			
(M)	**Engraving:**			
	1. Engraving of Sl.No. and name of firm			
	i) On bottom of clamping channel of core-coil assembly			
	ii) On side wall and top cover of tank			
	2. CT details/ Name plate			
	3. Bushing mountings			

TANTRANSCO'S INSPECTING OFFICER **FIRM'S REPRESENTATIVE**

DATE OF INSPECTION:

ANNEXURE – V

PROFORMA FOR PRE-DELIVERY (FINAL) INSPECTION OF AUTO TRANSFORMERS

1.	Name of firm	:	
2.	Details of offer made	:	
	(i) Order No. and date	:	
	(ii) Rating	:	
	(iii) Quantity	:	
	(iv) Sl.No. of transformers	:	
3.	Date of stage inspection of the lot	:	
4.	Reference of stage inspection clearance	:	
5.	Quantity offered and inspected against the order prior to this lot	:	

(A) ACCEPTANCE TESTS TO BE CARRIED OUT

Sl. No.	Particulars	Observations
1.	(a) Ratio Test	
	(b) Polarity Test	
2.	No load loss measurement	
	TOTAL	
	Multiplying factor	
	CT	
	Wattmeter	
	Total X Mf	
	NET LOSS	
3.	Load loss measurement	
	TOTAL	
	Multiplying factors:	
	CT	
	Wattmeter	
	PT	
	Total X Mf	
	NET LOSS	
	Loss at ambient temperature (watt)	
	Loss at 75ºC (with calculation sheet) (watt)	

4.	Winding Resistance :			
	HV (in ohms)on all taps (a) At ambient temperature of 45ºC			
	(b) Resistance at 75ºC			
	IV (in ohms)			
	(a) At ambient temperature of 45ºC			
	(b) Per phase Resistance at 75ºC			
	LV (in ohms)			
	(a) At ambient temperature of 45ºC			
	(b) Per phase Resistance at 75ºC			
5.	Insulation Resistance in M. ohms			
	HV-E			
	LV-E			
6.	Separate source POWER FREQUENCY withstand test voltage			
	HV	..... for 60 secs		
	LV	..... for 60 secs		
7.	Induced over-voltage withstand test at double voltage and double frequency			
8.	No load current at			
	90% volts			
	110% volts			
9.	Unbalance current			
10.	Vector group test	Diagram and readings be shown in separate sheets		
11.	Percentage Impedance at 75º·C (Please furnish calculation sheet)			
12.	Transformer oil test (BDV)			
13.	Oil leakage test			
14.	Heat run test (Temperature Rise)	To be carried out once against the order		
15.	Bushing clearance (mm)	HV	IV	LV
	(a) Phase to phase			
	(b) Phase to earth			
16.	Comments on compliance by the firm on the modifications done as per stage inspection clearance letter issued			
17.	Whether silica gel breather with container is fitted on the transformers offered			
18.	Whether engraving of Sl.No. & name of the firm			

	on core clamping channel has been verified.	
19.	Oil:	
	1. Name of Supplier	
	2. Break down voltage of oil (KV)	
	i) Filled in tanked transformer	
	ii) In storage tank (to be tested by Inspecting Officer)	
	3. Supplier's test certificate (enclose copy)	
20.	Test certificate for painted surface	
21.	Routine test reports for OLTC	
22.	Type test reports for 1st unit	
23.	Magnetic Balance test	
24.	Pressure test (Type test for 1st unit)	
25.	Vacuum test (Type test for 1st unit)	
26.	Test on Bushing CT	
	a) Polarity & ratio check	
	b) Knee point voltage test	
	c) Magnetising current	
27	Impulse test	
28	Manufacturer's Test certificate for accessories (bought out components) as per Section VI –cl. 36.5.4	
29	i) Rating plate of size 300X300 mm. welded on width side of stiffener	
	ii) Following details engraved (as per approved GTP)	
	a) Serial Number	
	b) Name of firm	
	c) Order No. and date	
	d) Rating	
	e) Name of Inspecting Officer	
	f) Designation	
	g) Probable Date/month of dispatch	
30	Name Plate details	
	Whether name plate is as per approved drawing	

NOTE: Apart from the tests mentioned above, any other tests as per the requirement of the P.O. specifications, shall also to be conducted during final inspection.

