

CENTRALIZED CONTRACTS GROUP**NIT No.: TPCODL / CCG / 2025-26 / 1000003846****Corrigendum- I****NIT No.: TPCODL / CCG / 2025-26 / 1000003846****Rate Contract - Supply of Power Transformer for Tata Power Odisha DISCOMs****Dated 01st July 2025****Following changes in tender document is made;****1.1 Scope of work (Page No. 4)**

Bids are invited from interested Bidders to award Rate Contract (RC) for Supply of Power Transformer for Tata Power Odisha DISCOMs as mentioned below:

Sl. No.	Item Description	TPCODL	TPNODL	TPWODL	Grand Total
1	Power Transformer 5 MVA 33/11KV	0	0	1	1
2	Power Transformer 8 MVA 33/11KV	0	6	4	10
3	Power Transformer 12.5/16MVA 33/11KV	10	2	2	14
4	Power Transformer 20/25 MVA 33/11kV	9	1	0	10

1.3 Calendar of Events (Page No. 6)

(b)	Date by which Interested and Eligible Bidder to pay Tender Fee and confirm participation as mentioned in "Procedure to Participate in Tender"	04-07-2025 [15:00 Hrs]
(c)	Due Date and time of receipt of pre-bid queries by e-mail, if any	04-07-2025 [15:00 Hrs]
(d)	Due Date of Posting Consolidated replies to all the pre-bid queries as received	09-07-2025
(e)	Due date and time of receipt of Bids	14-07-2025 [15:00 Hrs]
(f)	Date & Time of opening technical bids	14-07-2025 [15:30 Hrs]
(g)	Date & Time of opening of Price of qualified bids	To be notified to the successful bidders

Revised Specification (Annexure-II) & Annexure-I as attached below;

All other terms and conditions of the above tender shall remain unaltered.

Yours faithfully,**-sd-****HEAD – CCG & Contracts (TPCODL)**

CENTRALIZED CONTRACTS GROUP**NIT No.: TPCODL / CCG / 2025-26 / 1000003846****ANNEXURE-I : Price Schedule**

Sl. No.	Item Description	UoM	Qty	Unit Ex-Work Price (Rs. / Unit)	Supervision Charges (Avg-5Days / PT) (Rs. / Unit)	GST per Unit (Rs. / Unit)	All Inclusive Unit Rate (Rs.)	Total All Inclusive Value (Rs.)
			(A)	(B)	(C)	(D)	(E=B+C+D)	(F=A x E)
1	Power Transformer 5 MVA 33/11KV	EA	1					
2	Power Transformer 8 MVA 33/11KV	EA	10					
3	Power Transformer 12.5 / 16MVA 33/11KV	EA	14					
4	Power Transformer 20 / 25 MVA 33/11kV	EA	10					

NOTE:

- Prices shall remain variable as per IEEMA. 20th June 2025 is the Base Date for PV Calculation (IEEMA Circular- May 2025).
- The bids will be evaluated commercially on **the Line item wise Lowest Cost** basis.
- The prices mentioned above shall be on FOR basis for all the TPNODL, TPCODL, TPSODL & TPWODL locations.
- Issuance of Release Orders (RO) shall be done by respective DISCOMs as per their requirement.
- The material shall be delivered as per the location captured in the Release Order.
- The bidders are advised to quote prices strictly in the above format. Failing to do so, bids are liable for rejection.
- The bidder must fill each and every column of the above format. ***Mentioning “extra/inclusive”/other conditions in any of the column may lead for rejection of the price bid.***
- No cutting/ overwriting in the prices is permissible.
- The quantity mentioned above are for evaluation purpose only and may vary as per actual site requirement.



TATA POWER

TECHNICAL SPECIFICATION COVER SHEET

Document No. : TPU-D-ENG-HV-20066-R-01

Document Title : Technical specification for 3.15,5 & 8 MVA Power Transformer (33/11KV)

Release date : 07-05-2025

Revision	Prepared by	Reviewed by	Reviewed by	Reviewed by	Reviewed by	Reviewed by	Reviewed by	Approved by	Released by
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TECHNICAL SPECIFICATION

3.15 /5/8 MVA, 33KV/11KV Power Transformer

Central Engineering Services

TPC-M/TPDDL/TPCODL/TPNODL/TPWODL/TPSODL/TPADL

Central Engineering Services		TECHNICAL SPECIFICATION FOR 3.15 /5/8 MVA ,33KV/11KV PTR
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Specification Title: Technical specification for 3.15 /5/8 MVA, 33KV/11KV Power Transformer

REVISION HISTORY

<i>Rev. #</i>	<i>Date of revision</i>	<i>Purpose of revision</i>	<i>Summary of revisions / comments (Attach separate sheet if required)</i>	<i>Initiated by</i>	<i>Revised / Reviewed by</i>	<i>Approved by</i>
<i>R0</i>						
<i>R1</i>						
<i>R2</i>						

Central Engineering Services

TPC-M/TPDDL/TPCODL/TPNODL/TPWODL/TPSODL/TPADL

Central Engineering Services		TECHNICAL SPECIFICATION FOR 3.15 /5/8 MVA ,33KV/11KV PTR
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1. SCOPE:

This Specification provides for design, engineering, manufacture, assembly, stage inspection, final inspection and testing before dispatch, packing and unloading at destination Sub-station / stores by road transport, transit insurance, of 3.15 MVA, 5 MVA and 8 MVA, 33/11 KV Power Transformer(s) complete with On Load Flange Mounted Type Tap Changer including all fittings, accessories, associated equipment, spares required for its satisfactory operation in any of the sub-stations of the Purchaser.

Such of the parts that may have not been specifically included, but otherwise form part of the transformer as per standard trade and/or professional practice and/or are necessary for proper operation of transformer, will be deemed to be also included in this specification. The successful bidder shall not be eligible for any extra charges for such accessories etc. notwithstanding the fact that at the time of an initial offer bidder had segregated such items and quoted for them separately.

Note: Service Support for the Installation, testing & commissioning shall be provided by Bidder.

2. APPLICABLE STANDARDS:

The equipment (and the materials used) covered by this specification shall unless otherwise stated, be designed, manufactured and tested in accordance with the latest editions of the following Indian standards & other relevant standards for components, BEE & CEA guidelines with latest amendment from time to time, thereof, some of which are listed below:

Sl.No	Reference Standard	Reference Standard Name
1	IS 5	Specification for Colors for Ready Mixed Paints and Enamels
2	IS 104	Specification for ready mixed paint, brushing, zinc chrome, priming
3	IS 335	Specification for New insulating oils
4	IS 649	Methods for testing steel sheets for magnetic circuits of power Electrical apparatus.
5	IS 1576	Solid Pressboard for Electrical Purposes - Specification
6	IS 2026	Specification for Power Transformers
7	IS 2099 / IEC-61037	Specification for Bushings for Alternating Voltages Above 1000 Volt
8	IS 2362	Determination of Water content in oil by Karl in oil Fischer Method- Test Method
9	IS 2544	Specification for Porcelain post insulators for systems with nominal Voltage Greater than 1000V

10	IS 2705	Specification for Current Transformers
11	IS 3401	Specification of Silica Gel
12	IS 3637/ IEC-364	Specification for gas operated relay (Buchholz relay).
13	IS 4253: Part II	Specification for cork composition sheets - Part II: Cork and Rubber
14	IS 4257 (PART I)	Dimensions for Clamping Arrangements for Porcelain Transformer Bushings - Part I : For 12 kV to 36 kV Bushings
15	IS 5082	Specification for Wrought Aluminum and Aluminum Alloy Bars, Rods, Tubes, Selection, Plates and Sheets for Electrical purposes
16	IS 5561	Specification for Electric Power Connectors.
17	IS 6103	Specification for Method of Testing of specific resistance (Resistivity) of electrical insulating liquids
18	IS 6262	Method of test for power factor and dielectric constant of electrical Insulating liquids
19	IS 6600	Guide for Loading of Oil-immersed Transformer.
20	IS 6792/ IEC-156	Method for Determination of Electric Strength of Insulating Oil
21	IS 8468	On-load tap changers
22	IS 8603 (PART-1)	Dimensions for Porcelain Transformer Bushings for Use in Heavily Polluted Atmospheres - Part I: 12 kV, 17.5 kV, 24 kV and 36 kV Bushing
23	IS 9335	Specification for Cellulosic Papers for Electrical Purposes
24	IS 10028:	Code of Practice for Selection, Installation and Maintenance of Transformers
25	IS 12444	Specification for Continuously Cast and Rolled Electrolytic Copper Wire Rods for Electrical Conductors.
26	IS 13964	Methods of Measurement of Transformer and Reactor Sound level
27	IS 3639	Specification for fitting & accessories of Power Transformer
28	IS 1866	Code of practice for maintenance of transformer oil

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29	IEC 60156	Insulating liquids - Determination of the breakdown voltage at Power frequency - Test method
30	IS 2074	Ready Mixed Paint, Air Drying, Red Oxide Zinc Chrome, Priming – Specification
31	IS 2932	Enamel, Synthetic, Exterior: (a) Undercoating (b) Finishing – Specification
32	IEC 60296	Specification for unused mineral insulating oils for transformers And switchgear
33	IEC 60529	Degrees of protection provided by enclosures (IP Code)
34	IEC 60437	Radial Interference test on high-voltage insulator
35	IEC 61936-1	Power Installation exceeding 1kV.
36	C.B.I.P Publication	Manual on Transformers
37	IEC 60641	Pressboard and press paper for electrical purposes

: the stricter requirement mentioned in the relevant standard shall be valid.

3. CLIMATIC CONDITIONS:

1	Maximum ambient temperature	50 deg C
2	Max. Daily average ambient temp	35 deg C
3	Min Ambient Temperature	0 deg C
4	Maximum Humidity	95%
5	Average Annual Rainfall	1500mm
6	Average No. of rainy days per annum	120
7	Altitude above MSL not exceeding	1000m
8	Wind Pressure	300 Km/hr
9	Earthquakes of an intensity in horizontal direction	equivalent to seismic acceleration of 0.3g
10	Earthquakes of an intensity in vertical direction	equivalent to seismic acceleration of 0.15g (g being acceleration due to gravity)

Tata Power DISCOM service area has heavy saline conditions along the coast and High Intensity winds with speed up to 200 km/hr & sometimes up to 300 km/hr. The atmosphere is generally laden with mild acid and dust in suspension during the dry months and is subjected to fog in cold

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months

4. GENERAL TECHNICAL REQUIREMENTS:

4.1 The transformer shall conform to the following specific parameters.

Sl.no.	Parameters	Desired Values		
1	Rated MVA (ONAN rating)(MVA)	3.15 MVA	5 MVA	8 MVA
2	No. of phases	3		
3	Type of installation	Outdoor		
4	Frequency	50 Hz (± 3%)		
7	Rated voltage			
	a) High voltage winding	33 KV		
	b) Low voltage winding	11 KV		
8	Highest continuous system voltage			
	a) HV Winding	36 KV		
	b) LV	12 KV		
9	No. of Windings	Two Winding Transformer		
10	Type of Cooling	ONAN		
12	Method of connection			
	HV	Delta		
	LV	Star		
13	Vector Group	Dyn11		
14	System Direction of Power Flow (Neutral terminal to be brought out)	Secondary Neutral Grounding: EC Grade copper flat of suitable ratings shall be provided up to the base level of Transformer for grounding, with suitable support insulator arrangement.		
15	Percentage impedance voltage on normal tap at Base MVA (Tolerance shall be as per IS 2026 Part-1,Clause 9, Table No.1)	7%	7%	8%
16	Transformer shall be suitable for continuous operation at a voltage of 110% on each operating tap.			
17	Phase Arrangement	UVW as per IS 2026 -4		
18	Overloading capability	As per IS 2026-7		
19	Maximum Flux Density	1.6 Tesla		
20	Basic Insulation levels for windings(Neutral should not be graded) :-			
	a) 1.2 / 50 microsecond wave shape Impulse withstand (KVP)	33KV : 170 11KV: 95		
	b) Power frequency voltage withstand (KV rms)	33KV : 70 11KV: 28		

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21	Type of winding insulation	Uniform
22	Withstand time for three phase short circuit at LV Bushings	3 Seconds
23	Permissible Temperature Rise over ambient temperature of 50 deg C	
	a) top oil measured by resistance	45 Deg C
	b) winding measured by resistance.	55 Deg C
24	Minimum clearances in air (mm) :-	
	HV	Phase to Phase: 350 Phase to ground: 320 Phase to ground : 222 in Box
	LV	Phase to Phase: 170 Phase to ground: 170
25	Core Material	CRGO Silicon Steel, M3, 23HP85D(0.23mm) or better
26	Class of Insulation	A/A
27	Terminals	
	a) HV winding	36 KV oil filled communicating type porcelain bushings (Anti-fog type)
	b) LV winding	17.5 KV porcelain type of bushing (Anti-fog type)
	C) Creepage distance (min)	31mm/KV for Outdoor and 25mm/KV for Indoor system
28	Material of HV & LV Conductor	Electrolytic copper
29	Maximum current density for HV and LV winding for rated current (At Minimum Tap)	2.6 A / mm ²
30	Polarisation index i.e ratio of megger values at 600 sec. to 60 sec for HV to earth, L.V to earth and HV to LV.	Shall be greater than or equal to 1.5, but less than or equal to 5
31	Core Assembly	Boltless Type
32	WTI & OTI	1 nos each
33	Losses	The losses shall not exceed the value given below
	a)No load loss(fixed losses) KW	3.15 MVA=3.0kW 5 MVA=3.6 KW 8 MVA=4.2 KW
	b) Load losses at 75°C KW	3.15 MVA=16 kW 5 MVA=20 KW 8 MVA=32 KW

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34	Wheels	The transformer shall be provided with four flanged bi-directional rollers suitable for rail gauges in both the axis for movement of the transformer in either direction. (Rail is in respective TP DISCOM Scope)
35	Over fluxing capability	Transformers shall be designed for continuous over fluxing withstands capability due to +10% to –10% voltage variation on HV side and frequency variation of $\pm 3\%$. Combined variation of voltage and frequency shall be within $\pm 10\%$.
36	Fault level	The anticipated fault levels on the 33kV and 11kV sides shall be 1500 MVA and 500 MVA respectively.
37	Auxiliary Supply	
	a) AC	415 Volts 3 phase 4 wire, ungrounded (Provision to connect neutral to be made in the terminal block). Two 415 V sources shall be made available by TATA POWER DISCOM
	b) DC	24/48V/110/220V DC Note: Control Voltage will be confirmed by concern TP DISCOM at the release of RO/PO.
38	No Load Current	No Load Current shall be 0.5% of full load current. Tolerance for No-Load Current shall be +30% of the declared value.
39	Core Grounding	The core and frame grounding connection shall be brought out through a suitable bushing for provision of external grounding. The bidder shall submit the drawing clearly showing the details of core grounding.
40	On Load Tap changer (OLTC)	
	a) Type	On Load (Flanged type) Tap changer
	b) Range	Option 1: +5% to -15% in steps of 1.25% Option 2 : +4.68% to -20.28% in steps of 1.56% Note: Tapping range to be confirmed at the time of release of PO by concerned DISCOM.
	c) Number of Steps	16 (17 Position)
	d) Principal Tap Position	5 th For Option 1 and 4 th For Option 2
	e) Manual / Automatic	Yes (Both)
	f) Remote / Local	Yes (Both)
	g) IS	8468-2006
	h) All contacts should be SCADA compatible and suitable for connection to TMU	Yes
	i) Separate Conservator and OSR, PRV & MOG	Yes
	j) Potential free contacts for SCADA shall be Provided	Yes

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k) 415 V Auto change over facilities for OLTC Motor shall be Provided	Yes
l) Flow of Power	Bidirectional
m) Surge Relay	Yes
n) Whether separate tap winding provided for OLTC	Yes
o) RTCC	No
p) SCADA and TMU compatibility	Yes

WTI CT for LV Side								
Core	Purpose	CTR for WTI	Class	Burden	Knee Point Volt	Imag at Vk/2	ISF	Rct
I	WTI	165/1 A for (3.15MVA) 262/1A for (5 MVA) 420/1A for (8MVA)	0.5	30 VA	-	-	<10	-

4.2 Neutral CT (Bushing CT): Supplier to provide suitably sized 2 core CT with PS class & 5P20. **CTR & other parameters shall be decided during detailed Engineering.**

4.3 CTs shall not limited to the below mentioned points.

All CTs shall be as per IS: 2705 latest amendment

- All turret CTs shall have 2A test windings for ratio test.
- All cabling from equipment to terminal boxes shall be of FRLS copper of size not less than 4 sq.mm and shall have insulated sleeve throughout the length and shall be laid in covered Fire-Retardant cable duct. Wire terminals shall be hard core copper using round lugs. Wiring of all the cores shall be brought up to the terminal block and disconnecting type terminals shall be used. The CTs shall be shorted at CT terminals from the bidder's end only.
- Brass nuts along with lock-nuts, brass washers and spring washers shall be provided for all CT connections.
- All CTs shall have polarity marking and terminals shall have well defined marking for the purpose of usage, which shall be clearly written on CT terminal plates.
- CT specifications along with winding diagrams shall be provided in the transformer nameplate.
- Turret CT test certificates shall be provided along with Transformer test certificates.
- In marshalling box protection CT and WTI CT wiring shall be properly marked with proper distinct identification for wiring purpose. Also marking plate on WTI and HV bushing CT to be provided on top of tank.
- Location of WTI and LV CT shall be such that it can be accessible at the time of commissioning and maintenance.

4.4 PERFORMANCE

For 3.15, 5 & 8 MVA PTR

- The transformer shall be capable of being operated, without danger, on any tapping at the rated MVA with voltage variation of $\pm 10\%$ corresponding to the voltage of the tapping.

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- II. Transformer shall be capable of operating under natural cooled condition up to specified load.
- III. The transformer shall be designed with particular attention to the suppression of maximum harmonic voltage, especially the third and fifth harmonics so as to minimize interference with communication circuit.
- IV. The transformer shall be able to withstand thermal and mechanical stresses caused by symmetrical or asymmetrical fault on any winding.
- V. The transformer and all its accessories including CTs etc. shall be designed to withstand thermal and mechanical effects of any external short circuits to earth and short circuits at the terminals of any winding for a period of 3 sec without any damage/injury.
- VI. Loading of the transformer shall be as per IS: 2026 part-7.
- VII. Transformer shall be compatible for Operation along with Tap Changer Control panel or Transformer Monitoring Unit (TMU). Supply of TMU is not in scope of Bidder.
- VIII. Transformer shall be capable of withstanding for three seconds without damage to any external short circuit, with the short circuit MVA available at the terminals.
- IX. Transformer shall under exceptional circumstances due to sudden disconnection of the load, be capable of operating at the voltage approximately 25% above normal rated voltage for a period of not exceeding one minute and 40% above normal for a period of 5 seconds.
- X. The thermal ability to withstand short circuit shall be demonstrated by calculation.

5. GENERAL CONSTRUCTION:

5.1 GENERAL:

- I. All transformers shall be provided with detachable, flanged, bi-directional wheels for movement and mounting on rail gauge. TATA POWER DISCOM shall provide rail tracks grouted in concrete foundation. Bidder shall provide means for locking the wheels in positions parallel to and at right angles to the longitudinal axis of the tank.
- II. Transformer shall be two winding type, with cold rolled grain oriented, silicon-steel laminations having excellent magnetic properties, insulated and clamped to minimize vibration and noise. Laminations shall be insulated from each other with material having high inter-lamination insulation resistance and rust inhibiting property All covers and seals shall be oil and airtight and shall not be affected by mineral or synthetic oil action.
- III. All fasteners of M10 and below size should be of stainless steel. All fasteners of M12 and above size should be hot dip galvanized. To achieve a good quality corrosion free painting, bidder should provide epoxy plus polyurethane paint with minimum paint thickness of 120 microns.
- IV. Nuts, bolts and pins used inside the transformers and tap changer compartments shall be provided with lock washer or locknuts.
- V. The framework, clamping arrangement and general structure of the cores of each transformer shall be of robust construction, having proper support structure and shall be capable of withstanding any shock to which they may be subjected during transport, installation and service. Detailed calculation for selection of bolts shall be submitted. The framework and the core bolts shall be efficiently insulated from the core so as to reduce the eddy-currents to a minimum.
- VI. The limbs and the yokes of the core shall have similar sections to minimize heating and noise arising from transverse flux. The joints in the laminated magnetic circuit shall be interleaved.
- VII. The core clamping frame shall be provided with lifting eyes having ample strength to lift the complete core and winding assembly. The core assembly of oil immersed transformers shall be electrically connected to the transformer tank for effective core earthing.
- VIII. The neutral terminal shall be brought out through neutral bushing from the tank and the same shall be brought up to the skid level, duly insulated by means of suitably rated epoxy insulators. The neutral conductor lead shall be of copper conductor designed to carry the

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maximum Earth Fault Current with solidly earthed neutral. The bidder shall justify the voltage/current rating of the neutral bushing chosen during detailed engineering. The voltage rating of the neutral bushing shall be chosen considering the probable voltage rise for neutral floating conditions. The current rating shall be chosen considering solidly earthed neutral. The neutral shall be formed at the bottom of the winding and brought to LVN bushing through a separate path.

- IX. Top sampling valve shall be internally/externally piped and brought out of the tank sideways at skid level.
- X. Transformer with all accessories shall be of free-standing type. Transformer accessories shall be designed in such a way that no supporting posts/structures are necessary other than the rail.
- XI. The sets of radiator banks shall be connected to the main tank through a header pipe welded to the tank. Design wherein an individual radiator is connected to the main tank is not acceptable. Individual radiator tubes shall be connected to the main tank thru butterfly valves at both ends of radiator tubes. Arrangement shall be made for a suitable gap between main tank and radiator tubes.
- XII. Transformer conservator shall have Silica gel breather.
- XIII. The oil level shall be higher than HV bushing terminal.
- XIV. The part of the HV bushing terminal to which overhead conductor is connected should not be involved either in the oil sealing arrangement or air release arrangement. This is to be specifically confirmed by the bidder at the time of offer.
- XV. Two separate parts shall perform the two functions of receiving the jumper and oil sealing.
- XVI. Air seals are not acceptable at HV bushing terminals.
- XVII. The oil shall be supplied in non-returnable drums. The quantity shall be of 10% excess over the requirement of transformer at 30°C.
- XVIII. Magnetic oil level indicator shall comprise with 2 nos. Magnetic type contact / Mercury contact / switch (for High / Low oil level alarm).
- XIX. Silica gel breather (with orange coloured eco-friendly indicating type gel) shall be used for main tank and Silica gel/ Silica gel beads breather with clear sight glass & oil sealing arrangement shall be used for OLTC purpose.
- XX. The transformer shall be suitable for operation at full rated power on all tap positions without exceeding the applicable temperature rise. The transformer shall be designed to suppress harmonic content, especially the third and fifth, so as to eliminate distortion in the waveform and consequent additional insulation stress, noise on communication system and undesirable circulating currents between the neutrals at different transformer stations.
- XXI. The design of each transformer shall be such that the risk of accidental short-circuits due to birds or vermin are obviated.
- XXII. All outdoor apparatus, including bushing insulators and fittings shall be so designed that they do not collect water at any point.
- XXIII. All electrical connections and contacts shall be of ample cross sections for carrying the rated current without excessive heating. All such contacts shall be tinned copper to avoid bi-metallic affect.
- XXIV. Each transformer shall be designed for minimum no-load and load losses within the economic limit and as per the Indian Standards.
- XXV. Ground terminals shall also be provided on marshalling box, OLTC local control panel and cable end box to ensure effective earthing.
- XXVI. For continuity of earth connection, all gasket joints shall be provided with minimum two numbers tinned copper strip jumpers of adequate size.
- XXVII. Rain Guard shall be provided for LV compartment, Bucholz Relay, OSR, PRV, and Marshalling Box so that rain water can enter to the junction box of these relays/ cubicles. Wiring shall be bottom entry.