TANTRANSCO'S INSPECTING OFFICER **FIRM'S REPRESENTATIVE**

DATE OF INSPECTION:

ANNEXURE-VI

TRANSFORMER MATERIALS / ACCESSORIES RECEIPT --- CHECK LIST

TRANSFORMER MATERIALS / ACCESSORIES RECEIPT --- CHECK LIST		
SL.NO.	**CHECKS***	**OBSERVATION**
1	DOCUMENTS INCLUDING DRAWINGS, GTP AND SPECFICATIONS – 6 sets booklet complete.	
2	RATING PLATE, VALVE PLATE, GA DRAWING PLATE, RATIO SEL. PLATE, AIRCELL FILLING INSTRUCTION PLATE	
3	MAIN TANK - TYPE, WELDING,SL.NO ENGRAVED,OIL LEAKS, EARTH BONDS	
4	CONSERVATOR TANK WITH ALL VALVES INCLUDING MOG, AIRCELL FAIL RELAY	
5	AIR CELL – check for Leakage	
6	CONSERVATOR SUPPORT STAND	
7	CONSERVATOR LADDER	
8	BUCHOLZ RELAY PIPE LINE - NO SHARP BEND	
9	EQUALISER PIPELINE	
10	HV TURRET (with CT) - CT MAKE,SL.NO,CLASS	
11	LV / NEUTRAL TURRET (with CT) - CT MAKE,SL.NO, CLASS	
12	RADIATORS, HEADER PIPELINE, PIPELINE ASSEMBLY, STIFFNERS	
13	COOLER BANK -- A FRAME	
14	PIPELINE SUPPORTS	
15	BUTTERFLY / WHEEL VALVES	
16	THERMOMETER POCKET - SPARE POCKETS SEALED.	
17	OLTC ASSEMBLY - MAKE, SL.NO, DIAPHRAGM, ALIGNMENT	
18	DM BOX - MAKE, SL.NO, MOTOR RATING, MANUAL DRIVE HANDLE	
19	VALVES MOUNTED ON MAIN TANK – AS PER DRAWING	
20	WHEELS AND AXLES - ANTI-EARTHQUAKE DEVICES	
21	PRV – MAIN & OLTC - MAKE,SL.NO	
22	BUCHOLZ RELAY - MAKE,SL.NO,OPERATING PRESURRE	
23	OIL SURGE RELAY - MAKE , SL.NO.	
24	FANS WITH MOUNTING BRACKET , GUARDS- MAKE, SL.NO, RATING	
25	PUMPS, FLOW METER - MAKE, SL.NO, RATING	
26	BELLOWS - RUPTURE	

27	HV BUSHING – Make, Sl.No as per Final Inspection report, CRACKS, OIL LEAK	
28	LV BUSHING – Make, Sl.No as per Final Inspection report , CRACKS, OIL LEAK	
29	IV BUSHING – Make, Sl.No as per Final Inspection report , CRACKS, OIL LEAK	
30	NEUTRAL BUSHING - MAKE, SL.NO, CRACKS	
31	SPARE GASKETS	
32	NITROGEN CYLINDER - CAPACITY, PRESSURE,PIPELINE FIXING.	
33	MARSHALLING BOX - INTERNALS AS PER DRAWING	
34	COOLER CONTROL PANEL- INTERNALS AS PER DRAWING	
35	RTCC PANEL - INTERNALS AS PER DRAWING	
36	TRANSFORMER OIL IN DRUMS – SEALS,LEAK,BATCH NUMBER	
37	OIL LEVEL IN MAIN TANK FOR 110 KV CLASS TRANSFORMERS	
38	GAS PRESSURE IN 230KV AND ABOVE CLASS TRANSFORMER	
39	CABLES & WIRING MATERIALS	
40	NEUTRAL EARTHING MATERIALS – FLEXIBLE COPPER, SUPPORT INSULATORS	
41	HV BUSHING CLAMP with Bimetallic sheets 2 mm	
42	IV BUSHING CLAMP with Bimetallic sheets 2 mm	
43	LV BUSHING CLAMP with Bimetallic sheets 2 mm	
44	NEUTRAL BUSHING CLAMP	
45	BREATHER FOR MAIN AND OLTC CONSERVATOR with Silica Gel	
46	LADDER WTH LOCKING ARRANGEMENT	
47	INSPECTION covers with Blanking Plates.	
48	DIFFERENTIAL RELAY –AS PER SPECN.WITH BOOKLETS, SOFTWARE CDs	
49	NITROGEN INJECTION FIRE PREVENTION SYSTEM – ACCESSORIES, BOOKLETS	
50	CONTROL CABLE QUALITY AND SPECIFICATION COMPATIBILITY CHK	
51	MANDATORY SPARES FOR LIFTING OLTC DIVERTOIR SWITCH AND OTHER SPARES IF ANY	

*As applicable

ANNEXURE- VII

TRANSFORMER ERECTION AND PRE- COMMISSIONING CHECKS		
Note : 1. Copy of drawings, GTP, P.O, final inspection reports, RTCC Panel manual, OLTC manual, Differential Relay manual and bought out items test certificates to be made ready for inspection		
2. If any deviation from GTP and Specification is observed. The deviation is to be brought to the notice. The changes accepted by the Compentent Authority is to be reflected in the drawing and the amendment to the GTP is to be obtained.		
3. Points not applicable for the make, capacity and voltage rating may be mentioned as not applicable in the observation column.		
EXTERNAL CHECKS*		
GENERAL		
S.NO	**Description**	**OBSERVATION**
1	MAKE	
2	S.NO	
3	CAPACITY	
4	VOLTAGE RATIO	
5	RAIL CENTRE - mm (As per standard TANTRANSCO practice)	
6	HEIGHT OF THE PLINTH - 0.3 M from GANTRY PLINTH level	
7	PLINTH LEVEL - offset if any in the corners to be recorded	
8	RAIL GAUGE LENGTH to match the length of plinth	
9	MAIN TANK WELDING,PAINTING, OIL LEAKS, SL.NO ENGRAVED.	
10	NAME/RATING PLATE AS PER DRG	
11	OIL LEAKAGE IF ANY - POINT OF LEAKS	
12	ANY DENTS/ DAMAGES TO MAIN TANK STIFFNERS (YES/NO)	
13	TRANSFORMER NEW OIL DRUM- SEALING TO BE CONFIRM	
14	MAIN TANK INTERNAL WIRING CABLES AS PER P.O	
15	MANDATORY SPARES AVALABLE AS PER P.O	
16	**TRANSFORMER OIL TEST RESULTS AS PER P.O CONDITION**	
17	FOR 230KV AND ABOVE- SHOCK/IMPACT RECORDER, DISTURBANCE RECORDER - DOWNLOADING -CLEARANCE BY MANUFACTURER.	
	TRANSFORMER ERECTION CHECKS	
1	**ALL INSPECTION COVER TO BE PROVIDED WITH 8 MM GASKET**	
2	**OIL TO BE VERRIFIED IN THERMOMETER POCKETS, SPARE POCKET TO BE CLOSED WITH DUMMY**	
3	**LADDER WITH LOCKING ARRANGEMENTS**	
4	A FRAME ASSEMBLY, HEADER PIPE ALIGNMENT	
5	RADIATOR FIXING ALIGNMENT,FASTENERS	
6	ANY DENTS/ DAMAGES TO RADIATOR COOLING FINS (YES/NO)	