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- XXVIII. At the time of erection and commissioning, authorized person of the bidder shall be present at the site till completion of the work.
- XXIX. Cable trays of appropriate size to be provided at necessary locations.

5.2 CORE:

- I. The core shall be of high grade cold rolled, non-ageing, grain oriented, annealed silicon steel lamination (CRGO), having low loss & good grain properties, coated with hot oil proof insulation, bolted together to the frames firmly to prevent vibration or noise.
- II. The grade of core shall be M3, 23HP85D (0.23mm) or better. The core shall be stress relieved by annealing under inert atmosphere if required, especially suitable for transformer.
- III. All core clamping bolts (If any) shall be effectively insulated. Only one grade and one thickness of core shall be accepted and no mixing of different grades shall be allowed.
- IV. The complete design of the core must ensure permanency of the core losses with continuous working of the transformers.
- V. The value of the maximum flux density allowed in the design & grade of laminations used shall be clearly stated in the offer.
- VI. The successful bidder is required to submit the following documents with regard to the procurement of core material:
 - a) Invoice of supplier
 - b) Mill's test certificate
 - c) Packing list
 - d) Bill of landing
 - e) Bill of entry certificate by custom
 - f) Description of material, electrical analysis, physical inspection certificate for surface defects, thickness and width of the material
 - g) Subjecting to at least 10% of the transformer to routine tests and no load and load loss measurement
- VII. TATA POWER DISCOM shall impose heavy penalty or black list bidders using seconds/ defective CRGO sheets or load losses found to be more than stipulated limit.
- VIII. After being sheared the laminations shall be treated to remove all burrs. Both sides of steel laminations shall be so constructed that eddy currents will be minimum.
- IX. The core frame shall be provided with lugs suitable for lifting the complete core and coil assembly of the transformer.
- X. The core and the coil shall be so fixed in the tank that shifting will not occur when the transformer is moved or during a short circuit.
- XI. All steel sections used for supporting the core shall be thoroughly sand blasted after cutting, drilling and welding. Each core lamination shall be insulated with a material that will not deteriorate due to pressure and hot oil.
- XII. The supporting frame work of the core shall be so designed as to avoid presence of pockets which would prevent complete emptying of tank through drain valve or cause trapping of air during oil filling. Adequate lifting lugs shall be provided to enable the core and windings to be lifted.
- XIII. Core Grounding:
 - a) The grounding lead from the core shall be brought out of the tank through an 11kV class bushing and grounded externally.
 - b) A protective cover shall be provided for the bushing.
 - c) The core grounding rod (stem) through the bushing shall be solid rod (stem).
 - d) The design of core grounding arrangement shall be such that the grounding links shall not come out of core during installation as well service conditions.

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- e) The supplier shall submit a drawing clearly showing the details of core grounding.
- f) The core / frame grounding's both connections shall be brought out through a suitable bushing for provision of external grounding.

5.3 WINDINGS:

- I. The windings shall be so designed that all coil assemblies of identical voltage ratings shall be interchangeable, and field repairs to the windings can be made readily, without special equipment.
- II. The coils shall be supported between adjacent sections by insulating spacers, and the barriers bracings and other insulation used in the assembly of the windings shall be arranged to ensure a free circulation of the oil and to reduce hot spots in the windings.
- III. Coils should be transposed to minimize magnetic forces and extra supports shall provide for inter-disc connection.
- IV. All materials used in the insulation and assembly of the winding shall be new, insoluble, non-catalytic and chemically inactive in the hot transformer oil and shall not soften or otherwise be adversely affected under the operating conditions.
- V. The current density of coil shall not exceed 2.6 Amps/ sq mm at min tap of respective PTR's higher rating.
- VI. All threaded connections shall be provided with locking facilities. All leads from the winding to the terminal board and bushings shall be rigidly supported to prevent injury from vibration. Guide tubes shall be used where practicable.
- VII. The winding shall be brought out through bushing and provided with suitable terminal connectors, the details of which will be forwarded later.
- VIII. The windings shall be clamped securely in place so that they will not be displaced or deformed during short circuits. The assembled core and windings shall be vacuum-dried and suitably impregnated before removal from the treating tank. The copper conductors used in the coil structure shall be best suited to the requirements and all permanent current carrying joints in the windings and the leads shall be brazed.
- IX. Sharp bends should be avoided in the windings as far as possible, where unavoidable such bends should be reinforced with extra insulation tapes.
- X. The tolerance for the winding resistance measurement for different phases but at same taps shall be limited to 1%.
- XI. The change in impedance values between the winding (HV/LV) shall not exceed $\pm 10\%$ of nominal impedance value as specified at all taps on HV/LV side.
- XII. The windings shall be brought out through bushing. The windings shall be designed to withstand the specified thermal and dynamic short-circuit stresses.
- XIII. The end turns of the high voltage windings shall have reinforced insulation to take care of the voltage surges likely to occur during switching or any other abnormal condition.
- XIV. Winding shall be suitable for connection of reactors or capacitors which would be subjected to frequent switching. All the windings shall be capable of withstanding stresses that may be caused by such switching.
- XV. Primary and secondary windings shall be constructed from high- conductivity (copper conductors), Double Paper Covered (DPC) copper conductor.
- XVI. The insulation between core and bolts and core and clamps shall withstand 2.5 kV for one minute.
- XVII. Proper bonding of inter layer insulation with the conductor shall be ensured. Test for bonding strength shall be conducted as per standards.
- XVIII. All turns of windings shall be adequately supported (by which material) to prevent movement. The core/coil assembly shall be securely held in position to avoid any movement under short circuit conditions.
- XIX. The joints in the winding shall be avoided but if it is necessary then, these shall be properly brazed and the resistance of the joints shall be less than that of parent conductor. Crimping is not allowed at any joints.

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5.4 INSULATING PAPER AND INSULATING PRESS BOARD :

- I. The bidder shall submit characteristics along with make for all the type of insulation papers and Pressboards to be used with the offer.
- II. Inter layer insulation both for HV and LV windings shall be DPC and compressed pressboard of reputed make (subject to approval of TATA POWER DISCOM).
- III. For Winding insulation, only Double Paper Covered insulation is acceptable with laying in opposite direction to each other and each paper must have overlapping more than 25% of its width.
- IV. Kraft paper and Pressboard should be made of pure Cellulose from soft wood pulp manufactured from sulphate process. No additive, adhesive or colouring matter shall be present.
- V. Kraft paper and Pressboard should be of class 'A' (105°C) insulation material.
- VI. All spacers, axial wedges / runners used in windings shall be made of pre-compressed solid pressboard.
- VII. All axial wedges/runners shall be properly milled to dovetail shape so that they pass through the designed spacers freely.
- VIII. Insulation shearing, milling and punching operations shall be carried out in such a way, that there should not be any burr, sharp edges and dimensional variations.
- IX. Kraft paper self-adhesive tape to be used for bonding of insulating paper layer, spanner and paperboards that are immersed in the oil filled transformer.

Below required values could be verified if required at any stage of the inspection and it should fulfil the requirement as per below table

Characteristics	Kraft Paper	Pressboard (all Sizes)
1. Dimension	As specified by bidder with $\pm 5\%$ tolerance.	As specified by bidder with Tolerance as per IS1576.
2. Apparent Density	$>0.80 \text{ g/cm}^3$	as per IS1576 w.r.t Thickness
3. pH of Aqueous extract	6-8%	6-8%
4. Electrical strength i) in air ii) In Oil	7KV/mm -----	12KV/mm 35KV/mm
5. Ash content	Maximum 1%	Maximum 0.7
6. Moisture content	Maximum 8%	Maximum 8%
7. Oil absorption	-----	Minimum 9%

Bidder has to submit the test certificates as per IS-9335, IS-1576 for all type of insulating materials covering above stated parameters along with below parameters during stage inspection:

1. Substance (Grammage) (g/m³)

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2. Compressibility
3. Tensile strength
4. Conductivity of water extract
5. Shrinkage in air
6. Flexibility
7. Cohesion between plies1.
8. Elongation
9. Air permeability
10. Tear index
11. Heat stability

5.5 TRANSFORMER TANK :

- I. The transformer tank and cover shall be fabricated from good commercial grade low carbon steel suitable for welding and shall be of adequate thickness.
- II. The tank shall be welded Type. Top cover shall be Flanged type. All seams shall be welded and where practicable they shall be double welded.
- III. The main tank body of the transformer, excluding tap changing compartments and radiators, shall be capable of withstand pressure of 0.8 kg/cm².
- IV. The tank material shall be as per IS: 2026 or equivalent with ultrasonic testing done for elimination of defects in rolled plates.
- V. The welding shall be as per prior approved WPS (Welding Procedure Specs) by trained and tested welders. Calculations and documents should be submitted bidders.
- VI. The welding plan shall be shown in general i.e. Category-wise or for each type of weld in the mechanical fabrication drawing, which shall be submitted to TATA POWER DISCOM
- VII. All fittings like elbows, bends etc. shall be seamless as per applicable American or Indian Standards.
- VIII. No resistance welding of fasteners shall be done anywhere on the transformer.
- IX. To ensure oil tightness, recessed neoprene or equivalent gaskets shall be used.
- X. Manholes with welded flange and bolted covers shall be provided on the tank.
- XI. The manhole shall be of sufficient size to afford easy access to the lower ends of all the bushings, OLTC terminals etc. to permit replacement of auxiliaries without removing tank covers.
- XII. Suitable guides shall be provided for positioning the various parts during assembly or dismantling.
- XIII. Adequate space shall be provided between the cores and windings and the bottom of the tank for collection of any sediment.
- XIV. All joints including bolted as well as flanged, shall have machined matching surfaces/inner edges with smooth finish, to ensure leak proof joints.
- XV. Lifting eyes or lugs shall be provided on all parts of the transformer requiring independent handling during assembly or dismantling. In addition, the transformer tank shall be provided with lifting lugs and bosses properly secured to the sides of the tank, for lifting the transformer either by crane or by jacks.
- XVI. The design of the tank, the lifting lugs and bosses shall be such that the complete transformer assembly filled with oil can be lifted with the use of these lugs without any damage or distortions.
- XVII. The tank shall be provided with two nos. of suitable copper alloy lugs for the purpose of grounding.
- XVIII. The grounding pads should be mirror finished. Two grounding pads, located on opposite sides of the tank shall be provided with two tapped holes for connecting it with station

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- ground mat. Necessary hardware like M10 GS bolts and spring washers shall also be provided for connections. All outer nuts & bolts should be stainless steel type.
- XIX. Each tank shall be equipped with the following valves with standard flange connection for external piping,
- One drain valve located on the low voltage side of the transformer and placed to completely drain the tank. At the option of the TATA POWER DISCOM's a large valve may be furnished with an eccentric reducer. This valve shall be equipped with a small sampling cock.
 - One filter valve located at the top of the tank on the high-voltage side. The opening of this valve shall be baffled to prevent aeration of the oil.
 - One filter valve, located slightly above the bottom of the tank.
 - One relief valve to operate at a pressure below the test pressure for the tank.
 - Other two nos. valves shall also be provided, as required for proper functioning of the transformer.
 - A suitable locking arrangement shall be provided for locking these valves in close/open position.
- XX. All valves should be provided with clear open/close position indications. Wherever rising spindle type valves are provided the valves should be clockwise rotating for closing operations. Any valve opening should not create hindrance to other operation.
- XXI. For the auxiliary lead wiring from individual instrument to marshalling box, the cables shall be provided in the conduits.
- XXII. All the transformers shall be provided with a ladder having 'anti-climbing' device.
- XXIII. Transformer tank shall be of welded sheet steel construction and provided with gaskets steel cover plates.
- XXIV. Base shall be suitably reinforced to prevent any distortion during lifting. Base channels shall be provided with skids and pulling eyes to facilitate handling.
- XXV. All seams shall be electrically double welded for absolute oil tightness.
- XXVI. Guards shall be provided for drain, bottom sampling and filter valves to prevent oil pilferage.
- XXVII. Gaskets of nitrile rubber or equivalent shall be used to ensure perfect oil tightness. All gaskets shall be closed design (without open ends) and shall be of one piece only. Rubber gaskets used for flange type connections of the various oil compartments, shall be laid in grooves or in groove-equivalent sections on bolt sides of the gasket, throughout their total length. Care shall be taken to secure uniformly distributed mechanical strength over the gaskets and retains throughout the total length. Gaskets of neoprene and / or any kind of impregnated / bonded core or cork only which can easily be damaged by over-pressing are not acceptable. Use of hemp as gasket material is also not acceptable.
- XXVIII. Inspection hole(s) with welded flange(s) and bolted cover(s) shall be provided on the tank cover. The inspection hole(s) shall be of sufficient size to afford easy access to the lower ends of the bushings, terminals etc.
- XXIX. Minimum Thickness for the transformer shall be as follows:
- Tank Side wall (mm) 6 mm for 3.15MVA & 8mm for 5 MVA & 8 MVA
 - Tank Top Cover (mm) 8 mm for 3.15MVA & 10 for 5 MVA & 12 mm for 8 MVA
 - Tank Bottom Plate (mm) 8 for 3.15MVA & 10 for 5 MVA & 12 mm for 8 MVA

5.6 PAINTING

- Before painting, surface preparation shall be done by sand blasting and procedure for sand blasting has to be submitted by the Vendor along with the bid. The surface preparation for all external surface prior to painting or coating shall be witnessed by customer or shall be treated as customer hold points. After sand blasting at all edges Belzona E metal to be applied.

- ii. Before shipment all steelwork not under oil shall be painted with a primary coat of anti-corrosive paint of durable nature and two coats of battleship grey paint (Shade 631 of IS: 5). Paint shall be epoxy type. The interior surfaces shall be painted as per bidder's standard practice. All the paint including primer shall be applied after testing such as air test, hydraulic test etc. Bidder shall submit their procedure for painting for TATA POWER DISCOM's approval, along with the offer.
- iii. Painting of Marshalling box: Two coats of red oxide primer & two coats of synthetic enameled paint after chemical treatment.
- iv. Metal parts not accessible for painting shall be made of corrosion resistant material.
- v. Paint shall be as per Indian Standard/International Standard for quality, surface preparation, application method, thickness check and any other test.
- vi. Additional paint shall be supplied along with the transformer for applying touch up paint at site during installation. The shade of the paint used shall be shade 631 as per IS: 5.
- vii. Paint Thickness should be at least 120 micron and paint shade is same for tank, radiator, Conservator & Marshalling Box etc.

5.7 SURFACE PREPARATION AND PAINTING

- I. The paint shall be applied by airless spray.
- II. Steel surfaces shall be prepared by proper cleaning method (IS-9954) to grade Sq.2.5 of ISO 8501-1 or chemical cleaning including phosphating of the appropriate quality (IS 3618).
- III. Heat resistant (Hot oil proof) paint shall be used for the inside surface and whereas for external surface one coat of thermosetting powder paint or one coat of epoxy primer (zinc phosphate) followed by two coats of polyurethane (P.U.) base paint. as per table given below:

Sl. No.	Paint type (should be UV restraint, non-fading)	Area to be painted	No of coats	Total dry film thickness (min); micron
1	Thermosetting powder paint	Inside Outside	01 01	30 60
2	Liquid Paint			
a.	Epoxy (primer)	Outside	1	45
b.	P.U. Paint (finish paint)	Outside	2	35 (each)
c.	Hot oil resistant paint	Inside	1	35

The two coats shall be of oil and weather-resistant nature with final coat as flossy and non-fading paint of shade 631 as per IS 5.

- IV. The dry film thickness shall not exceed the specified minimum dry film thickness by more than 25%.
- V. Any damaged part shall be cleaned to bare metal with an area extending 25 mm around its boundary. A priming coat shall be immediately applied followed by full paint finish equal to that originally applied and extending 50 mm around the perimeter of the original damage. The repainted surface shall present a smooth surface which shall be obtained by carefully chamfering the paint edges before and after priming.
- VI. Painting shall not affect by weather changes & performance against pilling out or fading etc. to be guaranteed for 5 Years.

5.8 BUSHINGS:

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- I. Bushings provided by the bidder shall be as per IS2099-1986. The bushings shall have high factors of safety against leakage to ground and shall be so located as to provide adequate electrical clearance between bushings and grounded parts. Bushings of identical voltage rating shall be interchangeable. All bushings shall be equipped with suitable terminals of approved type and size and all external current carrying contact surfaces shall be plated, adequately. The insulation class of the high voltage neutral bushing shall be properly coordinate with the insulation class of the neutral of the high voltage winding.
- II. All main winding leads shall be brought out through outdoor type bushings as specified which shall be so located that the full flashover strength will be utilized and the adequate phase clearance shall be realized.
- III. Each bushing shall be so coordinated with the transformer insulation that all flash-over will occur outside the tank.
- IV. All porcelain used in bushings shall be of the wet process, homogeneous and free from cavities or other flaws. The insulation (porcelain) shall be without any joint. The glazing shall be uniform in colour and free from blisters, burns and other defects. Stresses due to expansion and contraction in any part of the bushing shall not lead to deterioration.
- V. In case of oil communicating type bushing (33kV & 11kV), venting screw of the hollow stud, shall be provided with suitable gasket as per IS 4253-2 (latest amendment), to avoid oil leakage problem through the same. Angle of inclination to vertical for any bushing shall not exceed 30 deg. All bushings shall have puncture strength greater than the dry flash-over value.
- VI. Main terminals shall be solder less terminals, and shall be of the type and size specified in the drawings. The spacing between the bushings must be adequate to prevent flashover between phases under all conditions of operation.
- VII. The Bidder shall give the guaranteed withstand voltages for the above and also furnish a calibration curve with different settings of the co-ordination gap, to the TATA POWER DISCOM to decide the actual gap setting. Bidder's recommendations are also invited in this respect.
- VIII. The following routine tests shall be carried out on all bushings in the presence of TATA POWER DISCOM's representative, in addition to any other specified in the IS:
 - a) Visual examination
 - b) One minute dry withstand test
 - c) Oil tightness test
- IX. The bushings shall have a link type isolating facility for tap for maintenance tests viz. power factor measurement etc. (Terminal shall be provided for the measurement of power factor and tan delta).
- X. Bushing shall be as per the approved make only. All Type test report should be submitted along with bid.
- XI. **Termination Arrangement on 11KV and 33KV Side :**

Option 1: (33KV Indoor AIS/GIS and 11KV indoor AIS)

- a. For 33 KV side cable termination, Palm Connector & Extended Bus-bar of suitable size (60mm X 10mm) for termination of 1 runs of 3C x 400 sqmm. Proper supporting arrangement for extended bus bar and cables shall be provided.
- b) For 11 KV side cable termination, Palm Connector & Extended Bus-bar of suitable size (60mm X 10mm) for termination of 2 runs of 1C x 630 sqmm. Proper supporting arrangement for extended bus bar and cables shall be provided.

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- c) Copper bus bar for connecting transformer bushings to cables with support insulators and insulation sleeve
- d) Frame for cable mounting with HDPE cleats.
- e) Detailed size of all the item shall be submitted during detailed engineering for approval.
- f) Suitable Bimetallic Connector to be supplied wherever applicable

Option 2: (33KV Outdoor Switchyard and 11KV indoor AIS)

- a) On 33KV side, suitable provision to connect Zebra/Panther/Dog/Coyote Conductor.
- b) For 11 KV side cable termination, Palm Connector & Extended Bus-bar of suitable size (60mm X 10mm) for termination of 2 runs of 1C x 630 sqmm. . Proper supporting arrangement for extended bus bar and cables shall be provided
- c) Frame for cable mounting with HDPE cleats.
- d) Detailed size of all the item shall be submitted during detailed engineering for approval.
- e) Suitable Bimetallic Connector to be supplied wherever applicable

Option 3: (33KV Outdoor Switchyard and 11KV Outdoor Switchyard)

- a) On 33KV side, suitable provision to connect Zebra/Panther/Dog/Coyote Conductor.
- b) On 11KV side, suitable provision to connect Zebra/Panther/Dog/Coyote Conductor.
- c) Detailed size of all the item shall be submitted during detailed engineering for approval.
- d) Suitable Bimetallic Connector to be supplied wherever applicable

5.9 RADIATORS

- I. The radiators shall be epoxy painted. The entire surface including edges should be cleaned properly before painting to avoid peeling of paint at the edges.
- II. Bidder shall submit procedure for surface preparation and painting of radiators along with the bid.
- III. The colour shade for the radiator shall be shade 631 as per IS: 5.
- IV. Tank mounted radiators shall be of the detachable type with bolted and gasketed flanged connections. Proper continuous earthing (may be through Transformer body) should be ensured.
- V. The following accessories shall be provided for radiator:
 - a. Shut off valves and blanking plates on transformer tank at each point of
 - b. Top and bottom shut off valves and blanking plates on each radiator.
 - c. Lifting Lugs
 - d. Top Oil filling Plugs
 - e. Air release plug on top
 - f. Oil Drain Plug at Bottom.

All radiators shall be tested for.

- a. Vacuum test for one hour
- b. Hydraulic pressure test using transformer oil for one and half hour (as per ASME)

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- c. Air test can be done in place of hydraulic pressure test provided.
 - d. Water tank will be made available for submerging the radiators into water for leak detection.
 - e. All the tests shall be done in black condition (i.e. before applying any paint).
- VI. The transformer design shall be such that the radiators and conservator can be mounted on either side of the tank connection

5.10 INTERNAL EARTHING

- I. Provision of complete earthing of transformer and associates should be ensure by bidders. Earthing of Main tank, OLTC Conservator, Radiator, and other shall be ensured through 50X6mm GI flat with double hole provision wherever applicable with minimum 80-100mm length.
- II. Provision of continuity of earthing shall also ensure for gasket arrangement, doors and all other extended/open able arrangements with flexible copper wire of adequate size.