7	RADIATORS-STIFFNERS OF APPROPRIATE SIZE SUITABLY FABRICATED	
8	SUPPORT STAND FOR COOLER BANK	
9	TIGHTNESS OF RADIATOR MOUNTING	
10	RADIATOR VALVE OPERATION (OPEN/CLOSE MARKING CLEAR & TO BE VERIFIED	
11	RADIATORE AIR RELEASE & DRAIN PLUG LEAK PROOF	
12	RADIATOR OIL LEAKAGE - FINS, FLANGES, AIR RELEASE SCREW PLUGS , DRAIN SCREW PLUGS.	
13	VALVE POSITION BET.CONSERVATOR TO BUCHOLZ RELAY (AS PER DRAWING)	
14	VALVE POSITION BET.BUCHOLZ RELAY TO MAIN TANK (AS PER DRAWING)	
15	VALVE POSITION BET. OLTC TO OSR (AS PER DRAWING)	
16	VALVE POSITION BET.OSR TO OLTC CONSERVATOR (AS PER DRAWING)	
17	VALVE POSITION CONSERVATOR TOP VALVE (AS PER DRAWING)	
18	CONSERVATOR VALVE ON THE TOP FOR OIL FILLING COVERED WITH BOX/CANOPY TYPE COVER	
19	CONSERVATOR FEED PIPE FREE FROM SHARPE BENDS	
20	VALVE POSITION OLTC CONSERVATOR TOP VALVE (AS PER DRAWING)	
21	VALVE POSITION DRAIN VALVE (AS PER DRAWING)	
22	VALVE POSITION FILTER VALVE (AS PER DRAWING)	
23	VALVE POSITION OIL SAMPLING VALVE (AS PER DRAWING)	
24	VALVE POSITION AIR RELEASE PLUG (AS PER DRAWING)	
25	MEHANICAL LOCK/PADLOCKS WITH DUPILICATE KEY FOR ALL VALVES (PROVIDED OR NOT)	
26	FAN MOTOR MAKE, CAPACITY AS PER TEST CERTIFICATE	
27	FAN MOTOR DIRECTION OF ROTATION	
28	TWO EARTH CONNECTION FOR EACH MOTOR	
29	PUMPS FIXING - LEVEL,DIRECTION - ROTATION CHECK	
30	PUMPS OIL FLOW METER CHECK	
31	MAIN AND STANDBY PUMPS OIL FLOW INTERLOCK CHAMBER -- DEFLECTOR PLATE FUNCTIONING.	
32	PUMPS SMOOTH OPERATION,VIBRATION,EARTH CONNECTION CHECK	
33	OIL LEAKAGE THRO PUMP WIRING TERMINAL	
34	HV SIDE BUSHING MAKE AND TYPE AS PER GTP/DRAWING	
35	HV SIDE BUSHING SERIAL NO AS PER FINAL INSPECTION REPORT	
36	HV SIDE BUSHING CURRENT RATING AS PER GTP/DRAWING	
37	HV SIDE BUSHING OIL LEVEL AS PER GLASS GAUGE	

38	HV SIDE BUSHING OIL LEAKAGE(DRAIN PLUG,TOP O RING,)	
39	HV SIDE BUSHING OIL LEAKAGE THRO TAN DELTA TEST CAP	
40	HV SIDE BUSHING HORN GAP DISTANCE	
41	HV SIDE BUSHING AIR RELEASE PLUG	
42	HV SIDE BUSHING TERMINAL " O" RING HEALTHINESS	
43	HV SIDE BUSHING TURRET GASKET AND ITS TIGHTNESS	
44	HV SIDE BUSHING TERMINAL CLAMP TIGHTNESS	
45	HV SIDE BUSHING TERMINAL STRAIN FREE	
46	HV BUSHING CONNECTORS AND CLAMPS WITH BI-METALLIC SHEET	
47	IV SIDE BUSHING MAKE AND TYPE AS PER GTP/DRAWING	
48	IV SIDE BUSHING SERIAL NO AS PER FINAL INSPECTION REPORT	
49	IV SIDE BUSHING CURRENT RATING AS PER GTP/DRAWING	
50	IV SIDE BUSHING OIL LEVEL AS PER GLASS GAUGE	
51	IV SIDE BUSHING OIL LEAKAGE -AIR RELEASE,TANDELTA TEST CAP,TOP 'O' RING	
52	IV SIDE BUSHING TERMINAL " O" RING HEALTHINESS	
53	IV SIDE BUSHING TURRET GASKET AND ITS TIGHTNESS	
54	IV SIDE BUSHING TERMINAL CLAMP TIGHTNESS	
55	IV SIDE BUSHING TERMINAL STRAIN FREE	
56	IV SIDE BUSHING HORN GAP DISTANCE	
57	IV BUSHING CONNECTORS AND CLAMPS WITH BI-METALLIC SHEET	
58	LV SIDE BUSHING MAKE AND TYPE AS PER GTP/DRAWING	
59	LV SIDE BUSHING SERIAL NO AS PER FINAL INSPECTION REPORT	
60	LV SIDE BUSHING CURRENT RATING AS PER GTP/DRAWING	
61	LV SIDE BUSHING ANY OIL LEAKAGE	
62	LV SIDE BUSHING ANY OIL LEAKAGE - AIR RELEASE PLUG, RUBBER WASHER RING	
63	LV BUSHING CONNECTORS AND CLAMPS WITH BI-METALLIC SHEET	
64	GAP BETWEEN HV AND IV / LV JUMPERS	
65	MAIN TANK/OLTC CONSERVATOR SEPERATION WITH WELDED PLATE	
66	CONSERVATOR ERECTION ON FRAME, TIGHTNESS,ALIGNMENT	
67	CONSERVATOR OIL LEAKAGE	
68	CONSERVATOR OIL LEVEL AS PER MOG	
69	CONSERVATOR OIL LEVEL - PRISMATIC GLASS GUAGE/NO DROP IN LEVEL	
70	CONSERVATOR LADDER AVALABLE - AS PER DRAWING	
71	OLTC SIDE CONSERVATOR OIL LEAKAGE	
72	OLTC SIDE CONSERVATOR OIL LEVEL -PRISMATIC / PLAIN GLASS GUAGE	
73	POSITION OF PRV AS PER DRAWING	