5.11 OIL:

Type: Type-II Unhibited

- I. Oil for first filling, together with 10% extra shall be supplied with each transformer. The oil shall comply in all respects with the provisions of IS 335 & IEC No.60296 latest amendment. Particular attention shall be paid to deliver the oil free from moisture having uniform quality throughout in non-returnable steel drums.
- II. The oil shall be of EHV grade and shall have the following main characteristics or equivalent (the requirements indicated are determined in accordance with the test methods as per IS: 335). The oil in the transformer shall be filled up to 'Transport filled level' before dispatch of the transformer.
- III. The maker of the oil shall be as per approved list and should comply below mentioned technical requirements:

Sl.no.	Characteristics	Requirement as per IS 335	Method of Test
1	Appearance	The oil shall be clear and transparent and free from suspended matter or sediment temperature.	A sample of Oil shall be examined in 100mm thick layer at 27deg C
2	Density at 29.5° C (max)	0.89 g/cm3	IS1448 [P:16]:1990
3	Kinematic Viscosity @ 27° C. (Max.)	270C	IS1448 (P:25):1976
4	Interfacial tension Min.	0.04 N/m	IS:6104:1971
5	Flash Point (Closed CUP)	140° C	IS1448 [P:21]:1992
6	Pour Point (max)	-6° C	IS1448 [P:10]:1970
7	Neutralization Value (total acidity) max.	0.03 mg/KOH/g	IS1448 [P:2]:1967
8	Corrosive sulphur (In terms of classification of copper strip)	Non Corrosive	IS 1448 (Part-I)/Annex B of IS:335

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9	Electric Strength (Breakdown voltage)	The sampling shall be done in accordance with the procedure laid down in IS 6855: 1973.	IS 6792 : 1992
	i) New untreated oil	30 kV (r.m.s)	
	If the above value is not attained, the oil shall be filtered		
	ii) After Filtration Min	70 kV (r.m.s)	
10	Dielectric Dissipation Factor (tan-delta) at 90°C, max.	0.002	IS:6262-1971
11	Specific resistance (resistivity) ohm/cm/min		IS:6103-1971
	a)At 90° C, Min	35 X 10 ¹² ohm-cm	
	b)At 27° C, Min	1500 X 10 ¹² ohm-cm	
12	Water content, max. per million	30 (avg. 20 ppm)	Karl Fischer Method
13	Oxidation Stability		
	(i) Neutralization value after oxidation Max.	0.40 mg. KOH/g	Appendix C of IS:335
	(ii) Total sludge, after oxidation, max.	0.1 percent by weight	
14	Tan delta at 90° C after ageing test (max)	0.2	IS 6262:1971
15	Saponification Value	Max. 1.0 mg. KOH/g	Appendix E IS-335
16	Presence of oxidation inhibitor	The oil shall contain anti-oxidant additives.	IS 13631 : 1992

Ester Oil (If Applicable) :

In case of Natural Ester oil or Synthetic Ester Oil below are the requirements to be fulfilled:
All transformers shall be filled to the required level with new, unused, clean, Natural or Synthetic Ester oil as per TATA POWER DISCOM approval. The use of recycled ester oil is not acceptable. Ester shall be filtered and tested for break down Voltage (BDV) and moisture content before filling. Ester shall be filled under vacuum. Ester oil shall be procured from approved vendor of TATA POWER DISCOM only.

Bidder has to provide the oil data in below table:

Sl. No.	Description	Unit	As furnished by bidder
1	Type of oil		
2	Oil Qty. for first filling	Ltr.	
3	Grade of Oil		
4	Maker's name		
5	BDV at the time of first filling	kV	

5.12 GASKET

- All bolted connection to the tank shall be fitted with suitable oil-tight gaskets which shall

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give satisfactory service under the operating conditions. Gaskets shall be NRBC (Nitrile rubber Bonded Cork).

- II. Special attention shall be given to the methods of making the oil-tight joints between the tank and the cover as also between the cover and the bushings and all other outlets to ensure that the joints can be remade satisfactorily and with ease, with the help of semi-skilled labour.
- III. Where compressible gaskets are used, steps shall be provided to prevent over compression.
- IV. All the bolts provided shall be of hot dip galvanized.
- V. All bolts shall be provided with one spring washer and two numbers of flat washers and with locking bolts.
- VI. All gasket joints shall be provided with equalizing links to extend earth connections.
- VII. All Gasket should be fixed such a way that there should not be any damage during operation.

5.13 OIL PRESERVING EQUIPMENT

- I. Oil preserving equipment shall be conservator (expansion tank) type. The conservator shall have two filter valves, one at the bottom at one end, the other at the top, opposite end, in addition to the valve specified in the Accessories for the main tank. The conservator or expansion tank shall also have a shutoff valve and a small drain valve and sampling cock, the latter so arranged as not to interfere with oil lines. The oil level gauges (prismatic and magnetic) shall be mounted on the conservator or expansion tank. The top of the conservator shall have contact with atmosphere through two silica gel / Envirogel breathers to facilitate replacement of breather without having to keep Buchholz relay inoperative. The breathers shall have clear transparent, UV stabilized /retardant Polycarbonate with min. 3 mm thickness.
- II. Conservator oil preservation bag (atmoseal bag) shall be provided with a design such that it can be installed at site with ease without any special tools and tackles. The price for COPS bag shall be clearly mentioned in the price schedule at the specified place. With COPS type conservator shall supply air or nitrogen filling arrangement with all accessories needed at the time of commission and pressure gauge arrangement shall be provided for monitoring COPS bag pressure.
- III. Proper valve arrangement (Two top valve & one bottom valve on conservator) is to be provided for proper oil filling.
- IV. Prismatic oil level indicators with red colour float shall be provided on main tank and OLTC tank Conservator. Dual contacts are required for both MOGs (Main Tank & OLTC conservator).
- V. Separate conservator tank shall be provided for OLTC.
- VI. Air-cell leakage detector to be provided for the main conservator. For Monitoring Potential Free Contacts to be wired up to marshalling Box.

5.14 OLTC CONSERVATOR TANK (For 3.15, 5 & 8 MVA PTR Only)

- I. Tank with air release valve on top.
- II. Prismatic Oil level indicator with red colour float.
- III. Magnetic Oil Level Indicator (MOG), round in shape having a diameter of 100 mm.
- IV. Bend assembly with flange - This includes two pipes, one connecting tank with OSR and another connecting OSR with OLTC along with two shut off valves. The diameter of this pipe shall be suitably sized for 5 MVA & 8 MVA mm tanks, the complete assembly formed after attaching both the pipes to OSR and connecting with the tank should be at an angle of 5 degrees with respect to the horizontal. Also, the pipe should be off set from the tank at an angle of 32 degrees in the horizontal plane.
- V. Silica gel/Silica gel beads breather along with the explosion vent assembly
- VI. Mounting structure with eight nut bolts (S/S) for attachment

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- VII. Tank shall be fabricated from good commercial grade low carbon steel.
- VIII. All joints, bolted or flanged, shall have machined matching surfaces/inner edges with smooth finish, to ensure leak proof joints.
- IX. All joints, bolted or flanged, shall have machined matching surfaces/inner edges with smooth finish, to ensure leak proof joints.
- X. The inside surface of the tank shall be painted with one coat of hot oil resistant varnish with two coats of red oxide zinc phosphate primer conforming to IS:2074 followed by two coats of fully glossy finishing paint conforming to IS:2932 and yellow in color.
- XI. The outside surface shall be painted with two coats of red oxide zinc phosphate primer conforming to IS: 2074 followed by two coats of fully glossy finishing paint conforming to IS: 2932 of shade 631 of IS 5.
- XII. Two Lifting lugs should be provided.

Sl. No	Description	3.15 MVA	5 MVA	8 MVA
1	Diameter	To be furnished by the bidder	To be furnished by the bidder	To be furnished by the bidder
2	Length of tank	To be furnished by the bidder	To be furnished by the bidder	To be furnished by the bidder
3	Thickness of sheet	To be furnished by the bidder	To be furnished by the bidder	To be furnished by the bidder
4	Weight	To be furnished by the bidder	To be furnished by the bidder	To be furnished by the bidder
5	Air release valve on top	Required	Required	Required
6	Prismatic oil level indicator with red color float	Required	Required	Required
7	MOG	Required	Required	Required
8	Bend assembly with two shut off valves	Required	Required	Required
9	Silica gel/Envirogel breather with explosion vent assembly	Required	Required	Required
10	Mounting structure	Required	Required	Required
11	Eight nut bolts (S/S) with mounting structure		Required	Required
12	Inside surface finishing		The transformer shall withstand the short circuit at its terminals for the specified fault levels for minimum duration of 3 seconds.	

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13	Outside surface finishing		As the Transformers will be installed in areas prone to earthquakes, they shall be designed to withstand seismic forces equivalent to 0.3 g acceleration. Necessary devices for clamping the wheels to the rails shall also be provided along with any other suitable anti earthquake clamping arrangement.
14	Color of tank's external paint		Shade 631 to IS 5
15	Lifting hooks		Required

5.15 ON LOAD TAP CHANGER (For 3.15 ,5 & 8 MVA PTR)

- I. OLTC shall have the entire feature to meet the requirement. The equipment shall conform to the latest applicable Indian standard / IEC standard. Equipment complying with any other authoritative standards such as British, VDE etc. shall also be considered if offered.
- II. The OLTC gear shall be designed to complete successfully tap changes for the maximum current to which transformer can be loaded i.e. 120% of the rated current. Devices shall be incorporated to prevent tap change when the through current is in excess of the safe current that the tap changer can handle. The OLTC gear shall withstand through fault currents without injury.
- III. When a tap change has been commenced it shall be completed independently of the operation of the control relays and switches. Necessary safeguards shall be provided to allow for failure of auxiliary power supply or any other contingency which may result in the tap changer movement not being completed once it is commenced.
- IV. OLTC shall be a separate compartment & should be external to transformer tank. Oil in compartments which contain the making and breaking contacts of the OLTC shall not mix with oil in other compartments of the OLTC or with transformer oil. Gases released from these compartments shall be conveyed by a pipe to a separate oil conservator or to a segregated compartment within the main transformer conservator. An OSR with shut off valves and MOG shall be installed between OLTC and conservator tank. The OLTC conservator shall be provided with prismatic oil level gauges with red color float. The length and alignment of the MOG and OSR pipe shall be such that, the transformer does not trip by the vibration of the pipe.
- V. Oil in compartments of OLTC which do not contain the make and break contacts, shall be maintained under conservator head through valve pipe connections. Any gas leaving these compartments shall pass through the OSR relay before entering the conservator. The cable entry of OSR should be from bottom end instead from side
- VI. Oil filled compartments shall be provided with filling plug, drain valve with plug, air release vent, oil sampling device, inspection opening with gasket and bolted cover with lifting handles.
- VII. The OLTC motor shall be provided with 415 V auto changeover facilities. Tap

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position indication along with the various alarms of tap changer shall be indicated in the marshalling box.

- VIII.** Separate OLTC tank should be provided at a height lower than that of the main conservator tank so that the same is easily accessible for maintenance.
- IX.** OLTC driving mechanism and its associated control equipment shall be mounted in an outdoor, weather proof cabinet, which shall include:
 - a) Driving motor (415 V - 3 phase, 50 Hz, AC squirrel cage)
 - b) Motor starting contactor with thermal overload relays, isolating switch and HRC fuses.
 - c) End Limit Switch shall be provided to prevent operation beyond extreme taps & Contacts shall be provided for operation through SCADA.
 - d) Limit switch to cut off electrical operation on insertion of manual handle (Contacts shall be provided for operation through SCADA).
 - e) Local/Remote selector switches shall be provided with status indication.
 - f) Control switch: Raise/off/lower (spring return to normal type). (Contacts shall be provided for operation through SCADA).
 - g) Remote/local selector switch (maintained contact type). (Contacts shall be provided for operation through SCADA).
 - h) Mechanical tap position indicator showing rated tap voltage against each position and resettable maximum and minimum indicators.
 - i) Limit switches to prevent motor over travel in either direction & final mechanical stops.
 - j) Brake or clutches to permit only one tap change at a time on manual operation.
 - k) Emergency manual operating device (hand crank or hand wheel).
 - l) Electrically interlocked reversing contactors (preferably also mechanically interlocked).
 - m) 240V, 50 HZ, AC space heaters with switch and MCB.
 - n) Interior lighting fixture with lamp door switch and MCB.
 - o) Gasketed and hinged door with locking arrangement.
 - p) Terminal blocks, internal wiring, earthing terminals and cable glands for power and control cables.
 - q) Necessary relays, contactors, current transformers etc.
 - r) Thermal device or other means shall be provided to protect the motor and control circuit. All relays, switches, fuses etc. shall be mounted in local OLTC control cabinet and shall be clearly marked for the purpose of identification.
 - s) A five digit counter shall be fitted to the tap changing equipment to indicate the number of operation completed.
 - t) The equipment shall be suitable for supervisory control and indication with 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 remote tap position indication.'
 - u) 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.
 - v) OLTC shall be provided with PRV.
 - w) Suitable manholes covers should be provided on the sidewalls to give access to the selector switches of the OLTC. There should be ample access

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for opening /Reconnecting tap-leads to the OLTC from all sides.

- x) Suitable valves shall be provided to take sample of oil from the OLTC chamber during operation of the transformer.

X. The following electrical control features shall be provided:

- a) Positive completion of load current transfer, once a tap change has been initiated, without stopping on any intermediate position, even in case of failure of external power supply.
- b) Only one tap change from each tap change impulse even if the control switches or push button is maintained in the operated position.
- c) Cut-off of electrical control when manual control is resorted to. It shall not be possible to operate the electric drive when the manual operating gear is in the use.
- d) Cut-off of a counter impulse for a reverse tap change until the mechanism comes to rest and resets the circuits for a fresh operation.
- e) Cut-off of electrical control when it tends to operate the tap beyond its extreme position. Mechanical limit switches shall be provided for this purpose to achieve suitable interlocking.

XI. Automatic / Parallel Operation with OLTC:

OLTC shall be able to do automatic / parallel operations through Transformer Monitoring Unit (TMU).

XII. ALARMS:

The following alarms shall be provided with the additional contact arrangement for connection to SCADA.

- a) End Limit Switch
- b) Manual Operation Insertion
- c) A.C. supply failure
- d) Drive motor auto tripped
- e) Tap Stuck up change delayed
- f) OSR trip
- g) MOG Alarms
- h) PRV Trip
- i) TC in Progress.
- j) Any other protective feature, if considered essential by the Bidder.

XIII. Tap Changer Control panel or Transformer Monitoring Unit (TMU): This equipment is not required to be supplied by the bidder of the transformer.

XIV. Auxiliary Power Supply of OLTC, and Power Circuit :

- a) Two auxiliary power supplies, 415 volt, three phase four wire shall be provided by the Purchaser for OLTC and power circuit.
- b) All loads shall be fed by one of the two feeders through an electrically interlocked automatic transfer switch housed in the marshalling box for on load tap changer control.
- c) Design features of the transfer switch shall include the following:
 1. Provision for the selection of one of the feeder as normal source and other as standby.

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2. Upon failure of the normal source, the load shall be automatically transferred after an adjustable time delay to standby sources.
3. Indication to be provided at marshalling box for failure of normal source and for transfer to standby source and also for failure to transfer.
4. Automatic re-transfer to normal source without any intentional time delay following re-energization of the normal source.
5. Both the transfer and the re-transfers shall be dead transfers and AC feeders shall not be paralleled at any time.

XV. Manual Control:

The cranking device for manual operation of the OLTC gear shall be removable and suitable for operation by a man standing at ground level.

The mechanism shall be complete with the following:

- a. Mechanical tap position indicator which shall be clearly visible from near the transformer.
- b. A mechanical operation counter.
- c. Mechanical stops to prevent over-cranking of the mechanism beyond the extreme tap positions.
- d. The manual control considered as back up to the motor operated load tap changer control shall be interlocked with the motor to block motor start-up during manual operation. The manual operating mechanism shall be able to show the direction of operation for raising the HV terminal voltage and vice- versa.

5.16 OIL SURGE RELAY (5 & 8 MVA Only)

Oil Surge Relay should be according to the following general technical parameters as mentioned in below table.

Sl. No.	Description	Unit	Requirements
1	Type of relay		Magnetic reed switch type OSR with 1 set of potential free contact to be used for station DC control Voltage.
2	No. of Switching systems		1
3	Suitable for OLTC		
4	Nominal Pipe Bore	mm	Suitable size
5	Type of Flange		Square
6	Diameter of flange	mm	78 square
7	Diameter of bolt circle	mm	72
8	Number of the bolts		4
9	Size of the bolts		M10
10	Flange Thickness	mm	6 mm
11	Surge Test (TRIP)	cm/s	70 to 130
12	Velocity Test	cm/s	70 to 130
13	Relay operating range: Oil Temperature		10°C to 100°C

14	Relay operating range: Oil Viscosity	66 to 75 centistokes at 10°C, 2 to 3.5 centistokes at 100°C
15	Element Test	With oil, at 1.75Kg/cm ² for 15 minutes,
16	High Voltage Test	Shall be able to withstand 2000 V at 50 Hz for 1 minute
17	Insulation Resistance Test	Shall be Greater than 10 Mega ohms with 500 V megger
18	Porosity Test	With oil, at 1.5 kg/cm ² for 4 hours - There shall not be any leakage or mechanical damage
19	Mechanical Strength Test	With oil at 8 kg/cm ² for 1 minute
20	Resistance of the Switch	Not to exceed 0.1 ohm across the electrodes of magnetic switch
21	Cable entry in terminal box	From bottom side

5.17 PRESSURE RELEASE VALVE

- I. Spring-loaded Pressure Relief Device (PRV) with mechanical flag indicator shall be provided on the main tank top of the transformer.
- II. Oil splashguard along with draining arrangement (with wire net on both side) up to ground level to be provided for prevention of oil splashing.
- III. Arrangement for air-release through a gate valve should be provided at the base of the PRV.
- IV. The PRV shall not be located in the vicinity of the Marshalling Box or OLTC Box for safety of operating personnel.
- V. A pair of potential free contacts shall be provided to trip the transformer on action of the pressure relief device.
- VI. It shall have the limit switch with 2NO and 2NC contacts, flag, switch operated rod etc.
- VII. PRV shall be tested for all the applicable test such as Leakage Test, Switch operation, break down test.

Sl. No	DESCRIPTION	UNIT	REQUIREMENT
1	Operating pressure		0.56 Kg/sq cm
2	Port opening diameter		150 mm
3	Operating time		Instantaneous
4	Contact rating		3A at Controlled DC magnetic blowout micro switch
5	Operating temperature		0 to 100 degree celcius
6	Valve resetting		Automatic
7	Switch		Limit switch DPDT
8	Accuracy class		+ - 1 %
9	Switch resetting		Manual
10	Number of switch		1 limit switch
11	Mechanical protection degree		IP67
12	Suitable for transformer rating	MVA	As per tender
13	Cable Entry		1" conduit

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14	Packing	Supplier shall ensure that the equipment covered by this specification shall be prepared for rail/road transport (local equipment) and be packed in such a manner so as to protect the equipment from damage in transit.
15	Marking	The unit shall be appropriately marked as TATA POWER DISCOM and with the name of the vendor, Manufacturer type/ serial no. and year of manufacturing at suitable location.
16	Warranty	2 years from the date of purchase of Transformer. In case any defects are found, the vendor shall replace the product free of cost.
17	Test Reports	Test certificates to be provided: 1) Protection Class. 2) Cold & Dry Test 3) Vibration Test 4) Salt spray Test 5) Micro switch rating Test
18	Acceptance test	Following tests shall be carried out: 1) Physical Test- Dimensions 2) Switch operation test 3) Valve operation test 4) Leakage Test 5) Insulation Test

5.18 BUCHOLZ RELAY

One double float gas detector relay (Buchholz relay) with alarm and tripping contacts to detect accumulation of gas and sudden changes of oil pressure complete with shut off valves between Relay and Conservator Tank flange-couplings to permit easy removal without lowering oil level in the main tank, a bleed valve for gas venting and test valve. The installation shall be weather proof to avoid any water seepage inside the relay. The cable entry should be from bottom end of Buchholz relay instead from side. **Marking of Magnetic reed type switches shall be available on Buchholz Relay.**

Gas collection device (GCD): Connected to the Buchholz relay gas collection petcock, and is used to collect samples of gas and oil from the Buchholz relay easily from ground level. The colour of collected gas is also very clearly visible in the GCD. SS pipes to connect the GCD to the Buchholz relays to be provided.

Buchholz Relays should be according to the following general technical parameters as mentioned in below table.

Sl. No.	Description	Unit	Requirements
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1	Type of relay		Magnetic reed switch type Buchholz relays suitable for nominal pipe bore of 50 mm with 2 sets of potential free contacts suitable for Stationed controlled DC Voltage.
2	No. of Switching systems		2
3	Suitable for Transformer Rating	MVA	As per tender
4	Nominal Pipe Bore	mm	50
5	Type of Flange		Round
6	Diameter of flange	mm	185
7	Diameter of bolt circle	mm	145
8	Number of the bolts		4
9	Size of the bolts		M16
10	Flange Thickness	mm	16
11	Surge Test (TRIP)	cm/s	90 to 160
12	Gas Volume (ALARM)	cc	200 to 300
13	Velocity Test	cm/s	90 to 160
14	Relay operating range: Oil Temperature		10°C to 100°C
15	Relay operating range: Oil Viscosity		65 to 75 centistokes at 10°C, 2 to 3.5 centistokes at 100°C
16	Element Test		With oil, at 1.75Kg/cm ² for 15 minutes,
17	High Voltage Test		Shall be able to withstand 2000 V at 50 Hz for 1 minute
18	Insulation Resistance Test		Shall be Greater than 10 Mega ohms with 500 V megger
19	Porosity Test		With oil, at 1.5 kg/cm ² for 4 hours - There shall not be any leakage or mechanical damage
20	Mechanical Strength Test		With oil at 8 kg/cm ² for 1 minute
21	Resistance of the Switch		Not to exceed 0.1 ohm across the electrodes of magnetic switch
22	Cable entry in terminal box		From bottom side

5.19 OTI

A dial-type indicating thermometer of robust pattern mounted on the side of the transformer at a convenient height to read the temperature in the hottest part of the oil and fitted with alarm and trip contacts and contacts for switching in and switching out the cooling system at predetermined temperatures.

5.20 WTI

There shall be one WTI on LV side

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- I. It shall be indicating type, responsive to the combination of top oil temperature and winding current, calibrated to follow the hottest spot temperature of the transformer winding.
- II. The winding temperature detector shall operate a remote alarm in the event the hottest spot temperature approaches a dangerous level and in the case of ONAN (Oil Natural and Air Natural) Thus WTI shall have 4 independent NO contacts for alarm and trip and spare.