74	PRV SHOULD BE COVERED WITH HOOD	
75	BUCHOLZ RELAY MAKE AND TYPE - AS PER GTP	
76	BUCHOLZ RELAY PIPELINE INCLINATION	
77	BUCHOLZ RELAY OIL LEAK CHECK - AIR RELEASE,DRAIN PLUG, WIRING TERMINALS.	
78	BUCHHOLZ RELAY POSSITION (AS PER DRAWING)	
79	BUCHHOLZ RELAY DIRECTION OF MOUNTING (AS PER MAKE)	
80	BUCHHOLZ RELAY ANY OIL LEAKAGE	
81	BUCHHOLZ RELAY IN SERVICE POSITION (TEST/SERVICE)	
82	BUCHHOLZ RELAY GLASS WINDOW CLEANED	
83	OSR MAKE AND TYPE AS PER GTP	
84	OSR RELAY POSITION (AS PER DRAWING)	
85	OSR RELAY DIRECTION OF MOUNTING (AS PER MAKE)	
86	OSR RELAY ANY OIL LEAKAGE	
87	OSR RELAY IN SERVICE POSITION (TEST/SERVICE)	
88	OSR RELAY GLASS WINDOW CLEAN	
89	HV BUSHING CT 1U,1V&1W NOTATIONS ARE OK	
90	LV BUSHING CT 21U,2V &2W NOTATIONS ARE OK	
91	HV BUSHING CONNECTION CHECK (INTERNAL INSPECTION)	
92	LV BUSHING CONNECTION CHECK (INTERNAL INSPECTION)	
93	LV RATIO SELECTION PLATE LINK CONNECTION CHECK,TIGHTNESS, (INTERNAL INSPECTION)	
94	TURRET CT RATIO AVAILABLE ON HV SIDE - AS PER GTP	
95	TURRET CT RATIO AVAILABLE ON LV SIDE - AS PER GTP	
96	TURRET CT RATIO AVAILABLE ON HV SIDE WTI - AS PER GTP	
97	TURRET CT RATIO AVAILABLE ON LV SIDEWTI - AS PER GTP	
98	CHECK CTS ARE SHORTED IF NOT IN IMMEDIATE USE	
99	HV WTI CT RATIO AND HV WTI CURRENT ARE SAME	
100	LV WTI CT RATIO AND LV WTI CURRENT ARE SAME	
101	CYT TERMINAL BOX INSIDE CONDITION (OIL LEAK, WATER ENTRY, RUST, etc.)	
102	CYT TERMINAL CONNECTIONS INTACT	
103	TAP CHANGER MAKE AND CAPACITY AS PER GTP	
104	TYPE OF TAP CHANGER OFF LOAD OR ON LOAD	
105	OLTC OIL LEVEL	
106	VERTICALITY OF DM BOX AND TOP BEVEL GEAR	
107	HORIZONTAL POSITION OF DRIVE ROD	
108	DM BOX, DOOR LOCK, DOOR BEADING	
109	DM BOX INSIDE LIGHT AND PANEL HEATER	

110	DM BOX- WITH ELECTRICAL DIAGRAM, T.B DETAILS (STICKERS FOR INTRENAL COMPONENTS), INTERCONECTION DIAGRAM (RTCC & DM BOX)	
111	MARSHALING BOX, DOOR LOCK, DOOR BEADING	
112	MARSHALING BOX INSIDE LIGHT AND PANEL HEATER	
113	MARSHALING BOX- ELECTRICAL DIAGRAM, T.B DETAILS TO BE PASTED 20% T.B SPARE, DISCONNECTING TYPE TB FOR WCT.	
114	OTI MAKE, TYPE, ACCURACY AS PER P.O	
115	WTI MAKE, TYPE, ACCURACY AS PER P.O	
116	OTI AND WTI WITH 4-20 MILLI AMPS	
117	ANY OIL LEAKAGE THROUGH OLTC,TOP COVER AND MECHANISM	
118	RTCC PANEL - ALL CONTACTORS TO BE VERIFIED FOR 110 V DC, 4 NOS SPARE CONTACTORS AVALABLE,	
119	BREATHER TYPE AND CAPACITY - AS PER P.O	
120	CONDITION OF SILICAGEL - COLOR	
121	BREATHER GLASS IS CLEAN CLEAR FOR VISION	
122	BREATHER OIL SEAL WITH OIL	
123	ANY LEAKAGE THROUH THE BREATHER & ITS PIPE LINE	
124	ANY OIL LEAKAGE THROUGH TRANSPORT OIL LEVEL GAUGE	
125	NEUTRAL EARTHING AS PER DRG.	
126	OMEGA FLEXIBLE CONNECTION AT NEUTRAL TERMINAL - SIZE AS PER DRAWING	
127	NEUTRAL EARTH FLATS SIZE AS PER P.O	
128	NEUTRAL EARTH FLATS SUPPROT INSULATORS - NUMBER AND RATING AS PER P.O	
129	MAIN TANK EARTHING (AS PER DRAWING)	
130	M.BOX & DM BOX DOUBLE EARTHING	
131	RTCC PANEL EARTHING	
132	WHEELS PROVIDED WITH ANTI EARTHQUAKE PADS AND STOP BLOCK	
133	FIRM CONTACT OF ALL THE WHEELS WITH RAIL	
134	HV SIDE LAS WITH SURGE MONITOR - FUCNTIONAL CHECK, EARTH LINK TO MAIN MAT	
135	LV SIDE LAS - IR TEST,EARTH LINK TO MAIN EARTH MAT	
136	HV BUSHING TOP - WITHIN THE CONE OF LIGHNING PROTECTION	
137	DRY ARCING DISTANCE BETWEEN HV TERMINAL TO NEAREST EARTH METAL PART	
138	DRY ARCING DISTANCE BETWEEN LV TERMINAL TO NEAREST EARTH METAL PART	

	INTERNAL INSPECTION	
139	HV, IV, LV AND NEDUTRL BUSING LEADS INTACT	
140	HV, IV, LV AND NEDUTRL BUSING LEADS CLEARNCES ADEQUATE	
141	OLTC TAP LEADS INTACT	
142	LV LINK BOARD LEADS INTACT	
143	LV LINK PLATES INTACT	
144	LV LINK PLATE CONNECTED FOR INTENED VOLTAGE RATION	
145	TIGHTNESS OF ALL PRESS SCREWES	
146	STAR LEAD AND DELTA LEAD INTACT	
147	OIL HEADERS IF PROVIDED INTACT	
148	PRESS BOARDS ON THE COILS INTACT	
149	WOODEN SUPPORTS, CLEADS INTACT	
150	CORE BOLTS/ CORE TIE-BANDS INTACT	
151	MAIN TANK BOTTOM SURFACE CLEAN	
152	ANY VISIBLE MARKS FOR DISTRUBANCE IN CORE COIL ASSEMBLY POSITION DURING TRANSPORT	
153	OLTC DOVA NEW AND HEALTHY	
154	NO OIL COMMUNICATION BETWEEN OLTC AND MAIN TANK	
155	CONSERVATOR INTERNAL INSPECTION - AIR CELL HEALTHY, MOG FLOAT HEALTHY, BOTTOM SURFACE CLEAN	
	FUNCTION TESTS	
156	BUCHHOLZ RELAY TOP FLOAT OPN CHECK (SET/RESET BY PLUNGER)	
157	BUCHHOLZ RELAY BOTTOM FLOAT OPN CHECK (SET/RESET BY PLUNGER)	
158	OSR RELAY TOP FLOAT OPN CHEKED (SET/RESET BY PLUNGER)	
159	OSR RELAY BOTTOM FLOAT OPN (SET/RESET BY PLUNGER)	
160	PRV OPERATION	
161	CONSERVATOR AIRCELL FAIL RELAY HEALTHINESS	
162	COOLING FAN AUTO / MANUAL OPERATION	
163	NOISE & VIBRATION OF THE COOLING FAN MOTOR - CHECK LOADING CURRENT,WINDING RESISTANCE	
164	NOISE & VIBRATION OF THE COOLING PUMP MOTOR - CHECK LOADING CURRENT,WINDING RESISTANCE	
165	CALIBRATION & FUNCTIONAL CHECK OF HV WTI	
166	CALIBRATION AND FUNCTIONAL CHECK OF LV WTI	
167	CALIBRATION & FUNCTIONAL CHECK OF OTI	