Note:

- I. **Equipment for remote winding and oil temperature Indicators** including these to be installed in the TATA POWER DISCOM control room shall be provided. Pocket with heater coil and CT for RTD for winding hot spots shall be provided.
- II. **For purpose of remote recording and data acquisition system**, Top oil temperature detector along with suitable transducer and other necessary devices to provide two sets of 4-20 mA signals with PT-100 type of sensors.
- III. Tap changer indicator of OLTC along with suitable transducer and other necessary devices to provide two sets of 4-20 mA signals along with one set of 1-16K resistance output shall be provided.
- IV. All digital outputs for remote annunciation/control/DAS shall be provided with two changeover (NO) contacts for alarm condition and two changeover (NO) contacts for trip condition. The OTI & WTI shall be provided with micro switches, instead of mercury switches for alarm and trip purpose. All the interconnected wiring between TJB, Marshalling box and OLTC etc. shall be done by the bidder and schematics drawings of the same shall be supplied.
- V. Digital OTI & WTI is preferable because easy integration with TMU.

5.21 VALVE

- I. Valves shall be of forged carbon steel up to 50mm size and of gun metal or of cast iron bodies with gunmetal fittings for sizes above 50mm. They shall be of full way type with screwed ends and shall be opened by turning counter clockwise when facing the hand wheel. There shall be no oil leakage when the valves are in closed position.
- II. Each valve shall be provided with an indicator to show the open and closed positions and shall be provided with facility for padlocking in either open or closed position. All screwed valves shall be furnished with pipe plugs for protection. Padlocks with duplicate keys shall be supplied along with the valves.
- III. All valves except screwed valves shall be provided with flanges having machined faced drilled to suit the applicable requirements, Oil tight blanking plates shall be provided for each connection for use when any radiator is detached and for all valves opening to atmosphere. If any special radiator valve tools are required the OEM shall supply the same.
- IV. Each transformer shall be provided with following valves on the tank:
 - a) Drain valve so located as to completely drain the tank & to be provided with locking arrangement.
 - b) Two filter valves on diagonally opposite corners of 50mm size & to be provided with locking arrangement.
 - c) Oil sampling valves not less than 8mm at top and bottom of main tank & to be provided with locking arrangement.
 - d) One 15mm air release plug.
 - e) Valves between radiators and tank.
 - f) Drain and filter valves shall be suitable for applying vacuum as specified in the

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specifications.

5.22 MOG:

One magnetic-type oil-level gauge each in Main Tank and OLTC Tank with low and high level alarm contacts for main tank MOG and low level alarm for OLTC tank MOG and a dial showing minimum, maximum and normal oil levels. The gauge shall be readable from the transformer base level. It should have cable disconnecting facility at top of MOG, to facilitate testing of MOG. Along with MOG, prismatic type oil level indicator (glass window) shall also be provided on conservator.

SI. No.	DESCRIPTION	UNIT	REQUIREMENTS
1	Mounting Pad Diameter	Mm	150
2	Electric Switch		Two no's Micro Switches / Mercury switch
3	Contact Rating		5 Amps 240V AC, 0.25 Amp, Stationed DC Controlled Voltage.
4	Switch Operation		Normally open, closes when oil level drops to near empty condition. Switch recovers automatically on rising of oil level
5	Mounting of indicator		Vertical
6	Dial Marking		Maximum, Minimum, 1/4, 1/2 & 3/4
7	Movement of float arm		In the plane perpendicular to seating face
8	Conservator Dia	Mm	500-700 mm (As per Tank Size and OEM Type Tested Design)
9	Air cell in conservator		Yes
10	Switches for		Low Oil level Alarm, High oil level Alarm.
11	Colour		Black marking with white/yellow background.
12	Readable from transformer base level		Yes
13	Cable disconnecting facility at top of MOG to facilitate testing of MOG		Yes
14	Mechanical Protection degree		IP55
15	Suitable for transformer Rating	MVA	As per tender requirement
16	Packing		Supplier shall ensure that the equipment covered by this specification shall be prepared for rail/road transport (local equipment) and be packed in such a manner so as to protect the equipment from damage in transit.

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17	Marking	The unit shall be appropriately marked as "TATA POWER DISCOM" and with the name of the vendor, Manufacturer type / serial no. and year of manufacturing at suitable location.
18	Warranty	2 years from the date of purchase of Transformer. In case any defects are found, the vendor shall replace the product free of cost.

5.23 Marshalling Box

- I. Marshalling Box suitable for distribution of 3 phase 4 wire, 415V power to various equipment shall be provided. Separate ground mounted marshalling box shall be provided for radiator banks, WTI, OTI, transducers, at least two (2) sets of 4-20mA converter cum indicator etc. and similarly tank mounted marshalling box shall be provided for HV/LV CT cable terminals. Two point earthing provision should be provided with 50X6mm GI flat with pad type connector, length should be of min. 80 mm. The marshalling box should include indication circuit with station controlled DC supply. All FRLS cables and conduits between the transformer and control cabinet shall be included in the scope of supply by bidder. All the wiring shall have provision for connection to SCADA.
- II. Two sets of independent, potential free contacts shall be provided for various alarms/trips as detailed below. The auxiliary voltage for alarm/ trip circuit shall be station controlled DC for 33/11kV Transformer).
For PTR # Potential free contacts is required for
 - a. Buchholz alarm
 - b. OTI alarm
 - c. WTI alarm (LV Side WTI CT)
 - d. MOG (main) alarm
 - e. Buchholz trip
 - f. OTI trip
 - g. WTI trip (LV based on WTI CT)
 - h. PRV trip
 - i. MOG (OLTC) Alarm
 - j. OSR trip
 - k. AC supply fail
 - l. Motor Auto Trip
 - m. Air-cell leakage detection

One sets of spare potential free contacts shall be provided for all alarms for remote annunciation through TATA POWER DISCOM SCADA panels suitable Transducers shall be provided for 4-20mA signals for tap position indication to the TATA POWER DISCOM SCADA panel. The variation in output signals shall be linear for the complete tapping range.

In addition to above, following potential free contacts/signals shall be provided in the marshalling box (whichever is applicable) for its interfacing with transformer monitoring unit or other approved make by TATA POWER DISCOM.

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Sl. No	Item	Provision
1	Supply of ON lamp 3 nos. R,Y,B	To be provided
2	Secondary of Control Transformer from the OLTC	Terminals shall be provided in Marshalling box
3	Tap Position Indicator	4-20 MA Signal in Marshalling box
4	Over Current Relay contact	Potential Free Contact in Marshalling box
5	Local remote Switch in OLTC	Potential Free Contact in Marshalling box
6	Raise Lower Switch	Potential Free Contact in Marshalling box
7	Hand interlocking Switch	Potential Free Contact in Marshalling box
8	Tap Change in progress	Potential Free Contact in Marshalling box
9	Odd even Switch	Potential Free Contact in Marshalling box
10	Maximum position reached	Potential Free Contact in Marshalling box
11	Minimum position reached	Potential Free Contact in Marshalling box
12	OTI	4-20mA Signal in Marshalling box
13	Annunciation - Oil level low & High (Main) - Oil level low (OLTC) - Winding Temp. High (HV+ LV) - Oil Temp High - B' relay Alarm - Winding temp trip (HV+LV) - Oil temp trip - B' relay trip - PRV trip for main & OLTC both - OSR trip -Air-cell leakage detection	Potential Free Contact in Marshalling box
14	Auto manual selector switch	Potential Free Contact in Marshalling box
15	Supply ON lamp 3 nos. (R,Y,B)	To be provided
16	Secondary of Control Transformer from the OLTC	TBs shall be provided

- III. The Enclosure shall be weather proof, sheet steel construction, not less than 3 mm thick. Degree of protection shall be IP55 minimum with Canopy. It shall be provided with two hinged doors one at front and one at back with locking knobs facilities. The doors shall open through 1800. Doors shall have glass window for viewing of OTI & WTI from outside when door is closed. Doors and glass windows shall have proper gaskets for vermin proof and dust tight arrangement. Proper extended rain shed shall be provided.

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- IV. Accessories: All accessories shall be mounted properly in suitable channel inside the box. The MCBs shall be mounted on a DIN channel by a MS plate with cut-out for MCBs knobs. This shall be covered by a hinged door on the front. Power cable wiring of MCBs to individual contactors shall be done through good quality copper cable of suitable rating with ferrule marking and suitable lugs at both ends. 2.5sqmm stranded copper cable with ring type lugs shall be used for control cabling purpose. All instrument and wiring shall be completely accessible.

Sl. No.	Item	Make	Rating	Quantity
1	Main Incomer MCB 3 Pole	Siemens/ABB/L&T	63 A	02 Nos.
2	3 Pole MCB	Siemens/ABB/L&T	6 A	12 Nos.
3	3 Pole MCB	Siemens/ABB/L&T	10A	10 Nos.
4	3 Pole MCB	Siemens/ABB/L&T	16 A	10 Nos.
5	Connector/Terminals	Wago or Phoenix, (Suitable for ring type lugs)	Suitable for 2.5 sq.mm. control cable	To accommodate all the wiring as mentioned below. Additional 10% terminals shall be provided as spare
6	Contactors, starter and relays	Siemens, L&T, English Electric		

- V. Following Tests shall be carried out on the Marshalling Box:
- Functional tests / 2kV withstand.
 - Dimensional checks.
 - Make and operation of contactors, relays.
 - Factory test report attached for bought out items.
 - Test for Enclosure Protection.

5.24 CENTRE OF GRAVITY & CENTRE LINE

MARKING 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 on the outline drawing.

CENTRAL LINE MARKING

Central line of the transformer, tank, etc. shall be marked properly with indication to avoid any confusion during installation of the transformer

5.25 ANTI RUSTING CORROSION TREATMENT

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- I. The bidder shall ensure that all fabrication i.e. transformer tank, radiators, marshalling boxes and other accessories are treated for highest quality performance for the entire life of the transformer. The Bidder shall submit plan for extra measures he is taking for prevention of corrosion, along with the offer.
- II. Finishes on transformer and appurtenant parts, edges (exposed to atmosphere)
- III. No gas cut edge on surface shall be acceptable unless smoothly ground to plane surface without irregular projections and corners (which cannot be blasted to the required roughness).
- IV. For all radiators (If Specifically Mentioned) the following painting procedure shall be followed. The metal spray (99.95% assay zinc) to a thickness about 100 microns with surface roughening and two coats of paints with proper supervision and quality checks. Bidder shall indicate separate price for metal spray of radiators.
- V. In this corrosion prevention measure it is imperative that the job is fully monitored for optimizing the proper conduct of the procedure as given in the various national standards. The coating shall be as per BS: 2569 (latest revision). The coating requirement shall be to BS: 5493 Gr. SC10Z.
- VI. The Bidder shall submit a Quality Plan, giving the parameters and checking methods, (major, critical, minor).
- VII. The paint shade used shall be shade 631 as per IS: 5.

5.26 MAKE OF MAJOR COMPONENTS & RAW MATERIALS

The BA shall procure the following constituent items from the designated vendors as follows:

S.no	RAW MATERIAL/EQUIPMENT	MAKE
a)	Copper	M/S Sterlite, M/S Hindustan Copper, M/S Hindalco , M/s NALCO etc.
b)	Core	M/S AK Steels, POSCO, Kawasaki/ JFE, Nippon Steel, Thyssenkrup etc.
c)	Insulation paper and Pressboards	ITC paper, ABB, Raman Boards- Mysore, Senapathy Whiteley – Bangalore
d)	Transformer Oil (Mineral oil)	Savita, Apar, Gandhar ,Columbia, IOCL
e)	Gaskets & Corks	Nu Cork, Anchor Corks
f)	Steel For Tank	M/s, TATA Steel, M/s SAIL, M/s. JSW Steel, M/s. IISCO, M/s. RINL/Vizag Steel, M/s. Jindal Steel,
g)	Dehydrating Breather	Yogya, Anushree, Electrical engineers
h)	Bucholz, PRD, OTI , WTI, and other devices	Reputed make to be approved by TATA POWER DISCOM during detailed engineering.
i)	Bushing	CJI,JP,GE etc.

Also, Bidder has to provide all test certificates from original manufacturers & relevant sourcing documents. BA shall also have shot blasting facility

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6. NAME PLATE AND MARKING RATING PLATE

- I. A stainless steel rating plate, of at least 1 mm thickness, shall be fitted to each transformer in a visible position and shall carry all the information as specified in the standards. **QR code shall be provided on name plate. QR code shall content the name plate details, approved GTP/Drawing and a video of overall functionality of transformer & associate components.**
- II. Sign writing shall also be provided as per the format attached with this specification.
- III. The letters on the rating plate shall be engraved black on the white/silver back ground.
- IV. Fixing screws for outdoor use shall be of stainless steel or any other corrosion resistant metals.
- V. The Name plate shall be embossed with “PO no. with date” & “TATA POWER DISCOM”.
- VI. Danger notice shall have red lettering written in English, Hindi and Local language on a white background or they may be pictorial as approved by the TATA POWER DISCOMs.
- VII. The name plate shall contain following information:
 - a. Type of transformer (Two Winding Transformer)
 - b. Relevant standard.
 - c. Manufacturer’s Name
 - d. Manufacturer’s Serial No.
 - e. Year of Manufacture (MM/YYYY)
 - f. No. of phases
 - g. Rated kVA
 - h. Rated frequency
 - i. Rated Voltage
 - j. Rated current
 - k. Connection symbol
 - l. Percentage impedance voltage at rated current.
 - m. Type of cooling (ONAN).
 - n. Total Mass
 - o. Mass and Volume of insulating Oil.
 - p. Connection diagram showing the internal connections.
 - q. Temperature rise
 - r. Insulation levels of the windings, including neutral end of windings with non-uniform insulation.
 - s. Transportation weight
 - t. Untanking weight.
 - u. Core and windings weight
 - v. Table giving the tapping voltage, tapping current and tapping power for each tapping.
 - w. Values of short circuit impedance on the extreme tapings and on the principal tapping and indication of the winding to which the impedance is related.
 - x. A table of all guaranteed particulars.
 - y. Quantity of oil required for normal filling.
 - z. HV and LV phase to phase clearances.
 - aa. Vector diagram
 - bb. Indication of the winding which is fitted with tapping.

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- cc. Table giving the tapping voltage, the tapping current and the tapping power of each winding, for each tap.
- dd. Value of short circuit impedance on the extreme tapping and on the principal tapping and indication of the winding to which the impedance is related.
- ee. Information of the ability of the transformer to operate at a voltage exceeding 110% of the tapping voltage or for the principal tapping and 110% of the rated voltage.
- ff. Tan delta value of insulating oil and kraft paper of transformer.

VALVE SCHEDULE PLATE

The name plate shall contain information of all the valves, their locations, quantities and schematic for the valves

OLTC PLATE (3.15, 5 & 8 MVA PTR)

The name plate shall contain following information:

- I. Type
- II. Sl. No.
- III. Year of Manufacturing (MM/YYYY)
- IV. Motor
 - a. Operating Voltage
 - b. Normal Working Current
 - c. Max. rated Though current
- V. Phase
- VI. Frequency (Hz)
- VII. Steps (Numbers)
- VIII. Step Voltage
- IX. Weight / Volume
 - a. Tap Changer without Oil (Kg)
 - b. Oil (Kg)
 - c. Total
- X. Control Voltage (V)
- XI. Transition Resistance (Ohms)

MARSHALLING BOX & OLTC BOX:

- I. Manufacture's Name
- II. Manufacture's Serial No.
- III. Year of Manufacturing (MM/YYYY)
- IV. Purchase Order No.

The following shall be clearly mentioned / Engraved on the Plate: "TATA POWER DISCOM".
Engraved drawing of control circuit, CT / PT circuit and TB shall be available on Marshalling Box and OLTC Box.

OIL FILLING INSTRUCTION PLATE FOR CONSERVATOR

The name plate shall contain

- I. Step wise process for filling oil in conservator
- II. Table of fittings with functions
- III. Conservator diagram with oil filling process
- IV. Precautions in detail

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7. TESTS:

All routine, acceptance & type tests shall be carried out in accordance with the IS 2026 relevant standards, & TATA POWER DISCOM approved QAP. All routine & acceptance tests shall be witnessed by the TATA POWER DISCOM/his authorized representative. All the components and fittings shall also be type tested as per the relevant standards.

Following tests shall be necessarily conducted on the Power Transformers in addition to others specified in IS/IEC standards. Test for the OLTC shall be done as per the IS 8468

7.1 ROUTINE TESTS

Transformer routine tests shall include tests stated in latest issue of IS: 2026 (Part –1). These tests shall also include but shall not be limited to the following:

- 1) Measurement of Winding Resistance.
- 2) Measurement of voltage ratio, polarity and vector group check.
- 3) Measurement of short impedance and load loss at 50% and 100% load.
- 4) Measurement of no load losses and magnetizing current at rated frequency and 90%, 100% and 112.5% of rated voltage
- 5) Measurement of insulation resistance.
- 6) Dielectric Test.
- 7) Test on-Load Tap Changer (Applicable for 3.15, 5 & 8 MVA PTR)
- 8) Measurement of Zero-sequence impedance on three phase transformer.
- 9) All CTs and resistance of image coil for winding temperature indicator shall be checked for ratio test, polarity and knee point voltage test.
- 10) Determination of Capacitances and dissipation factor winding-to-earth and between windings.
- 11) Magnetic balance test.
- 12) Measurement of Magnetizing current at low voltage.
- 13) Vacuum withstand test on tanks and radiators.
- 14) The total Losses shall comprise of the No Load Losses, Load Losses (I^2R loss + stray loss) and Auxiliary Losses at rated output duly converted at 75 °C average winding temperature and shall also be indicated in the test report. Load losses shall be that corresponding to rated load on HV, LV windings.
- 15) Physical Verification of complete Transformer with all assembly including test rollers, radiators etc.
- 16) Voltage Regulation at rated load and at unit, 0.9, 0.8 lagging power factor.
- 17) Measurement of Acoustic Noise Level.
- 18) Functional tests on auxiliary equipment:-
 - a. Test on OTI and WTI
 - b. High Voltage test on insulation test for Auxiliary Wiring
 - c. High Voltage test on insulation test for Auxiliary Wiring
- 19) Test on Oil filled in Transformer (Transformer tank as well as OLTC tank)
 - a. Dielectric strength of oil
 - b. Water content
 - c. Dielectric dissipation factor (tan delta at 90° celcius)
 - d. Resistivity.
- 21) Induced over voltage withstand test.

- 22) Separate Source voltage withstand test.
- 23) Oil Pressure test on completely assembled transformer at 0.35kg/sq.cm for 8 hrs.
- 24) BDV and moisture content of oil in transformer
- 25) Neutral Unbalance Test: Measurement of Neutral current during load loss test which shall not be more than 2% of the rated current of the transformer.

7.2 TYPE TESTS

The type tests to be carried out by the Bidder shall include but not limited to the following:

- 1) Measurement of winding resistance.
- 2) Measurement of voltage ratio and check of voltage vector relationship.
- 3) Measurement of impedance voltage / short-circuit impedance (Principal tapping) and load loss.
- 4) Measurement of no load loss and current.
- 5) Measurement of insulation resistance.
- 6) Dielectric Test.
- 7) Temperature rise for determining the maximum temperature rise after continuous full load run. The ambient temperature and time should be stated in the test certificate.
- 8) Tests on on-load tap-changer.
- 9) Short Circuit withstand test.
- 10) Test to verify IP55 of Marshalling and cable boxes(if applicable)
- 11) Lightning Impulse voltage test with chopped wave.

Note: The bidder shall submit the test report from CPRI or ERDA for the tests mentioned above.

Following type tests shall be carried out on one transformer of each rating, at the works of the bidder, in presence of TATA POWER DISCOM representative.

- a. Temperature rise test including DGA (DGA shall be done before & after the heat run test)
- b. Impulse Test (Including chopped wave on all the three limbs of HV & LV)

TYPE TESTS, ROUTINE TEST & ACCEPTANCE TEST OF MOG & OSR

All routine, acceptance & type tests shall be carried out in accordance with the relevant IS/IEC. All routine & acceptance tests shall be witnessed by the TATA POWER DISCOM/his authorized representative. All the components shall also be type tested as per the relevant standards. Following tests shall be necessarily conducted on the Joint and Termination Kits in addition to others specified in IS/IEC standards

Type Test

- a) Porosity test
- b) High voltage and insulation resistance test
- c) Elements test
- d) Gas Volume test
- e) Loss of oil and surge test
- f) Mechanical strength test
- g) Velocity calibration test

Routine Tests

- a) Porosity test
- b) High voltage and insulation resistance test
- c) Elements test
- d) Gas Volume test
- e) Loss of oil and surge test

Acceptance Tests

- a) Visual Inspection
- b) Porosity test
- b) High voltage and insulation resistance test
- c) Elements test
- d) Gas Volume test
- e) Loss of oil and surge test
- f) Mechanical strength test
- g) Velocity calibration test

SPECIAL TEST

The following tests shall be carried out by mutual agreement between the TATA POWER DISCOM and the bidder. All Tests shall be done as per the relevant standard. Test certificates shall be submitted for bought out items. High voltage withstand test shall be performed on auxiliary equipment and wiring after complete assembly.

- a. Measurement of the harmonics of the No-Load Current
- b. Determination of transient voltage transformer characteristics
- c. Measurement of insulation resistance to earth of the windings, and / or measurement of Dissipation factor ($\tan \delta$) of the insulation system capacitances. (These are reference values for comparison with later measurement in the field. No limitation for the values are given here.)
- d. Lightning impulse test on Neutral terminals
- e. Magnetic circuit (isolation) test
- f. SFRA Test.

7.3 ACCEPTANCE TEST :

- 1) Transformer of the offered lot shall be subjected to all the tests mentioned under the section 'ROUTINE Test' in presence of TATA POWER DISCOM representative at the place of manufacture before dispatch without any extra charges. The testing shall be carried out in accordance with IS: 2026.
- 2) Oil Leakage test for acceptance shall be conducted at pressure of 0.35kg/sq.cm for one hour as per IS2026.
- 3) Temperature Rise Test (on one unit of first lot against every Rate contract / PO for each rating, for further lots against the same RC, TATA POWER DISCOM reserves the right to perform Temperature rise if required) [As per IS 2026 (Part 2) Clause no.4]
- 4) The painted surface shall pass the Cross Adhesion Test (IS1180 part 1 clause no. 21.4.d).
- 5) At stage inspection -Checking of weight, dimensions, fitting and accessories, tank sheet thickness, oil quantity, material finish and workmanship, physical verification of core coil

assembly and measurement of flux density on one unit of each rating of the offered lot with reference to the GTP and contract drawings.

- 6) At Final inspection, the incoming raw material and its movement/consumption record in the related jobs of TATA POWER DISCOM will be verified by inspecting officer. In case of any deviation or non-availability of such records, the offered lot may get rejected.

8. TYPE TEST CERTIFICATES:

The Bidder shall furnish the type test certificates of the Two Winding Power Transformer for the tests as mentioned above as per the corresponding standards. All the tests shall be conducted at CPRI / ERDA as per the relevant standards. Type tests should have been conducted in during the period not exceeding 5 years from the date of opening the bid. In the event of any discrepancy in the test reports, i.e. any test report not acceptable or any/all type tests (including additional type tests, if any) not carried out, same shall be carried out without any cost implication to the TATA POWER DISCOM.

Note: Type test Validity will be as per CEA guideline.

9. PRE-DISPATCH INSPECTION:

1. Equipment shall be subject to inspection by a duly authorized representative of the TATA POWER DISCOM. Inspection may be made at any stage of manufacture at the option of the TATA POWER DISCOM and the equipment if found unsatisfactory as to workmanship or material, the same is liable to rejection.
2. Bidder shall grant free access to the places of manufacture to TATA POWER DISCOM's representatives at all times when the work is in progress.
3. Inspection by the TATA POWER DISCOM or its authorized representatives shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specifications.
4. Material shall be dispatched after specific MDCC (Material Dispatch Clearance Certificate) is issued by TATA POWER DISCOM.

Following documents shall be sent along with material:

- a. Test reports
- b. MDCC issued by TATA POWER DISCOM
- c. Invoice in duplicate
- d. Packing list
- e. Drawings & catalogue
- f. Guarantee / Warrantee card
- g. Delivery Challan
- h. Other Documents (as applicable)

5. In respect of raw material such as core stampings, winding conductors, insulating paper and oil, bidder shall use materials manufactured/supplied by standard manufacturers and furnish the manufacturers' test certificate as well as the proof of purchase from these manufacturers (excise gate pass) for information of the TATA POWER DISCOM. The bidder shall furnish following documents along with their offer in respect of the raw materials:

- a. Invoice of supplier
- b. Mill's certificate
- c. Packing List
- d. Bill of Landing
- e. Bill of entry certificate by custom

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6. After the main raw-material i.e. core and coil material and tanks are arranged and transformers are taken for production on the shop floor, to ensure the quality of transformers, the inspection shall be carried out by the TATA POWER DISCOM's representative at following stages:

- a. **Stage Inspection I** – Bidder has to facilitate for stage inspection of Tank, HV and LV windings and Core of the offered transformers. Dye Penetration test to be done in presence of Tata Power DISCOM representative. Bidder has to facilitate for stage inspection of Tank, HV and LV windings in one inspection call without any extra charges. Multiple inspections calls for stage inspection-I will not be considered and the delay will be accountable at bidder end. At this stage checking of weights, dimensions, tank sheet thickness, Pressure and vacuum test and quality of material, finish & workmanship as per GTP/QA Plan and approved drawings. During stage inspection TATA POWER DISCOM reserves the rights to dismantle the assembled core to ensure that the CRGO laminations used are of good quality.
- b. **Stage inspection II** – Bidder has to facilitate for stage inspection -II for Core coil assembly of the offered transformers in without any extra charges. The testing shall be carried out in accordance with IS: 2026 and as per GTP/QA plan/Drawing.
Note: For Stage inspection, Annexure –I will be referred.
- c. **Final Inspection** - Bidder has to facilitate for final inspection once the offered transformer is ready for dispatch. Inspection will be done as per w.r.t tests mentioned in Clause 7.2 and inspection test plan format in Annexure-II.

7. To ascertain the quality of the transformer oil, the original manufacturer's tests report shall be submitted at the time of inspection. Arrangements shall also be made for testing of transformer oil, after taking out the sample from the manufactured transformers and tested in the presence of TATA POWER DISCOM's representative.

8. The Bidder shall intimate the TATA POWER DISCOM in advance for inspection, so that an officer for carrying out inspection could be deputed, as far as possible within 07days (Within Delhi)/ 12_Days (outside Delhi) from the date of intimation.

9. Further, about the readiness of the transformers, for final inspection for carrying out tests as per relevant IS/IECs shall be sent by the Bidder along with routine test certificates. The inspection shall normally be arranged by the TATA POWER DISCOM at the earliest after receipt of offer for pre-delivery inspection.

10. In case of any defect/ defective workmanship observed at any stage by the TATA POWER DISCOM's Inspecting officer, the same shall be pointed out to the Bidder in writing for taking remedial measures. Further processing shall only be done after clearance from the inspecting officer / TATA POWER DISCOM.

11. All tests and inspection shall be carried out at the place of manufacture unless otherwise specifically agreed upon by the manufacturer and TATA POWER DISCOM at the time of purchase/tender.

12. The manufacturer shall offer the inspector representing the TATA POWER DISCOM all reasonable facilities, without charges, to satisfy him that the material is being supplied in accordance with this specification. This will include Stage Inspection during manufacturing stage as well as during Acceptance Tests.

13. The bidder shall provide all services to establish and maintain quality of workmanship in his works and to ensure the mechanical / electrical performance of components, compliance with drawings, identification and acceptability of all materials, parts and equipment as per latest quality standards of ISO 9000.

14. The TATA POWER DISCOM has the right to have the test carried out at his own by an independent agency wherever there is a dispute regarding the quality supplied. TATA POWER DISCOM has right to test 1% of the supply selected either from the stores or field to check the quality of the product. In case of any deviation TATA POWER DISCOM have every right to reject the entire lot or penalize the bidder, which may lead to blacklisting, among other things. _

10. INSPECTION AFTER RECEIPT AT SITE/STORE:

Inspection at site:

After erection at site, the transformers shall be subjected to the following tests and the bidder shall guarantee results of test certificates under service conditions.

- a. Measurement of winding resistance
- b. Measurement of voltage ratio and check of voltage vector relationship
- c. Measurement of magnetizing current.
- d. Magnetic balance test on three phase transformer
- e. Magnetic circuit (isolation) test
- f. Measurement of short circuit Impedance at low voltage
- g. Insulation resistance measurement
- h. Dielectric Test on oil.
- i. Determination of Capacitances and dissipation factor winding-to-earth and between windings.
- j. Bushing Capacitance and $\tan \delta$
- k. Test on other Auxiliaries
- l. No-Load and Excitation current
- M. Measurement of Neutral current during load loss test which shall not be more than 2% of the rated current of the transformer

This is for bidder's information that tests at site may be in bidder's scope based on mutual agreement between bidder and TATA POWER DISCOM's. However, in any case bidder shall be required to send their engineer to confirm that the erection & commissioning is done in a satisfactory manner.

TATA POWER DISCOM holds the discretion to obligate the bidder to carry out certain additional tests (e.g. SFRA, HV tan delta etc.) on transformer, for cross-checking and confirming the quality of incoming equipment owing to damages/deterioration that might have been caused during transportation/handling etc.

Inspection at Store:

- a) The material received at TATA POWER DISCOM store shall be inspected for acceptance and shall be liable for rejection, if found different from the reports of the pre-dispatch inspection and one copy of the report shall be sent to Project Engineering department.
- b) In case the transformers proposed for supply against the order are not exactly as per the tested design, the Bidder shall be required to carry out the short circuit test and impulse voltage withstand test at its own cost in the presence of the representative of the TATA POWER DISCOM. The supply shall be accepted only after such test is done successfully, as it confirms on successful withstand of short circuit and healthiness of the active parts thereafter on un-tanking after a short circuit test. Apart from dynamic ability test, the transformers shall also be required to withstand thermal ability test or thermal withstand ability will have to be established by way of calculations.
- c) The TATA POWER DISCOM reserves the right to conduct all tests on Transformer after arrival at site / stores and the manufacturer shall guarantee test certificate figures under actual service conditions.

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- d) The TATA POWER DISCOM reserves the right to conduct short circuit test and impulse voltage withstand test in accordance to IS, afresh on each ordered rating at TATA POWER DISCOM cost, even if the transformer of the same rating and similar design are already tested. This test shall be carried out on a transformer to be selected by the TATA POWER DISCOM either at the manufacturer's works when they are offered in a lot for supply or randomly from the supplies already made to TATA POWER DISCOM stores. The findings and conclusions of these tests shall be binding on the bidder.
- e) Test at TATA POWER DISCOM store/Site: after receipt of transformers at TATA POWER DISCOM stores/Site, following minimum tests will be carried out.
1. Total weight of the transformer. (It should be as per the offer, subjected to tolerance as per approved drawings & GTPs)
 2. Oil level in the transformer
 3. Verifications of all the fittings
 4. Physical verification of all the transformers for any damages, oil leakage, quality of painting etc.
- f) Test at site: The TATA POWER DISCOM reserves the right to conduct all tests on Transformer after arrival at site/stores and the manufacturer shall guarantee test certificate figures under actual service conditions.
- g) Shock/Impact recorder data analysis to be submitted by bidder to ascertain the concealed damage. (SFRA to be done before energising the PTR at site).

11. GUARANTEE:

- I. Bidder shall stand guarantee towards design, materials, workmanship & quality of process/ manufacturing of items under the contract for due and intended performance of the same, as an integrated product delivered under this contract.
- II. In the event any defect is found by the TATA POWER DISCOM up to a period of 48 months from the date of commissioning or 60 months from the date of last supplies made under the contract, whichever is earlier.
- III. Bidder shall be liable to undertake to replace/rectify such defects at his own costs, within mutually agreed timeframe, and to the entire satisfaction of the TATA POWER DISCOM, failing which the TATA POWER DISCOM will be at liberty to get it replaced/rectified at Bidder's risks and costs and recover all such expenses plus the TATA POWER DISCOM's own charges (@ 20% of expenses incurred), from the Bidder or from the "Security cum Performance Deposit" as the case may be.
- IV. In case of Two Winding Power Transformer fails within the guarantee period the TATA POWER DISCOM will immediately inform the Bidder who shall take back the failed Two Winding Power Transformer within 15 days from the date of intimation at his own cost and replace / repair the transformer within forty five days of date of intimation with a roll over guarantee.
- V. The outage period i.e. period from the date of failure till unit is repaired / replaced shall not be counted for arriving at the guarantee period. Bidder shall further be responsible for 'free replacement' for another period of THREE Years from the end of the guarantee period for any 'Latent Defects' if noticed and reported by the TATA POWER DISCOM.

12. PACKING AND TRANSPORT:

1. Bidder shall ensure that all the equipment covered under this specification shall be prepared for rail/road transport in a manner so as to protect the equipment from damage in transit.
2. The packing may be in accordance with the bidder's standard practice but he should give full particulars of packing for the approval of the TATA POWER DISCOM. Special

- arrangement should be made to facilitate handling and to protect the projecting connections from damage in transit.
3. The transformer shall be shipped filled with oil up to transport oil level guage. If transformer is transported without Oil or partially filled, the tank shall be filled with Nitrogen under pressure complete with gas cylinder reducer, connection and pressure gauges. (After testing dew point of the Nitrogen filled. Dispatch clearance will be given only after achieving satisfactory dryness i.e. dew point measurement results). These accessories will be part of purchase. However, if neutral grounding transformer and reactors are included in the scope, these can be transported with oil. (Whichever way desired by the TATA POWER DISCOM depending on the size etc.)
 4. Provisions for monitoring of oil and gas pressure during transport and storage and a make-up Nitrogen cylinder shall be made.
 5. Bushings shall be packed in proper containers for transport.
 6. All parts shall be adequately marked to facilitate field erection.
 7. Boxes and crates shall be marked with the contract number and shall have a packing list enclosed showing the parts contained therein.
 8. Unloading, dragging of transformer up to 50mtrs & keeping it on foundation at TATA POWER DISCOM site/stores will be in the scope of supplier. The bidder shall take care of this point while quoting the rates for Freight & Insurance charges.
 9. A Shock recorder also shall be provided during transport. Data of the same shall be shared during execution.

13. TENDER SAMPLE : (N/A)

14. QUALITY CONTROL:

1. The bidder shall submit with the offer Quality assurance plan indicating the various stages of inspection, the tests and checks which will be carried out on the material of construction, components during manufacture and bought out items and fully assembled component and equipment after finishing.
2. As part of the plan, a schedule for stage and final inspection within the parameters of the delivery schedule shall be furnished.
3. The TATA POWER DISCOM's engineer or its nominated representative shall have free access to the manufacturer's/sub-supplier's works to carry out inspections.
4. The Bidder shall invariably furnish following information along with his bid, failing which the bid shall be liable for rejection. Information shall be separately given for individual type of equipment offered.
 - i. Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards according to which the raw materials are tested.
 - ii. List of tests normally carried out on raw materials in the presence of Bidder's representative, copies of test certificates.
 - iii. Information and copies of test certificates as in (I) above in respect of bought out accessories.
 - iv. List of manufacturing facilities available.
 - v. **Level of automation achieved and list of areas where manual processing exists.**
 - vi. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspection.
 - vii. List of testing equipment available with the bidder for final testing of equipment along with valid calibration reports shall be furnished with the bid. Manufacturer shall possess 0.1 class instruments for measurement of losses.
 - viii. Quality Assurance Plan (QAP) withholds points for TATA POWER DISCOM's inspection.

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5. The successful Bidder shall within 30 days of placement of order, submit following information to the TATA POWER DISCOM.
 - a. List of raw materials as well as bought out accessories and the names of sub-Suppliers selected from those furnished along with offer.
 - b. Type test certificates of the raw materials and bought out accessories.
6. The successful Bidder shall submit the routine test certificates of bought out accessories and central excise passes for raw material at the time of routine testing.

15. TESTING FACILITIES:

Bidder shall have adequate in house testing facilities for carrying out all routine tests, acceptance tests and pre-dispatch inspection as per relevant International / Indian standards. The bidder shall have minimum testing facilities in house for following:

- a. Heat run test
- b. SFRA
- c. Pre dispatch inspection as per clause no. 9 above

16. MANUFACTURING FACILITIES:

The successful bidder will have to submit GTP & Drawing with 7 days from placement of outline agreement / RC and complete the approval process within 14 days.

The date of CAT B (manufacturing clearance) approval given by TATA Power will be treated as first day for assessment of LD (if applicable).

17. SPARES, ACCESSORIES AND TOOLS

1. Bidder shall provide a list of recommended spares with quantity and unit prices for 5 years of operation after commissioning.
2. The TATA POWER DISCOM may order all or any of the spare parts listed at the time of contract award and the spare parts so ordered shall be supplied as part of the definite works.
3. The TATA POWER DISCOM may order additional spares at any time during the contract period at the rates stated in the Contract Document.
4. Bidder shall give an assurance that spare parts and consumable items will continue to be available through the life of the equipment which shall be 25 years minimum.
5. However, the TATA POWER DISCOM shall be given a minimum of 12 months' notice in the event that the Bidder or any sub-vendor plans to discontinue manufacture of any component used in this equipment.
6. Any spare apparatus, parts or tools shall be subject to the same specification, tests and conditions as similar material supplied under the Contract. They shall be strictly interchangeable and suitable for use in place of the corresponding parts supplied with the equipment and must be suitably marked and numbered for identification.
7. The bidder shall also provide the following mandatory spares along with the transformer.
 - a. HT Bushing (1no.)
 - b. LT Bushing (1no.)
 - c. Neutral Bushing (1 no.)
 - d. Bucholtz Relay (1 no.)
 - e. Valves (1Set)
 - f. OTI, WTI (1 each)
 - g. PRV (1 no); OSR (1 no); MOG (1 no)
 - h. Transducers for OTI, WTI, PTI
 - i. Air cell (1 no.)
 - j. Set of gaskets (1 no.)

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- k. Set of mandatory spares for tap changer (1 no.)
- l. Oil – 10% extra
- m. Radiator tube plug – 5 No
- n. Radiator tube valves – 2 No
- o. Radiator tube plug oil seals – 12 No
- p. MCCB (1 no.)
- q. MCB (1 no.)
- r. L/R switch (1 no.)
- s. R/L switch (1 no.)
- t. OLTC counter (1 no.)
- u. Space heater & thermostat (1 no.)
- v. Bushing CT for HV (1 no.)
- w. Bushing CT for Neutral (1 no.)
- x. Bushing CT for LV (1 no.)

18. DRAWINGS AND DOCUMENTS:

1. Following drawings and documents shall be prepared based on TATA POWER DISCOM specifications and statutory requirements and shall be submitted with the bid:
 - a. Completely filled in Technical Particulars and compliance to each clause of the specification General Technical Requirements to Additional Details.
 - b. Description of the transformer and all components including brochures.
 - c. General arrangement for Transformer.
 - d. Bill of material.
 - e. Experience Certificate and list
 - f. Type test certificates.
 - g. List of makes of major components as listed above.
2. Drawings / documents to be submitted after the award of the contract are as under:

Sr. No	Description	For Approval	For Review Information	Final Submission
1	Technical Parameters	√	√	√
2	GA Drawing of Transformer	√	√	√
3	HV and LV bushing internal view with terminal connector	√	√	√
4	Internal coil arrangement with dimensions	√	√	√
5	Breather Drawing		√	√
6	Rating Plate	√	√	√
7	Cooling calculation with no. of radiators and fins mentioned specifically	√	√	√
8	Prismatic oil level gauge drawing			√
9	Installation Instruction		√	√
10	QA & QC Plan		√	√
11	Test Certificates	√	√	√

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12	Shipping drawings showing dimensions and weights of each package.	√	√	√
13	Assembly drawings and weight of main component parts.	√	√	√
14	Drawings giving Weights for foundations	√	√	√
15	Tap changing and name plate diagram.	√	√	√
16	Schematic control along with logic block diagram and wiring diagram for all auxiliary equipment.		√	√
17	Schematic diagram showing the flow of oil in the cooling system as well as each limb and winding. Longitudinal and cross-sectional views showing the duct sizes, cooling pipes etc.	√	√	√
18	Large scale drawings of high and low tension windings of the transformers showing the nature and arrangement of insulation and terminal connections.	√	√	√
19	Bushing drawing and specifications.	√	√	√
20	Crane requirement for assembly and dismantling.		√	√
21	Overhead Conductor Connections.		√	√
22	Foundation drawing of transformer, radiator supports, etc.	√	√	√
23	Valve Schedule details	√	√	√
24	HV , LV Bushing fixing and connection Details		√	√
25	Radiator drawing and their fixing arrangement.		√	√
26	Marshaling junction box details	√	√	√
27	Thermo junction box details.	√	√	√
28	Neutral arrangement	√	√	√
29	Drawing showing conservator with air bag and oil filling instructions	√	√	√

In addition to the above, the following drawing / information for each item pertaining to marshalling box and OLTC shall also be supplied.

30	General arrangement drawing of the marshaling box	√	√	√
31	Shipping drawings showing dimensions and weight of each package	√	√	√
32	Drawing giving the weight for its foundation.	√	√	√

33	Schematic control drawing and TB schedule / wiring diagram for all elements	√	√	√
34	Valve Schedule	√	√	√
35	Test report of all bought out elements.	√	√	√
36	The tightening torque chart	√	√	√

3. List of Calculations to be submitted:

- All the calculations shall be step by step showing the use of formulas and other practical considerations. **Concise calculations in table or excel sheet shall not be accepted.** Also, the reference (only standard sources as IS, IEC or any such standard is acceptable) of the formulas shall be mentioned.
- Resistance Calculation (75 deg. C)
- Load Losses Calculation (at 75 deg. C)
- No load Losses.
- Stray Losses.
- Weight of Copper (Bare and with Insulation also).
- Weight of Core.
- BH curve & Loss/Kg graph of core material offered.
- Flux Density calculations.
- Current Density Calculations.
- Short Circuit withstand.
- Temperature Rise Calculations.
- Conservator Volume calculations
- Cooling Calculations showing cooling with tank and radiators separately with no. of radiators and fins mentioned specifically (For both Mineral oil and Ester oil)
- Calculation sheet for Lifting lug design and mounting lug design to be submitted by Bidder.

4. Additional Documents to be submitted :

- List of raw materials as well as bought out accessories and name of sub-suppliers selected from those furnished along with offer.
- Type test certificates of the raw materials and bought out accessories.
- The successful Bidder shall submit the **routine test certificates of bought out accessories** and central excise passes for raw material at the time of routine testing.

All the documents & drawings shall be in English language. After the receipt of the order, the successful bidder will be required to furnish all relevant drawings/parameters/calculation to TATA POWER DISCOM for approval.

5. Instruction Manuals:

Bidder shall furnish softcopies of nicely bound manuals (In English language) covering erection and maintenance instructions and all relevant information and drawings pertaining to the main equipment as well as auxiliary devices.