168	FUNCTIONAL CHECK OF MARSHALLING BOX,CCP WIRING (AUTO AND MANUAL OPERATION OF PUMPS AND FANS)	
169	FREE OPERATION OF OLTC WHILE MANUAL INCREASE/DECREASE - NO OF ROTATIONS AS PER OLTC NAME PLATE	
170	ELECTRICAL OPERATION CHECK OF OLTC FROM DM BOX&RTCC PANEL	
171	TAP NO AT DM BOX AND OLTC MECHANISM ARE SAME	
172	FUNCTIONAL CHECK OF RTCC WIRING (TAP INCREASE & DECREASE LAMP INDICATION AND TAP POISTION INDICATION	
173	FUNCTIONAL CHECK OF DM BOX WIRING (LOCAL/REMOTE OPERATION)	
174	AIR CELL CONSERVATOR - AIR PRESSURE CHECK	
175	**RTCC PANEL ANNUCIATOR FUNCTION**	
	1. REMOTE OTI - TO MATCH LOCAL OTI	
	2. REMOTE WTI - TO MATCH LOCAL WTI	
	3. TPI REPEATER - TO MATCH LOCAL TPI	
	4. AC BELL	
	5. DC HOOTER	
	6 ALL LAMP INDICATIONS	
176	**NIFPS FUNCTION**	
	1. N2 CYLINDER PRESSURE	
	2. DIFFERENTIAL TRIP ONLY (ENSURE NO ACTUATION)	
	3. PRV TRIP ONLY (ENSURE NO ACTUATION)	
	4. BUCHOLZ TRIP ONLY (ENSURE NO ACTUATION)	
	5. PRV AND BUCHOLZ TRIP (ENSURE NO ACTUATION)	
	6. DIFFERENTIAL AND PRV TRIP (ENSURE ACTUATION OF SOLENOIED RELAY AND DRAIN VALVE OPENING)	
	7. DIFFERENTIAL AND BUCHOLZ TRIP (ENSURE ACTUATION OF SOLENOIED RELAY AND DRAIN VALVE OPENING)	
	HOT OIL CIRCULATION PROCESS - DRYING OUT - MAIN TANK & OLTC	
	FILTER	
177	FILTER RESIDUAL OIL FLUSHING	
178	ADEQUACY OF TEMPORARY POWER SOURCE SUPPLY TO FEED OIL FILTER.	
179	IF EXTERNAL TANK USED - FLUSHING OF TANK	
180	FILTER INLET,OUTLET TEMPERATURE INDICATOR CONDITION	
181	VACCUMING OF TANK - VACCUM GUAGE MEASUREMENT CHECK	
182	IF DRY AIR PURGING- DRY AIR PRESSURE,DEW POINT CHECK	

183	IF NITROGEN PURGING - N2 PRESSURE GUAGE FIXING AND PRESSURE CHECK	
184	BEFORE INITIAL FILLING IN TANK- BDV,WATER CONTENT CHECK	
185	HOT OIL CIRCULATION PROCESS - DRYING OUT LOG - IR VALUE, BOTTOM OIL TEMP, DRYING OUT CHART	
186	CIRCULATED OIL TEST REPORT	
	ELECTRICAL TESTS	
187	HV/IV BUSHING TAN DELTA,CAPACITANCE TEST REPORT	
188	WINDING TAN DELTA TEST REPORT	
189	IR VALUE AND PI VALUE TEST REPORT	
190	RATIO TEST REPORT	
191	HV &LV MAGNETISING CURRENT TEST REPORT	
192	CORE BALANCE TEST REPORT	
193	VECTOR GROUP TEST REPORT	
194	SHORT CKT TEST REPORT	
195	DIFF.RELAY TEST REPORT	
196	WINDING RESISTANCE TEST REPORT	
197	TURRET CT RATIO & KNEE POINT TEST REPORT	
198	SFRA TEST FOR 230KVCLASS AND ABOVE	
199	TRANSFORMER EARTHING - in case old Earth Electrodes - Check healthiness - Replace if necessary.	
200	TRANSFORMER NEUTRAL EARTHING,AS PER IS 3043 CLAUSE 20 - EARTH RESISTANCE CHECK	
201	TRANSFORMER NEUTRAL EARTH ELECTRODE - EARTH RESISTANCE VALUE	
202	SECOND FINISH COAT OF PAINTING	

*As applicable