19. SCHEDULE- "A" GUARANTEED TECHNICAL PARTICULARS:

Sl. No.	Description	Unit	As furnished by Bidder
1.0	Tapings on HV winding ON Load a) Range b) Number of steps c) Principal tap		
2.0	For ON load taps, specify details of OLTC gear(incl. type & make)		
2.1	Manual/automatic control		
2.2	Remote/local control		
2.3	If remote control, whether the remote Control cubicle included in Bidder's scope of supply		
2.4	Voltage class of OLTC		
2.5	Current rating of OLTC		
2.6	a) Location of OLTC with respect to HV winding (attach sketch). b) Location of OLTC (In Tank/Outside Tank)		
2.7	Whether separate tap winding provided for OLTC		
2.8	% Z Impedance at lowest & highest tap		
2.9	Whether Selector and diverter chamber are separate		
2.10	Total oil in the OLTC in selector switch		
	-- In diverter switch		
3.0	Winding		
3.1	Maximum current density in winding	Amps/mm ²	
3.2	Use of continuously transposed conductor (CTC) in LV winding.	Yes/No	Yes
3.3	Area of cross section of winding conductor (HV/LV/Reg).	mm ² (Min)	
3.4	Description of winding insulation		
3.5	Nature of insulation	Class	
3.6	Bare weight of copper in windings without paper insulation and leads.	Kg (Minimum)	
3.7	Details of winding and winding conductor		
3.8	Winding Resistance at 20 degree Celsius		
3.9	Volt per turn		
4.0	Tank :		
4.1	Approximate thickness		
	Sides Bottom Cover	mm mm mm	
4.2	Material of tank		

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5.0	Maximum temperature-rise above an ambient of (deg.C) a)Top oil b)Windings c) Temperature Gradient between Oil and Winding	°C °C °C	
6.0	Total loss at rated voltage at principal tapping and rated frequency.	kW	
7.0	Component losses: at 90%, at 100%, and At 110% :		
7.1	Maximum Guaranteed No load loss at rated voltage on principal tapping and at rated frequency :	kW	
7.2	Calculated No load loss at rated principal tapping & rated frequency. Submit necessary calculations	kW	
7.3	Maximum guaranteed I ² R loss at rated current for the principal tapping at 75°C.	kW	
7.4	Calculated I ² R loss at rated current for the principal tapping at 75°C. Submit necessary calculations.	kW	
7.5	Calculated additional losses (Eddy + stray losses) at rated current for the principal tapping at 75°C. Submit necessary Calculations.	kW	
7.6	Maximum guaranteed additional losses (Eddy + stray losses) at rated current for the principal tapping at 75°C.	kW	
7.7	Maximum Guaranteed auxiliary losses	kW	
7.8	Auxiliary losses at rated current for principal tripping:	kW	
7.9	Maximum Calculated total Losses (sum of sr.no.19.2+19.4+19.5+ 19.7) submit necessary calculation.	kW	
7.10	Guaranteed Total Losses (sum of sr. no. 19.1+19.3+19.6+19.7) submit necessary calculation.	kW	
8.0	Im edance voltage at rated current for the principal tapping HV LV (Percent) Note: (The above impedance values shall be on full MVA rating of transformer i.e. For 2 winding transformer on 5 mva or 8 mva base)	%	
9.0	Reactance at rated current and rated frequency (On full MVA rating of transformer i.e.For 2 winding transformer on 5 mva or 8 mva base) i) HV LV ii) No load current at rated voltage and rated frequency	%	
10.0	a)Partial discharge level : b)Noise level : c)Harmonic content in charging current :		
11.0	Insulation level		

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11.1	Separate source power-frequency voltage withstand : i)HV winding ii)LV winding iii)LV neutral	kV rms kV rms kV rms	
11.2	Induced over voltage withstand i)HV winding ii)LV winding iii)LV neutral	kV rms kV rms kV rms	
11.3	Full wave lightning impulse withstand voltage nd i)HV winding ii) LV winding iii)LV neutral	kV peak kV peak kV peak	
11.4	Uniform/Graded Insulation i)HV winding ii)LV winding iii)LV neutral	kV peak kV peak kV peak	
12.0	a)External short circuit withstand capacity b)External short circuit withstand capacity i) for HV side ii) for LV side c)Duration of external short withstand capacity	MVA kA kA In Sec.	
13.0	Efficiencies at 75 deg.C at unity power factor : a) At full load b) At 3/4 full load c) At 1/2 full load d) At 1/4 full load	% % % %	
14.0	Efficiencies at 75 deg.C at 0.8 power factor : a) At full load b) At 3/4 full load c) At 1/2 full load d) At 1/4 full load	% % % %	
15.0	a) 415 V single phase short circuit impedance b) Percentage variation between phases.		
16.0	Regulation at full load at 75 deg.C a)At unity power factor b)At 0.8 power factor lagging	% %	
17.0	Terminal arrangement: a) High voltage b) Low voltage c) Neutral (LV) d) HV terminal phase spacing e) LV terminal phase spacing f) Any other information		
18.0	Approximate masses: a) Core b) Winding c) Bare weight of copper in windings without paper insulation and leads d) Tanks, fittings and accessories. e) Oil f) Total mass	Kg Kg Kg Kg Kg Kg	

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19.0	Approximate quantity of oil required for filling (main tank) OLTC Overall maximum dimensions of the transformer complete with accessories : a) Length b) Breadth c) Height	mm mm mm	
	Untanking height Reference standards		
20.0	Details of HV Bushings line a) Voltage class, b) Current rating, c) 1.2/50 s impulse withstand d) Make e) Type f) Creepage distance, total g) Creepage distance, protected. h) Year of manufacture. i) Qty. of oil in oil filled bushing	kV A kV (rms) mm mm MM/YYYY Ltr.	
21.0	Details of LV Bushings line (LV line end) a) Voltage class, b) Current rating, c) 1.2/50 s impulse withstand d) Make e) Type f) Creepage distance, total g) Creepage distance, protected. h) Year of manufacture. i) Qty. of oil in oil filled bushing	kV A kV (rms) mm mm MM/YYYY Ltr.	
22.0	Details of Neutral Bushings a) Voltage class, b) Current rating, c) 1.2/50 s impulse withstand d) Make e) Type f) Creepage distance, total g) Creepage distance, protected. h) Year of manufacture. i) Qty. of oil in oil filled bushing	kV A kV (rms) mm mm MM/YYYY Ltr.	

Central Engineering Services		TECHNICAL SPECIFICATION FOR 3.15 /5/8 MVA ,33KV/11KV PTR
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23.0	Details of Core Grounding Bushings a) Voltage class, b) Current rating, c) 1.2/50 s impulse withstand d) Make e) Type f) Creepage distance, total g) Creepage distance, protected. h) Year of manufacture. i) Qty. of oil in oil filled bushing	kV A kV (rms) mm mm MM/YYYY Ltr.	
24.0	Details of LV Cable Connection a) Clearances i) Phase to Phase ii) Phase to Earth b) Drawing enclosed c) Length Of Each phase Bus Bars. The Bus bars are suitable for how many numbers of 1Cx 1000 sq mm, 11kV, XLPE cable.		
25.0	Designed Fault Levels: a) HV b) LV	MVA MVA	
26.0	Core a) Material & Grade b) thickness in mm c) Type of core d) Operating flux density e) Maximum flux density f) Over fluxing capability for 10% voltage & 3% frequency variation g) Specific No load loss for the grade of core chosen at the specified flux density. h) Net weight of CRGO lamination in core. (Kg minimum). (Please submit copy of graph in support of this)	Yes / No Watts/Kg	
27.0	Details of CTs on HV Bushings (Line) a) No. of cores b) Ratio for each core c) VA burden - for each core (along with Imag and VK wherever necessary) d) Accuracy class of each core e) Year of manufacture. f) Short time thermal current rating i) Current ii) Rated time	kA	

Central Engineering Services		TECHNICAL SPECIFICATION FOR 3.15 /5/8 MVA ,33KV/11KV PTR
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28.0	Details of CTs on LV Bushings.(Line) a) No. of cores b) Ratio for each core c) VA burden - for each core (along with Imag and VK wherever necessary) d) Accuracy class of each core. e) Year of manufacture. f) Short time thermal current rating i) Current ii) Rated time	kA	
29.0	Rail gauge (along both axis)		
30.0	Whether Neutral end surge diverter recommended by bidder		
31.0	If yes details of surge diverter a) Type b) Make kV class kV rating		
32.0	Tertiary winding if any kept isolated then the bidder to state whether one terminal to be earthed or any other precautions required during service conditions		
33.0	On load tap changer Particulars a) Make b) Type, designation c) Suitable for auto/manual operation d) Rated voltage kV e) Basic insulation level (BIL) of OLTC (kV peak) f) One minute power frequency voltage withstand of OLTC g) Rated current (A) h) No. of steps i) Step voltage (V) j) Rated voltage of drive motor V k) Whether diverter and selector chambers are separate. l) Rated voltage of control circuit V m) Time to complete tap changing operation from any one step to next higher or lower tap. i) On auto operation - Sec. ii) On manual operation through push button - Sec. n) List of routine tests to be carried out on tap changer o) Location of the taps with respect to the terminals of the tapped winding p) Drawing or pamphlet number of the technical and descriptive particulars of the OLTC, enclosed with the bid. q) Separate conservator and Buchholz relay provided for OLTC (Yes/No) r) RTCC (Remote Tap Changer Control Panel)		

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	i. List of tap changer Annunciation ii. Two sets of potential free contacts for SCADA provided. iii. Two sets of 0/20 mA output for tap position indication provided. iv. 415 V Auto changeover facility for OLTC motor provided.		
34.0	Marshalling Box a) Derived control supply Voltage b) 415 V /control supply auto-changeover facility provided. c) Local OTI/WIT provided. d) Remote OTI/WIT provided. e) Two sets of 0/4-20 mA signals for OTI/WIT provided. f) List of annunciations. g) Two sets of potential free contacts for annunciations provided.		
35.0	Whether Marshalling boxes (ground as well as tank) provided as per specifications		
36.0	Surface Preparation/Painting 1) Material used fir Adequate rust proofing done on transformer and radiator (Details of measures to be enclosed) 2) Type of paint (epoxy/enamel) 3) Whether galvanized radiator offered as alternative.		
37.0	Conservator Oil preservation system Details (Air bag) a) Material of separator/Air bag b) Details of air pressure for the separator i. Design pressure ii. Working pressure iii. Bursting pressure (Puncture strength) c) Procedure of oil filling with air bag to be enclosed. d) Any precautions to be taken during maintenance of transformer with air bag to be mentioned here.		
38.0	General arrangement drawing of the transformer indicating details of HV/MV/LV terminals and over all dimensions enclosed		Yes/No
39.0	Neutral Bushing Calculation to be submit.		Yes

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20. SCHEDULE “B” DEVIATIONS:

(TO BE ENCLOSED WITH TECHNICAL BID)

All deviations from this specification shall be set out by the Bidders, clause by Clause in this schedule. Unless specifically mentioned in this Schedule, the tender shall be deemed to confirm the purchaser's specifications:

SL. No	Clause No.	Details of deviation with justifications

We confirm that there are no deviations apart from those detailed above.

Seal of the Company:

Signature

Designation



TECHNICAL SPECIFICATION COVER SHEET

Document No. : TPU-D-ENG-HV-20065

Document Title : Technical specification for 12.5/16, 16/20, 20/25 and 25/31.5MVA Power Transformer (33/11KV & 66/11KV)

Release date : 28-10-2024

Prepared by	Reviewed by	Reviewed by	Reviewed by	Reviewed by	Reviewed by	Reviewed by	Approved by	Released by
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Central Engineering Services		TECHNICAL SPECIFICATION FOR 12.5/16, 16/20, 20/25 and 25/31.5MVA Power Transformer (33/11KV & 66/11KV)
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TECHNICAL SPECIFICATION

12.5/16,16/20, 20/25 and 25/31.5MVA Power Transformer (33/11KV & 66/11KV)

Central Engineering Services

TPC-M/TPDDL/TPCODL/TPNODL/TPWODL/TPSODL/TPADL

Specification No: CENG-HV-XXXX-R0

Central Engineering Services		TECHNICAL SPECIFICATION FOR 12.5/16, 16/20, 20/25 and 25/31.5MVA Power Transformer (33/11KV & 66/11KV)
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Specification Title: Technical Specification for 12.5/16, 16/20, 20/25, 25/31.5 MVA Power Transformer (33/11KV & 66/11KV)

REVISION HISTORY

<i>Rev. #</i>	<i>Date of revision</i>	<i>Purpose of revision</i>	<i>Summary of revisions / comments (Attach separate sheet if required)</i>	<i>Initiated by</i>	<i>Revised / Reviewed by</i>	<i>Approved by</i>
<i>R0</i>						
<i>R1</i>						
<i>R2</i>						

Central Engineering Services

TPC-M/TPDDL/TPCODL/TPNODL/TPWODL/TPSODL/TPADL

Central Engineering Services		TECHNICAL SPECIFICATION FOR 12.5/16, 16/20, 20/25 and 25/31.5MVA Power Transformer (33/11KV & 66/11KV)
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Central Engineering Services		TECHNICAL SPECIFICATION FOR 12.5/16, 16/20, 20/25 and 25/31.5MVA Power Transformer (33/11KV & 66/11KV)
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1. SCOPE:

This Specification provides for design, engineering, manufacture, assembly, stage inspection, final inspection and testing before dispatch, packing and unloading at destination Sub-station / stores by road transport, transit insurance, of 33kV/11KV & 66/11KV Power Transformer of rating 12.5/16 MVA, 16/20MVA, 20/25MVA and 25/31.5MVA, complete with all fittings including On Load Flange mounted type Tap Changer and NIFPS system and all other accessories, associated equipment, spares, required for its satisfactory operation in any of the sub-stations of the Purchaser.

Such of the parts that may have not been specifically included, but otherwise form part of the transformer as per standard trade and/or professional practice and/or are necessary for proper operation of transformer, will be deemed to be also included in this specification. The successful bidder shall not be eligible for any extra charges for such accessories etc. notwithstanding the fact that at the time of an initial offer bidder had segregated such items and quoted for them separately.

Note: Installation, Testing & Commissioning Support service shall be provided by Bidder.

2. APPLICABLE STANDARDS:

The equipment (and the materials used) covered by this specification shall unless otherwise stated, be designed, manufactured and tested in accordance with the latest editions of the following Indian standards & other relevant standards for components, BEE & CEA guidelines with latest amendment from time to time, thereof, some of which are listed below:

Sl. no.	Reference Standard	Reference Standard Name
1	IS 5	Specification for Colors for Ready Mixed Paints and Enamels
2	IS 104	Specification for ready mixed paint, brushing, zinc chrome, priming
3	IS 335	Specification for New insulating oils
4	IS 649	Methods for testing steel sheets for magnetic circuits of power Electrical apparatus.
5	IS 1576	Solid Pressboard for Electrical Purposes -Specification
6	IS 2026	Specification for Power Transformers

Central Engineering Services		TECHNICAL SPECIFICATION FOR 12.5/16, 16/20, 20/25 and 25/31.5MVA Power Transformer (33/11KV & 66/11KV)
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7	IS 2099 / IEC-61037	Specification for Bushings for Alternating Voltages Above 1000 Volt
8	IS 2362	Determination of Water content in oil by Karl in oil Fischer Method- Test Method
9	IS 2544	Specification for Porcelain post insulators for systems with nominal Voltage Greater than 1000V
10	IS 2705	Specification for Current Transformers
11	IS 3401	Specification of Silica Gel
12	IS 3637/ IEC-364	Specification for gas operated relay (Buchholz relay).
13	IS 4253: Part II	Specification for cork composition sheets - Part II: Cork and Rubber
14	IS 4257 (PART I)	Dimensions for Clamping Arrangements for Porcelain Transformer Bushings - Part I : For 12 kV to 36 kV Bushings
15	IS 4257(PART II): 1986(REAFFIRMED 2004)	Dimensions for Clamping Arrangements for Porcelain Transformer Bushings for 72 kV to 123 kV Bushings
16	IS 5082	Specification for Wrought Aluminum and Aluminum Alloy Bars, Rods, Tubes, Selection, Plates and Sheets for Electrical purposes
17	IS 5561	Specification for Electric Power Connectors.
18	IS 6103	Specification for Method of Testing of specific resistance (Resistivity) of electrical insulating liquids
19	IS 6262	Method of test for power factor and dielectric constant of electrical Insulating liquids
20	IS 6600	Guide for Loading of Oil-immersed Transformer.
21	IS 6792/ IEC-156	Method for Determination of Electric Strength of Insulating Oil
22	IS 8468	On-load tap changers
23	IS 8603 (PART-1)	Dimensions for Porcelain Transformer Bushings for Use in Heavily Polluted Atmospheres - Part I: 12 kV, 17.5 kV, 24 kV and 36 kV Bushing
24	IS 9335	Specification for Cellulosic Papers for Electrical Purposes
25	IS 10028:	Code of Practice for Selection, Installation and Maintenance of Transformers

Central Engineering Services		TECHNICAL SPECIFICATION FOR 12.5/16, 16/20, 20/25 and 25/31.5MVA Power Transformer (33/11KV & 66/11KV)
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26	IS 12444	Specification for Continuously Cast and Rolled Electrolytic Copper Wire Rods for Electrical Conductors.
27	IS 13964	Methods of Measurement of Transformer and Reactor Sound level
28	IS 3639	Specification for fitting & accessories of Power Transformer
29	IS 1866	Code of practice for maintenance of transformer oil
30	IEC 60156	Insulating liquids - Determination of the breakdown voltage at Power frequency - Test method
31	IS 2074	Ready Mixed Paint, Air Drying, Red Oxide Zinc Chrome, Priming – Specification
32	IS 2932	Enamel, Synthetic, Exterior: (a) Undercoating (b) Finishing – Specification
33	IEC 60296	Specification for unused mineral insulating oils for transformers And switchgear
34	IEC 60529	Degrees of protection provided by enclosures (IP Code)
35	IEC 60437	Radial Interference test on high-voltage insulator
36	IEC 61936-1	Power Installation exceeding 1kV.
37	C.B.I.P Publication	Manual on Transformers
38	IEC 60641	Pressboard and press paper for electrical purposes

****In case of any conflict on any technical particular in the specification, the stricter requirement mentioned in the relevant standard shall be valid.***

3. CLIMATIC CONDITIONS:

1	Maximum ambient temperature	50 deg C
2	Max. Daily average ambient temp	35 deg C
3	Min Ambient Temperature	0 deg C
4	Maximum Humidity	95%
5	Average Annual Rainfall	1500mm

Central Engineering Services		TECHNICAL SPECIFICATION FOR 12.5/16, 16/20, 20/25 and 25/31.5MVA Power Transformer (33/11KV & 66/11KV)
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6	Average No. of rainy days per annum	120
7	Altitude above MSL not exceeding	1000m
8	Wind Pressure	200 Km/hr
9	Earthquakes of an intensity in horizontal direction	equivalent to seismic acceleration of 0.3g
10	Earthquakes of an intensity in vertical direction	equivalent to seismic acceleration of 0.15g (g being acceleration due to gravity)

Tata Power DISCOM service area has heavy saline conditions along the coast and High Intensity winds with speed up to 200 km/hr & sometimes up to 300 km/hr. The atmosphere is generally laden with mild acid and dust in suspension during the dry months and is subjected to fog in cold months.

4. GENERAL TECHNICAL REQUIREMENTS:

4.1 The transformer shall conform to the following specific parameters.

Sl.no	Parameters	33/11KV PTR			66/11KV PTR		
1	Rated MVA (MVA)	12.5/16 MVA	16/20MVA	20/25 MVA	16/20MVA	20/25MVA	25/31.5MVA
	ONAN	12.5MVA	16MVA	20 MVA	16MVA	20MVA	25MVA
	ONAF	16MVA	20MVA	25 MVA	20MVA	25MVA	31.5MVA
2	No. of phases	3	3	3	3	3	3
3	Type of installation	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor
4	Frequency	50 Hz (± 3%)	50 Hz (± 3%)	50 Hz (± 3%)	50 Hz (± 3%)	50 Hz (± 3%)	50 Hz (± 3%)
5	Rated voltage						
	a) Primary Winding	33 KV	33 KV	33 KV	66KV	66KV	66KV
	b) Secondary winding	11 KV	11 KV	11 KV	11KV	11KV	11KV
6	Highest continuous system voltage						

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	a) Primary	36 KV	36 KV	36 KV	72.5KV	72.5KV	72.5KV
	b) Secondary	12 KV	12 KV	12 KV	12KV	12KV	12KV
7	No. of Windings	Two Winding Transformer	Two Winding Transformer	Two Winding Transformer	Two Winding Transformer	Two Winding Transformer	Two Winding Transformer
8	Type of Cooling	ONAN/ONAF with Automatic Control					
9	Method of connection						
	Primary	Delta					
	Secondary	Star					
10	Vector Group	Dyn11					
11	System Earthing (Neutral terminal to be brought out)	Secondary Neutral Grounding. EC Grade copper flat of suitable ratings shall be provided up to the base level of Transformer for grounding, with suitable support insulator arrangement.					
12	Percentage impedance voltage on normal tap at Base MVA (Tolerance shall be as per IS 2026 Part-1, Clause 9, Table No.1)	10 % or 12% Note: Percentage Impedance will specified during Tender/Detailed engineering					
13	Transformer shall be suitable for continuous operation at a voltage of 110% on each operating tap.						
14	Maximum Flux Density	1.6 Tesla					
15	Basic Insulation levels for windings(Neutral should not be graded) :-						
	a) 1.2 / 50 microsecond wave shape Impulse withstand (KVP)	33KV : 170 11KV: 95	33KV : 170 11KV: 95	33KV : 170 11KV: 95	66KV :325 11KV:95	66KV :325 11KV:95	66KV :325 11KV:95
	b) Power frequency voltage withstand (KV rms)	33KV : 70 11KV: 28	33KV : 70 11KV: 28	33KV : 70 11KV: 28	66KV :140 11KV:28	66KV :140 11KV:28	66KV :140 11KV:28
16	Type of winding insulation	Uniform					
17	Withstand time for three phase short circuit at LV Bushings	3 Seconds					
18	Permissible Temperature Rise over ambient temperature of 50deg C						

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	a) Of top oil measured by resistance	45 Deg C	45 Deg C	45 Deg C	45 Deg C	45 Deg C	45 Deg C
	b) Of winding Measured by resistance.	55 Deg C	55 Deg C	55 Deg C	55 Deg C	55 Deg C	55 Deg C
19	Minimum clearances in air (mm) :-						
	Primary Side	For 33KV/11 PTR Phase to Phase: 350 mm ;Phase to ground: 320 mm; Phase to Earth (In Box) : 222 mm			For 66KV/11KV PTR : Phase to Phase: 630 mm ;Phase to ground: 630mm		
	Secondary Side	Phase to Phase: 170mm ; Phase to ground: 170 mm					
	Creepage Distance for 66KV,33KV & 11KV	For Outdoor type 31mm/KV & For Indoor type 25mm/KV					
20	Core Material	CRGO Silicon Steel, M3, 23HP85D(0.23 mm) or better					
21	Class of Insulation	A/A					
22	Phase arrangement	Phase markings U-V-W from left to right when viewed from HV side.					
23	Terminals						
	a) Primary winding	For 33KV/11KV PTR # 36 KV oil filled communicating type porcelain bushings(Anti-fog type)			For 66KV/11 KV PTR # 72.5 KV oil filled communicating type porcelain bushings (Anti-fog type)		
	b) Secondary winding	17.5 KV porcelain type of bushing (Anti-fog type)					
24	Material of Primary and Secondary Conductor	Electrolytic copper					
25	Maximum current density for Primary and Secondary winding for rated current	2.6 A / mm ²					
26	Core Assembly	Boltless Type					
27	WTI & OTI	1 OTI, 2 WTI for Primary & Sec. winding					
28	Losses	The losses shall not exceed the value given below					
	a) No load loss(fixed losses) KW	9.7	12	12.60	12.60	12.6	14.0
	b) Load losses at 75°C KW (at 20MVA Base)	58	64	64	82	82	92

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	c) Maximum guaranteed Auxiliary load losses(includes fans/coolers capacity)	2	2	2	2	2	2
	d) Maximum guaranteed Total losses (TL max) (a+b+c)	69.7	78	78.6	96.60	96.60	108.0
29	Wheels	The transformer shall be provided with four flanged bi-directional rollers suitable for rail gauges in both the axis for movement of the transformer in either direction.					
30	Over fluxing capability	Transformers shall be designed for continuous over fluxing withstands capability due to +10% to – 10% voltage variation on HV side and frequency variation of ±3%. Combined variation of voltage and frequency shall be within ±10%.					
31	Overloading capacity	Loading of the transformer shall be as per IS: 2026 part-7.					
32	Fault Level	The anticipated fault levels on the 66kV, 33kV and 11kV sides shall be 3000 MVA and 1500 MVA and 500 MVA respectively.					
33	Auxiliary Supply						
	a) AC	Two source with changeover, 415 Volts 3 phase 4 wire, ungrounded (Provision to connect neutral to be made in the terminal block). Two 415V sources shall be made available by DISCOM					
	b) DC	24V/48V/110/220V DC (Note: Control DC Voltage will be confirmed by concern TP DISCOM at the release of PO/RO.)					
34	No Load Current	No Load Current shall be 0.5% of full load current. Tolerance for No-Load Current shall be +30% of the declared value.					
35	Core Grounding	The core and frame grounding connection shall be brought out through a suitable bushing for provision of external grounding. The bidder shall submit the drawing clearly showing the details of core grounding.					
36	On Load Tap changer (OLTC) on HV Side						
	a) Type	On Load (Flanged type) (33/11 KV)			On Load (Flanged type) (66/11 KV)		
	b) Range	Option-01 # (+ 4.686%) to (-20.28 %) in steps of 1.56%. Option-02 # (+ 5%) to (-15%) in steps of 1.25% Option-03 # (+10%) to (-10%) in steps of 1.25% Note: Tapping range will be confirmed by respective TP DISCOM during Detailed engineering Stage.)					
	c) Number of Steps	16 (17 Position)					
	d) Principal Tap Position	Principal Tap : Option 01 # 5th Option 02 # 9Th Note: Principal Tap Position to be confirmed at the release of PO by Concerned DISCOM.					
	e) Manual / Automatic	Yes (Both)					
	f) Remote / Local	Yes (Both)					
	g) IS	8468-2006					
	h) Potential free contacts suitable for connection to SCADA & TMU	Yes					
	i) Separate Conservator and OSR, PRV & MOG	Yes					

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	j) Potential free contacts for SCADA shall be Provided	Yes
	k) 415 V Auto change over facilities for OLTC Motor shall be Provided	Yes
	l) Flow of Power	Bidirectional
	m) Surge Relay	Yes
	n) Whether separate tap winding provided for OLTC	Yes
	o) RTCC	No
	p) SCADA and TMU compatibility	Yes
37 .Terminal Arrangement		
(a)	Primary Terminal	Refer Cl. 5.8 (XIII)
(b)	Secondary Terminal	Refer Cl. 5.8 (XIII)
(c)	Neutral Terminal Arrangement	Refer Cl. 5.8 (XIII)
38	Transformer Dimension(Limiting)	Limiting dimension: 20 MVA (ONAN)(33/11KV) : 5.5MX4.8M 12.5/16MVA(ONAN/ONAF)(33/11KV) : 5.3Mx4.7M 20/25 MVA (ONAN/ONAF) (33/11KV) : 6M x4.8 M 25/31.5MVA (ONAN/ONAF)(66/11KV) :6.7M x5.6M

4.2 WTI CT

Sl. No.	PTR (V1/V2)		<u>12.5/16MVA</u>	<u>20/25MVA</u>	<u>16/20MVA</u>	<u>20/25MVA</u>	<u>25/31.5MVA</u>
1	66/11	66KV side	-----	-----	175/1	218/1A	350/1A
		11KV side	-----	-----	1049/1	1312/1A	2085/1 A
2	33/11	33KV side	280/1	435/1	350/1	-----	-----
		11KV Side	840/1	1312/1	1049/1	-----	-----
3	Other CT Parameters						
(a)	Class		0.5				
(b)	Burden		30 VA				
(C)	ISF		<10				

*WTI HV and LV side to be wired in Marshalling Panel.

Optional for NCT (To be finalized during Tender Evaluation)

4.3 Neutral CT (Bushing CT): Supplier to provide suitably sized 2 core CT with PS class & 5P20. CTR & other parameters shall be decided during detailed Engineering.

4.4 CTs shall not limited to the below mentioned points.
All CTs shall be as per IS: 2705 latest amendment

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- a) All turret CTs shall have 2A test windings for ratio test.
- b) All cabling from equipment to terminal boxes shall be of FRLS copper of size not less than 4 sq.mm and shall have insulated sleeve throughout the length and shall be laid in covered Fire Retardant cable duct. Wire terminals shall be hard core copper using round lugs. Wiring of all the cores shall be brought up to the terminal block and disconnecting type terminals shall be used. The CTs shall be shorted at CT terminals from the bidder's end only.
- c) Brass nuts along with lock-nuts, brass washers and spring washers shall be provided for all CT connections.
- d) All CTs shall have polarity marking and terminals shall have well defined marking for the purpose of usage, which shall be clearly written on CT terminal plates.
- e) CT specifications along with winding diagrams shall be provided in the transformer nameplate.
- f) Turret CT test certificates shall be provided along with Transformer test certificates.
- g) In marshalling box protection CT and WTI CT wiring shall be properly marked with proper distinct identification for wiring purpose. Also marking plate on WTI and HV bushing CT to be provided on top of tank.
- h) Location of WTI and LV CT shall be such that it can be accessible at the time of commissioning and maintenance.

4.2 PERFORMANCE

- I. The transformer shall be capable of being operated, without danger, on any tapping at the rated MVA with voltage variation of $\pm 10\%$ corresponding to the voltage of the tapping.
- II. Transformer shall be capable of operating under natural cooled condition up to specified load.
- III. The transformer shall be designed with particular attention to the suppression of maximum harmonic voltage, especially the third and fifth harmonics so as to minimize interference with communication circuit.
- IV. The transformer shall be able to withstand thermal and mechanical stresses caused by symmetrical or asymmetrical fault on any winding.
- V. The transformer and all its accessories including CTs etc. shall be designed to withstand thermal and mechanical effects of any external short circuits to earth and short circuits at the terminals of any winding for a period of 3 sec without any damage/injury.
- VI. Loading of the transformer shall be as per -, IS: 2026 part-7, IEC 60076-7
- VII. Transformer shall be compatible for Operation along with Tap Changer Control panel or Transformer Monitoring Unit (TMU). Supply of TMU is not in scope of Bidder.
- VIII. The forced cooling equipment shall come into operation by pre-set contacts of winding temperature indicator and shall operate as forced cooling unit (ONAF).
- I. Cooling shall be designed such that during total failure of power supply to cooling fans, the transformer shall be able to operate at full load for at least ten (10) minutes without referring the calculated winding hot spot temperature.

5. GENERAL CONSTRUCTION:

5.1 GENERAL:

- I. All transformers shall be provided with detachable, flanged, bi-directional wheels for movement and mounting on rail gauge. TATA POWER DISCOM shall provide rail tracks grouted in concrete

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- foundation. Bidder shall provide means for locking the wheels in positions parallel to and at right angles to the longitudinal axis of the tank.
- II. Transformer shall be two winding type, with cold rolled grain oriented, silicon-steel laminations having excellent magnetic properties, insulated and clamped to minimize vibration and noise. Laminations shall be insulated from each other with material having high inter-lamination insulation resistance and rust inhibiting property. All covers and seals shall be oil and airtight and shall not be affected by mineral or synthetic oil action.
 - III. All fasteners of M10 and below size should be of stainless steel. All fasteners of M12 and above size should be hot dip galvanized. To achieve a good quality corrosion free painting, bidder should provide epoxy plus polyurethane paint with minimum paint thickness of 120 microns.
 - IV. The framework, clamping arrangement and general structure of the cores of each transformer shall be of robust construction, having proper support structure and shall be capable of withstanding any shock to which they may be subjected during transport, installation and service. Detailed calculation for selection of bolts shall be submitted. The framework and the core bolts shall be efficiently insulated from the core so as to reduce the eddy-currents to a minimum.
 - V. The limbs and the yokes of the core shall have similar sections to minimize heating and noise arising from transverse flux. The joints in the laminated magnetic circuit shall be interleaved.
 - VI. The core clamping frame shall be provided with lifting eyes having ample strength to lift the complete core and winding assembly. The core assembly of oil immersed transformers shall be electrically connected to the transformer tank for effective core earthing.
 - VII. The neutral terminal shall be brought out through neutral bushing from the tank and the same shall be brought up to the skid level, duly insulated by means of suitably rated epoxy insulators. The neutral conductor lead shall be of copper conductor designed to carry the maximum Earth Fault Current with solidly earthed neutral. The bidder shall justify the voltage/current rating of the neutral bushing chosen during detailed engineering. The voltage rating of the neutral bushing shall be chosen considering the probable voltage rise for neutral floating conditions. The current rating shall be chosen considering solidly earthed neutral. The neutral shall be formed at the bottom of the winding and brought to LVN bushing through a separate path.
 - VIII. Top sampling valve shall be internally/externally piped and brought out of the tank sideways at skid level.
 - IX. Transformer with all accessories shall be of free-standing type. Transformer accessories shall be designed in such a way that no supporting posts/structures are necessary other than the rail.
 - X. The sets of radiator banks shall be connected to the main tank through a header pipe welded to the tank. Design wherein individual radiator is connected to main tank is not acceptable. Individual radiator tubes shall be connected to main tank thru butterfly valves at both ends of radiator tubes. Arrangement shall be made for suitable gap between main tank and radiator tubes.
 - XI. Transformer conservator shall have Silica gel breather.
 - XII. The oil level shall be higher than HV bushing terminal.
 - XIII. The part of the HV bushing terminal to which overhead conductor is connected should not be involved either in the oil sealing arrangement or air release arrangement. This is to be specifically confirmed by the bidder at the time of offer.
 - XIV. Two separate parts shall perform the two functions of receiving the jumper and oil sealing.
 - XV. Air seals are not acceptable at HV bushing terminals.
 - XVI. The oil shall be supplied in non-returnable drums. The quantity shall be of 10% excess over the requirement of transformer at 30°C.
 - XVII. Magnetic oil level indicator shall comprise with 2 nos. mercury contact/magnetic type contacts

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/switch (for High / Low oil level alarm).

- XVIII. Silica gel breather (**With Enviro-Gel orange color eco-friendly indicating type Gel**) with clear sight glass & oil sealing arrangement shall be used for Main tank conservator & OLTC purpose.
- XIX. Breather shall be used for main tank and Silica gel/ Silica gel beads breather with clear sightglass & oil sealing arrangement shall be used for OLTC purpose.
- XX. The transformer shall be suitable for operation at full rated power on all tap positions without exceeding the applicable temperature rise. The transformer shall be designed to suppress harmonic content, especially the third and fifth, so as to eliminate distortion in the waveform and consequent additional insulation stress, noise on communication system and undesirable circulating currents between the neutrals at different transformer stations.
- XXI. The design of each transformer shall be such that the risk of accidental short-circuits due to birds or vermin are obviated.
- XXII. All outdoor apparatus, including bushing insulators and fittings shall be so designed that they do not collect water at any point.
- XXIII. All electrical connections and contacts shall be of ample cross sections for carrying the rated current without excessive heating. All such contacts shall be tinned copper to avoid bi-metallic affect.
- XXIV. Each transformer shall be designed for minimum no-load and load losses within the economic limit and as per the Indian Standards.
- XXV. Ground terminals shall also be provided on **cooler control cubicle**, marshalling box, OLTC local control panel and cable end box to ensure effective earthing.
- XXVI. For continuity of earth connection, all gasket joints shall be provided with minimum two numbers tinned copper strip jumpers of adequate size.
- XXVII. Rain Guard shall be provided for **cooler control cubicle** LV compartment, Buchholz Relay, OSR, PRV, SPR, and Marshalling Box so that rain water can enter to the junction box of these relays/ cubicles. Wiring shall be bottom entry.
- XXVIII. At the time of erection and commissioning, authorized person of the bidder shall be present at the site till completion of the work.
- XXIX. Cable trays of appropriate size to be provided at necessary locations.
- XXX. The following are to be provided
 - a) One oil filling valve (inlet)
 - b) One oil drain valve
 - c) One filter valve located at the top of the tank on the HV side.
 - d) Oil sampling valves.
 - e) Oil Preserving Equipment
 - f) Eye bolts and lugs on all parts for ease of handling.
 - g) Two grounding terminals.
 - h) Diagram and rating plate.
 - i) One set of equipment for control, protection, indication and annunciation for each transformer comprising motor contactors, detecting elements or devices, indicating apparatus instruments, relay, annunciators, etc.
 - j) Separate tank mounted marshalling box for terminal blocks for current transformer secondary only with Cable conduits for cables from devices to marshalling box.
 - k) Provision shall be made for installing resistance temperature detectors for temperature recording instruments arranged separately for the following:
 - Hot oil
 - Winding hot spot
 - l) Two silica gel/Enviro-gel breathers (more than 5kg) each of 100% capacity for main tank.
 - m) Ladder with anti-climbing arrangement and lock. Ladder should mount on side of transformer and not on HV/ LV side bushing. Ladder shall have suitable slope for safety purpose.

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- n) Inspection covers for transformer inspections on all phases (on vertical plane)
- o) Separate contacts for OSR relay in marshalling box to be provided.

5.2 CORE:

- I. The core shall be of high grade cold rolled, non-ageing, grain oriented, annealed silicon steel lamination (CRGO), having low loss & good grain properties, coated with hot oil proof insulation, bolted together to the frames firmly to prevent vibration or noise.
- II. The grade of core shall be M3 or 23PH85D (0.23 MM). The core shall be stress relieved by annealing under inert atmosphere if required, especially suitable for transformer.
- III. All core clamping bolts (If any) shall be effectively insulated. Only one grade and one thickness of core shall be accepted and no mixing of different grades shall be allowed.
- IV. The complete design of the core must ensure permanency of the core losses with continuous working of the transformers.
- V. The value of the maximum flux density allowed in the design & grade of laminations used shall be clearly stated in the offer.
- VI. The successful bidder is required to submit the following documents with regard to the procurement of core material:
 - a) Invoice of supplier
 - b) Mill's test certificate
 - 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, thickness and width of the material
 - g) Subjecting to at least 10% of the transformer to routine tests and no load and load loss measurement
- VII. TATA POWER DISCOM shall impose heavy penalty or black list bidders using seconds/ defective CRGO sheets or load losses found to be more than stipulated limit.
- VIII. After being sheared the laminations shall be treated to remove all burrs. Both sides of steel laminations shall be so constructed that eddy currents will be minimum.
- IX. The core frame shall be provided with lugs suitable for lifting the complete core and coil assembly of the transformer.
- X. The core and the coil shall be so fixed in the tank that shifting will not occur when the transformer is moved or during a short circuit.
- XI. All steel sections used for supporting the core shall be thoroughly sand blasted after cutting, drilling and welding. Each core lamination shall be insulated with a material that will not deteriorate due to pressure and hot oil.
- XII. The supporting frame work of the core shall be so designed as to avoid presence of pockets which would prevent complete emptying of tank through drain valve or cause trapping of air during oil filling. Adequate lifting lugs shall be provided to enable the core and windings to be lifted.
- XIII. Core Grounding:
 - a) The grounding lead from the core shall be brought out of the tank through a 1.1kV class bushing and grounded externally.
 - b) A protective cover shall be provided for the bushing.
 - c) The core grounding rod (stem) through the bushing shall be solid rod (stem).
 - d) The design of core grounding arrangement shall be such that the grounding links shall not come out of core during installation as well service conditions.

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- e) The supplier shall submit a drawing clearly showing the details of core grounding.
- f) The core / frame grounding's both connections shall be brought out through a suitable bushing for provision of external grounding.

5.3 WINDINGS:

- I. The windings shall be so designed that all coil assemblies of identical voltage ratings shall be interchangeable, and field repairs to the windings can be made readily, without special equipment.
- II. The coils shall be supported between adjacent sections by insulating spacers, and the barriers bracings and other insulation used in the assembly of the windings shall be arranged to ensure a free circulation of the oil and to reduce hot spots in the windings.
- III. Coils should be transposed to minimize magnetic forces and extra supports shall provide for inter-disc connection.
- IV. All materials used in the insulation and assembly of the winding shall be new, insoluble, non-catalytic and chemically inactive in the hot transformer oil and shall not soften or otherwise be adversely affected under the operating conditions.
- V. The current density of coil shall not exceed 2.6 Amps/ sq mm at min tap of Respective PTR's higher rating.
- VI. All threaded connections shall be provided with locking facilities. All leads from the winding to the terminal board and bushings shall be rigidly supported to prevent injury from vibration. Guide tubes shall be used where practicable.
- VII. The winding shall be brought out through bushing and provided with suitable terminal connectors, the details of which will be forwarded later.
- VIII. The windings shall be clamped securely in place so that they will not be displaced or deformed during short circuits. The assembled core and windings shall be vacuum-dried and suitably impregnated before removal from the treating tank. The copper conductors used in the coil structure shall be best suited to the requirements and all permanent current carrying joints in the windings and the leads shall be brazed.
- IX. Sharp bends should be avoided in the windings as far as possible, where unavoidable such bends should be reinforced with extra insulation tapes.
- X. The tolerance for the winding resistance measurement for different phases but at same tap shall be limited to 1%.
- XI. The change in impedance values between the winding (HV/LV) shall not exceed $\pm 10\%$ of nominal impedance value as specified at all taps on HV/LV side.
- XII. The windings shall be brought out through bushing. The windings shall be designed to withstand the specified thermal and dynamic short-circuit stresses.
- XIII. The end turns of the high voltage windings shall have reinforced insulation to take care of the voltage surges likely to occur during switching or any other abnormal condition.
- XIV. Winding shall be suitable for connection of reactors or capacitors which would be subjected to frequent switching. All the windings shall be capable of withstanding stresses that may be caused by such switching.
- XV. Primary and secondary windings shall be constructed from high- conductivity (copper conductors), Double Paper Covered (DPC) copper conductor.
- XVI. The insulation between core and bolts and core and clamps shall withstand 2.5 kV for one minute.
- XVII. Proper bonding of inter layer insulation with the conductor shall be ensured. Test for bonding strength shall be conducted as per standards.

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- XVIII. All turns of windings shall be adequately supported (by which material) to prevent movement. The core/coil assembly shall be securely held in position to avoid any movement under short circuit conditions.
- XIX. The joints in the winding shall be avoided but if it is necessary then, these shall be properly brazed and the resistance of the joints shall be less than that of parent conductor. Crimping is not allowed at any joints.

5.4 INSULATING PAPER AND INSULATING PRESS BOARD:

- I. The bidder shall submit characteristics along with make for all the type of insulation papers and Pressboards to be used with the offer.
 - II. Inter layer insulation both for HV and LV windings shall be DPC and compressed pressboard of reputed make (as per approved make).
 - III. For Winding insulation, only Double Paper Covered insulation is acceptable with laying in opposite direction to each other and each paper must have overlapping more than 25% of its width.
 - IV. Kraft paper and Pressboard should be made of pure Cellulose from soft wood pulp manufactured from sulphate process. No additive, adhesive or coloring matter shall be present.
 - V. Kraft paper and Pressboard should be of class A (105°C) insulation material.
 - VI. All spacers, axial wedges / runners used in windings shall be made of pre-compressed solid pressboard.
 - VII. All axial wedges/runners shall be properly milled to dovetail shape so that they pass through the designed spacers freely.
 - VIII. Insulation shearing, milling and punching operations shall be carried out in such a way, that there should not be any burr, sharp edges and dimensional variations.
 - IX. Kraft paper self-adhesive tape to be used for bonding of insulating paper layer, spanner and paperboards that are immersed in the oil filled transformer.
- Below required values could be verified if required at any stage of the inspection and it should fulfill the requirement as per below table

Characteristics	Kraft Paper	Pressboard (all sizes)
1. Dimension	As specified by bidder with $\pm 5\%$ tolerance.	As specified by bidder with Tolerance as per IS: 1576.
2. Apparent Density	$>0.80 \text{ g/cm}^3$	As per IS: 1576 w.r.t Thickness.
3. pH of Aqueous extract	6-8%	6-8%
1. Electrical strength i) in air ii) In Oil	7KV/mm -----	12KV/mm 35KV/mm
5. Ash content	Maximum 1%	Maximum 0.7
6. Moisture content	Maximum 8%	Maximum 8%
7. Oil absorption	-----	Minimum 9%

Bidder has to submit the test certificates as per IS-9335, IS-1576 for all type of insulating materials covering above stated parameters along with below parameters during stage inspection:

1. Substance (grammage) (g/m³)
2. Compressibility
3. Tensile strength
4. Conductivity of water extract
5. Shrinkage in air
6. Flexibility
7. Cohesion between plies¹.
8. Elongation
9. Air permeability
10. Tear index
11. Heat stability

5.5 TRANSFORMER TANK:

- I. The transformer tank and cover shall be fabricated from good commercial grade low carbon steel suitable for welding and shall be of adequate thickness.
- II. The tank shall be welded construction & top cover shall be flanged type. All seams shall be welded and where practicable they shall be double welded.
- III. The tank shall have sufficient strength to withstand without permanent distortion (i) filling by vacuum and (ii) continuous internal gas pressure of 0.35 atm. with oil and 0.8kg/cm² on empty tank.
- IV. The tank material shall be as per IS: 2026 or equivalent with ultrasonic testing done for elimination of defects in rolled plates.
- V. The welding shall be as per prior approved WPS (Welding Procedure Specs) by trained and tested welders. Calculations and documents should be submitted bidders.
- VI. The welding plan shall be shown in general i.e. Category-wise or for each type of weld in the mechanical fabrication drawing, which shall be submitted to TATA POWER DISCOM
- VII. All fittings like elbows, bends etc. shall be seamless as per applicable American or Indian Standards.
- VIII. No resistance welding of fasteners shall be done anywhere on the transformer.
- IX. The tank shall have an oil tight bolted flanged joint near the base of the transformer so that the tank can be lifted off to provide access to the core and coils
- X. To ensure oil tightness, recessed neoprene or equivalent gaskets shall be used.
- XI. Manholes with welded flange and bolted covers shall be provided on the tank.
- XII. The manhole shall be of sufficient size to afford easy access to the lower ends of all the bushings, OLTC terminals etc. to permit replacement of auxiliaries without removing tank covers.
- XIII. Suitable guides shall be provided for positioning the various parts during assembly or dismantling.
- XIV. Adequate space shall be provided between the cores and windings and the bottom of the tank for collection of any sediment.

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- XV. All joints including bolted as well as flanged, shall have machined matching surfaces/inner edges with smooth finish, to ensure leak proof joints.
- XVI. Lifting eyes or lugs shall be provided on all parts of the transformer requiring independent handling during assembly or dismantling. In addition, the transformer tank shall be provided with lifting lugs and bosses properly secured to the sides of the tank, for lifting the transformer either by crane or by jacks.
- XVII. The design of the tank, the lifting lugs and bosses shall be such that the complete transformer assembly filled with oil can be lifted with the use of these lugs without any damage or distortions.
- XVIII. The tank shall be provided with two nos. of suitable copper alloy lugs for the purpose of grounding.
- XIX. The grounding pads should be mirror finished. Two grounding pads, located on opposite sides of the tank shall be provided with two tapped holes for connecting it with station ground mat. Necessary hardware like M10 GS bolts and spring washers shall also be provided for connections. All outer nuts & bolts should be stainless steel type.
- XX. Each tank shall be equipped with the following valves with standard flange connection for external piping,
 - a) One drain valve located on the low voltage side of the transformer and placed to completely drain the tank. At the option of the Tata Power DISCOMs a large valve may be furnished with an eccentric reducer. This valve shall be equipped with a small sampling cock.
 - b) One filter valve located at the top of the tank on the high-voltage side. The opening of this valve shall be baffled to prevent aeration of the oil.
 - c) One filter valve, located slightly above the bottom of the tank.
 - d) One relief valve to operate at a pressure below the test pressure for the tank.
 - e) Other two nos. valves shall also be provided, as required for proper functioning of the transformer.
 - f) A suitable locking arrangement shall be provided for locking these valves in close/open position.
- XXI. All valves should be provided with clear open/close position indications. Wherever rising spindle type valves are provided the valves should be clockwise rotating for closing operations. Any valve opening should not create hindrance to other operation.
- XXII. For the auxiliary lead wiring from individual instrument to marshalling box, the cables shall be provided in the conduits.
- XXIII. All the transformers shall be provided with a ladder having 'anti-climbing' device.
- XXIV. Transformer tank shall be of welded sheet steel construction and provided with gaskets steel cover plates.
- XXV. Base shall be suitably reinforced to prevent any distortion during lifting. Base channels shall be provided with skids and pulling eyes to facilitate handling.
- XXVI. All seams shall be electrically double welded for absolute oil tightness.
- XXVII. Suitable arrangement shall be made for mounting HV and LV lightning arrestors of the transformer.
- XXVIII. Guards shall be provided for drain, bottom sampling and filter valves to prevent oil pilferage.
- XXIX. Inspection covers for transformer inspections on all phases (on vertical plane)
- XXX. Minimum Thickness for the transformer shall be as follows:
 - a) Tank Side wall :10mm
 - b) Tank Top Cover :12mm
 - c) Tank Bottom Plate :12mm
 - d) Conservator: 6mm

5.6 PAINTING

- I. Before painting, surface preparation shall be done by sand blasting and procedure for sand blasting has to be submitted by the Vendor along with the bid. The surface preparation for all external surface prior to painting or coating shall be witnessed by customer or shall be treated as customer hold points. After sand blasting at all edges Belzona E metal to be applied.
- II. Before shipment all steelwork not under oil shall be painted with a primary coat of anti-corrosive paint of durable nature and two coats of battleship grey paint (Shade 631 of IS: 5). Paint shall be epoxy type. The interior surfaces shall be painted as per bidder's standard practice. All the paint including primer shall be applied after testing such as air test, hydraulic test etc. Bidders shall submit their procedure for painting for TATA POWER DISCOM's approval, along with the offer.
- III. Painting of Marshalling box: Two coats of red oxide primer & two coats of synthetic enameled paint after chemical treatment.
- IV. Metal parts not accessible for painting shall be made of corrosion resistant material.
- V. Paint shall be as per Indian Standard/International Standard for quality, surface preparation, application method, thickness check and any other test.
- VI. Additional paint shall be supplied along with the transformer for applying touch up paint at site during installation. The shade of the paint used shall be shade 631 as per IS: 5.
- VII. Paint Thickness should be at least 120 micron and paint shade is same for tank, radiator, Conservator & Marshalling Box etc.

5.7 SURFACE PREPARATION AND PAINTING

- I. The paint shall be applied by airless spray.
- II. Steel surfaces shall be prepared by proper cleaning method (IS-9954) to grade Sq.2.5 of ISO8501-1 or chemical cleaning including phosphating of the appropriate quality (IS 3618).
- III. Heat resistant (Hot oil proof) paint shall be used for the inside surface and whereas for external surface one coat of thermosetting powder paint or one coat of epoxy primer (zinc phosphate) followed by two coats of polyurethane (P.U.) base paint. as per table given below:

Sl. No.	Paint type (should be UV restraint, non-fading)	Area to be painted	No of coats	Total dry film thickness (min); micron
1	Thermosetting powder paint	Inside Outside	01 01	30 60
2	Liquid Paint			
a.	Epoxy (primer)	Outside	1	45
b.	P.U. Paint (finish paint)	Outside	2	35 (each)
c.	Hot oil resistant paint	Inside	1	35

The two coats shall be of oil and weather-resistant nature with final coat as glossy and non-fading paint of shade 631 as per IS 5.

- IV. The dry film thickness shall not exceed the specified minimum dry film thickness by more than 25%.
- V. Any damaged part shall be cleaned to bare metal with an area extending 25 mm around its boundary. A priming coat shall be immediately applied followed by full paint finish equal to that

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originally applied and extending 50 mm around the perimeter of the original damage. The repainted surface shall present a smooth surface which shall be obtained by carefully chamfering the paint edges before and after priming.

- VI. Painting shall not affect by weather changes & performance against pilling out or fading etc. to be guaranteed for 5 Years.

5.8 BUSHINGS:

- I. Bushings provided by the bidder shall be as per IS2099-1986. The bushings shall have high factors of safety against leakage to ground and shall be so located as to provide adequate electrical clearance between bushings and grounded parts. Bushings of identical voltage rating shall be interchangeable. All bushings shall be equipped with suitable terminals of approved type and size and all external current carrying contact surfaces shall be plated, adequately. The insulation class of the high voltage neutral bushing shall be properly co-ordinate with the insulation class of the neutral of the high voltage winding.
- II. All main winding leads shall be brought out through outdoor type bushings as specified which shall be so located that the full flashover strength will be utilized and the adequate phase clearance shall be realized.
- III. Each bushing shall be so coordinated with the transformer insulation that all flash-over will occur outside the tank.
- IV. All porcelain used in bushings shall be of the wet process, homogeneous and free from cavities or other flaws. The insulation (porcelain) shall be without any joint. The glazing shall be uniform in colour and free from blisters, burns and other defects. Stresses due to expansion and contraction in any part of the bushing shall not lead to deterioration.
- V. Bushings rated for 72.5kV and above shall be of the oil filled condenser type with a central tube and draw-in conductor which shall be connected to the connector housed in the helmet of the bushings. The pull through lead shall be fitted with a gas bubble deflector. Condenser type bushings shall be equipped with following :
 - a) Provision for power factor, dissipation factor and tan delta testing without disconnecting main leads.
 - b) Stress rings and lower end shields.
 - c) Current transformers shall be provided, if specified and the bushing shall be so arranged that it can be removed without disturbing the current transformers and secondary terminals.
 - d) Bushing turrets shall be provided with vent pipes which shall be connected to route any gas collection through the Buchholz relay.
- VI. All oil filled bushing shall be provided with prismatic type oil gauge with red colored float inside the gauge for oil level indication. The oil gauge glass shall be so designed that it shall give satisfactory service (without melting/cracking or bulging) at specified site conditions, throughout the life of transformer/bushing. It shall not turn opaque during the service.
- VII. In case of oil communicating type bushing (33kV & 11kV), venting screw of the hollow stud, shall be provided with Teflon gaskets, to avoid oil leakage problem through the same. Angle of inclination to vertical for any bushing shall not exceed 30 deg. All bushings shall have puncture strength greater than the dry flash-over value.
- VIII. Main terminals shall be solder less terminals, and shall be of the type and size specified in the drawings. The spacing between the bushings must be adequate to prevent flashover

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- between phases under all conditions of operation.
- IX. The Bidder shall give the guaranteed withstand voltages for the above and also furnish a calibration curve with different settings of the co-ordination gap, to the TATA POWER DISCOM to decide the actual gap setting. Bidder's recommendations are also invited in this respect.
 - X. The following routine tests shall be carried out on all bushings in the presence of Tata Power DISCOM's representative, in addition to specified in the IS.
 - a. Visual examination
 - b. One minute dry withstand test
 - c. Oil tightness test
 - d. Partial discharge test (Applicable on 66 kV only)
 - e. Test for capacitance and power factor, dissipation factor and tan delta (on CT only) measurement
 - XI. The bushings shall have a link type isolating facility for tap for maintenance tests viz. power factor measurement etc. (Terminal shall be provided for the measurement of power factor and tan delta).
 - XII. Bushing shall be as per the approved make only. All Type test report should be submitted along with bid.
- XIII. Primary & Secondary Termination Arrangement**

Primary Side termination (66KV & 33KV)

Option-01 (For Outdoor Switchgear)

- a) On Primary side, suitable terminal connector for Zebra/Panther/Dog/Coyote Conductor.
- b) The Terminals shall be brought out through suitable 36kV or 72.5kV bushing for overhead connections. Silicon rubber based Insulation covers to be provided for complete live portion.
- c) Detailed size of all the item shall be submitted during detailed engineering for approval.
- d) Suitable Bimetallic Connector to be supplied wherever applicable

Option -02 (For Indoor Switchgear – with cable box)

- a) On HV side for 33kV, a suitable cable box arrangement shall be provided. Complete drawing need to submit.
- b) The HV cable box shall be detachable type with Ingress Protection (IP55). Suitable rain shed shall be provided.
- c) Front cover of cable box shall be Cover-in-cover type with lifting handles (2 nos. on each cover). Fixing bolts including 4 nos. (2 nos. for each cover) stud shall not exceed 24 nos.
- d) Silica gel (Granule size 5-8 mm)/ Cobalt Free Silica beads (Granule size 4-8 mm) breather (1 Kg) arrangement shall be provided for circulation of dry air to enhance heat dissipation. Cobalt Free Silica beads in breather will be preferred.
- e) Tin Plated copper bus bar of size 75mmx10mm shall be supported on silicon rubber composite support insulators.
- f) Bus bar shall have provision for connecting required cables size and Runs with lugs.

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- g) Bus bar shall be insulated through Raychem/ 3M make fire retardant, non-tracking heat shrinkable polyolefin sleeves/ tape with insulation voltage level of 33kV. Detail of the same need to submit.
- h) Undrilled Tin plated flexible strips of minimum area equal to the CSA of Bus-bar shall be provided in between Copper Bushing - Palm connector, Bus-bar and Bus-bar - cable connections.
- i) Area of bushing tin plated copper palm connectors shall be equal to area of bushing stem.
- j) Detachable Gland plates of cable box shall be of minimum 6mm thick MS material & shall have provision with entry arrangements for cable of suitable size & Run.
- k) 1Run 50mm x 6mm GI earth bus bar shall be provided on both sides of the cable box and extended through epoxy flat bushing for external earthing connections.
- l) The bus bars shall be provided with termination arrangements for the cables of required sizes and Runs. Double compression glands shall be in bidder's scope.
- m) Suitable Cable support structure for the cables with Fire retardant and UV resistant polyamide clamping cleats arrangements shall be provided.
- n) Space Heater (100 W) with thermostat arrangement shall be provided in the HV cablebox.
- o) Minimum phase to phase clearance-350 mm for 33kV & 630 mm for 66kV
- p) Minimum phase to earth clearance-320mm for 33kV & 630 mm for 66kV
- q) Cable Box should have the fault carrying capacity and necessary calculation/test should be submitted by bidders.

Secondary Side termination (11KV)

Option 01 (For Outdoor Switchgear)

- a) On Secondary side, suitable provision to connect Zebra/Panther/Dog/Coyote Conductor.
- b) The Terminals shall be brought out through suitable 17.5kV bushing for overhead connections. Silicon rubber based Insulation covers to be provided for complete live portion.
- c) Detailed size of all the item shall be submitted during detailed engineering for approval.
- d) Suitable Bimetallic Connector to be supplied wherever applicable

Option 02 (For Indoor Switchgear with Cable Box)

- a) On Secondary 11KV side, a suitable cable box arrangement with bus-bar extension shall be provided as per required Cable size and Run. Complete drawing to be submitted.
- b) The Secondary 11KV side cable box shall be detachable type with Ingress Protection (IP55). Suitable rain shed shall be provided.
- c) Front cover of cable box shall be cover-in -cover type with lifting handles (2 nos. on each cover). Fixing bolts including 4 nos. (2 nos. for each cover) stud shall not exceed 24 nos.
- d) Silica gel (Granule size 5-8 mm)/ Cobalt Free Silica beads (Granule size 4-8 mm) breather (1Kg) arrangement shall be provided for circulation of dry air to enhance heat dissipation. Cobalt Free Silica beads breather will be preferred.
- e) Bus bar shall be insulated through Raychem/ 3M make fire retardant, non- tracking heat shrinkable polyolefin sleeves/ tape insulation voltage level of 11kV. Detail of the same need to submit.
- f) Undrilled Tinned plated flexible strips of minimum area 1200 sqmm shall be provided in between Copper Bushing Palm connector ± Bus bar and Bus bar- cable connections.
- g) Area of bushing tin plated copper palm connectors shall be equal to area of bushing stem
- h) Detachable gland plates of cable box shall be of minimum 10mm thick Aluminum material & shall have provision with entry arrangements for required cable.

- i) 1Run 50mmx6mm GI bus bar shall be provided on both side of cable box and extended through epoxy flat bushing for external earthing connections.
- j) The bus bars shall be provided with termination arrangements of required cable.
- k) Double compression gland shall be in bidder's scope.
- l) Suitable Cable support structure for the cables with Fire retardant and UV resistant polyamide clamping cleats arrangements shall be provided.
- m) Space Heater (100 W) with thermostat arrangement shall be provided in the LV cable box.
- n) Minimum phase to phase clearance-170 mm.
- o) Minimum phase to earth clearance-170 mm.
- p) Cable Box should have the fault carrying capacity and necessary calculation/test should be submitted by Bidders.
- q) For Neutral Terminal Arrangement
 - Bidder shall submit the drawing for the cable box arrangement showing all the components, support structure arrangements and foundation details for the cable box support structure along with the offer.
 - LV neutral shall be brought out through 11kV class bushing and shall also be suitable for direct grounding as well as for connection to 11kV class NGR

5.9 RADIATORS:

- I. The radiators shall be epoxy painted the entire surface including edges should be cleaned properly before painting to avoid peeling of paint at the edges.
- II. Bidder shall submit procedure for surface preparation and painting of radiators along with the bid.
- III. The color shade for the radiator shall be shade 631 as per IS: 5.
- IV. Tank mounted radiators shall be of the detachable type with bolted and gasketed flanged connections. Proper continuous earthing (may be through Transformer body) should be ensured.
- V. The following accessories shall be provided for radiator:
 - a. Shut off valves and blanking plates on transformer tank at each point of
 - b. Top and bottom shut off valves and blanking plates on each radiator.
 - c. Lifting Lugs
 - d. Top Oil filling Plugs
 - e. Air release plug on top
 - f. Oil Drain Plug at Bottom.
- VI. All radiators shall be tested for.
 - a. Vacuum test for one hour
 - b. Hydraulic pressure test using transformer oil for one and half hour (as per ASME)
 - c. Air test can be done in place of hydraulic pressure test provided.
 - d. Water tank will be made available for submerging the radiators into water for leak detection.
 - e. All the tests shall be done in black condition (i.e. before applying any paint).
- VII. The transformer design shall be such that the radiators and conservator can be mounted on either side of the tank connection

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5.10 EARTHING

- I. Provision of complete earthing of transformer and associates should be ensure by bidders. Earthing of Main tank, OLTC Conservator, Radiator, NIDS, HV Cable box, LV Cable box and other shall be ensured through 50X6mm or 75X12MM GI flat, (as applicable) with double hole provision wherever applicable with minimum 80-100mm length.
- II. Provision of continuity of earthing shall also ensure for gasket arrangement, doors and all other extended/open able arrangements with flexible copper wire of adequate size.
- III. Equipotential strips need to be provided on flange joint (above Butterfly Valve) of radiators, flange joint of conservator tank, two places diagonally at top cover flange joint, flange joint of OLTC

5.11 OIL:

Type: Type-II Uninhibited

- I. Oil for first filling, together with 10% extra shall be supplied with each transformer. The oil shall comply in all respects with the provisions of IS 335 & IEC No.60296 latest amendment. Particular attention shall be paid to deliver the oil free from moisture having uniform quality throughout in non-returnable steel drums.
- II. The oil shall be of EHV grade and shall have the following main characteristics or equivalent (the requirements indicated are determined in accordance with the test methods as per IS: 335). The oil in the transformer shall be filled up to 'Transport filled level' before dispatch of the transformer.
- III. The maker of the oil shall be as per approved list and should comply below mentioned technical requirements:

Sl. no.	Characteristics	Requirements per IS 335	Method of Test
1	Appearance	The oil shall be clear and transparent and free from suspended matter or sediment Temperature.	A sample of Oil shall be examined in 100mm thick layer at 27deg C
2	Density at 29.5° C (max)	0.89 g/cm ³	IS 1448 (P:16):1990
3	Kinematic Viscosity @ 27° C. (Max.)	270C	IS 1448 (P:25):1976
4	Interfacial tension Min.	0.04 N/m	IS:6104:1971
5	Flash Point (Closed CUP)	140° C	IS 1448 [P:21]:1992
6	Pour Point (max)	-6° C	IS 1448 [P:10]:1970
7	Neutralization Value (total acidity) max.	0.03 mg/KOH/g	IS 1448 [P:2]:1967
8	Corrosive sulphur (In terms of classification of copper strip)	Non Corrosive	IS 1448 (Part-I)/Annex B of IS:335

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9	Electric Strength (Breakdown voltage)	The sampling shall be done in accordance with the procedure laid down in IS 6855: 1973.	IS 6792 : 1992
	i) New untreated oil	30 kV (rms)	
	If the above value is not attained, the oil shall be filtered		
	ii) After Filtration Min	70 kV (rms)	
10	Dielectric Dissipation Factor (tan-delta) at 90°C, max.	0.002	IS:6262-1971
11	Specific resistance (resistivity) ohm/cm/min		IS:6103-1971
	a) At 90° C, Min	35 X 10 ¹² ohm-cm	
	b) At 27° C, Min	1500 X 10 ¹² ohm-cm	
12	Water content, max. permillion	30 (avg. 20 ppm)	Karl Fischer Method
13	Oxidation Stability		
	(i) Neutralization value after oxidation Max.	0.40 mg. KOH/g	Appendix C of IS:335
	(ii) Total sludge, after oxidation, max.	0.1 percent by weight	
14	Tan delta at 90° C after ageing test (max)	0.2	IS 6262:1971
15	Saponification Value	Max. 1.0 mg. KOH/g	Appendix E IS-335
16	Presence of oxidation inhibitor	The oil shall contain anti-oxidant additives.	IS 13631 : 1992

Ester Oil: (If requirement is specifically mentioned in Tender)

In case of Natural Ester oil or Synthetic Ester Oil below are the requirements to be fulfilled: All transformers shall be filled to the required level with new, unused, clean, Natural or Synthetic Ester oil as per TATA POWER DISCOM approval. The use of recycled ester oil is not acceptable. Ester shall be filtered and tested for break down Voltage (BDV) and moisture content before filling. Ester shall be filled under vacuum. Ester oil shall be procured from approved vendor of TATA POWER DISCOM only.

Bidder has to provide the oil data in below table:

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Sl. No.	Description	Unit	As furnished by bidder
1	Type of oil		
2	Oil Qty. for first filling	Ltr.	
3	Grade of Oil		
4	Maker's name		
5	BDV at the time of firstfilling	kV	

5.12 GASKET

- I. All bolted connection to the tank shall be fitted with suitable oil-tight gaskets which shall give satisfactory service under the operating conditions. Gaskets shall be of NRBC.
 - II. Special attention shall be given to the methods of making the oil-tight joints between the tank and the cover as also between the cover and the bushings and all other outlets to ensure that the joints can be remade satisfactorily and with ease, with the help of semi-skilled labor.
 - III. Where compressible gaskets are used, steps shall be provided to prevent over compression.
 - IV. All the bolts provided shall be of hot dip galvanized.
 - V. All bolts shall be provided with one spring washer and two numbers of flat washers and with locking bolts.
 - VI. All gasket joints shall be provided with equalizing links to extend earth connections.
 - VII. All Gasket should be fixed such a way that there should not be any damage during operation.
 - VIII. Sheet Type Gasket of suitable Width to be used in Flanged Joint.
- We recommend, O-Ring Type Gaskets not to be used on Flanged joints. (Radiators/Valves etc.)

5.13 OIL PRESERVING EQUIPMENT

- I. Oil preserving equipment shall be conservator (expansion tank) type. The conservator shall have two filter valves, one at the bottom at one end, the other at the top, opposite end, in addition to the valve specified in the Accessories for the main tank. The conservator or expansion tank shall also have a shutoff valve and a small drain valve and sampling cock, the latter so arranged as not to interfere with oil lines. The oil level gauges (prismatic and magnetic) shall be mounted on the conservator or expansion tank. The top of the conservator shall have contact with atmosphere through two silica gel / Envirogel breathers to facilitate replacement of breather without having to keep Buchholz relay inoperative. The breathers shall have clear transparent, UV stabilized /retardant Polycarbonate with min. 3 mm thickness.
- II. Conservator oil preservation bag (atmosphere bag) shall be provided with a design such that it can be installed at site with ease without any special tools and tackles. The price for COPS bag shall be clearly mentioned in the price schedule at the specified place. With COPS type conservator shall supply air or nitrogen filling arrangement with all accessories needed at the time of commission and pressure gauge arrangement shall be provided for monitoring COPS bag pressure.
- III. Proper valve arrangement (Two top valve & one bottom valve on conservator) is to be provided for proper oil filling.
- IV. Prismatic oil level indicators with red colour float shall be provided on main tank and OLTC tank Conservator. Dual contacts are required for both MOGs (Main Tank & OLTC conservator).
- V. Separate conservator tank shall be provided for OLTC.
- VI. Air-cell leakage detector to be provided for main conservator and for monitoring Potential free contacts for the ALD to be wired up to Marshalling Box.

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VII. Conservator size to be at least 10% of the main tank oil capacity.

5.14 OLTC CONSERVATOR TANK

- I. Single Conservator Tank for Transformer Main Tank & OLTC with a Partition in Between shall not be accepted. Both Conservator should be independent & separate.
- II. Tank with air release valve on top.
- III. Prismatic Oil level indicator with red color float.
- IV. Magnetic Oil Level Indicator (MOG), round in shape having a diameter of 100 mm.
- V. Bend assembly with flange - This includes two pipes, one connecting tank with OSR and another connecting OSR with OLTC along with two shut off valves. The diameter of this pipe shall be suitably sized for tanks, the complete assembly formed after attaching both the pipe to OSR and connecting with the tank should be at an angle of 5 degrees with respect to the horizontal. Also, the pipe should be offset from the tank at an angle of 32 degrees in the horizontal plane.
- VI. Silica gel/Silica gel beads breather along with the explosion vent assembly
- VII. Mounting structure with eight nut bolts (S/S) for attachment
- VIII. Tank shall be fabricated from good commercial grade low carbon steel.
- IX. All joints, bolted or flanged, shall have machined matching surfaces/inner edges with smooth finish, to ensure leak proof joints.
- X. All joints, bolted or flanged, shall have machined matching surfaces/inner edges with smooth finish, to ensure leak proof joints.
- XI. The inside surface of the tank shall be painted with one coat of hot oil resistant varnish with two coats of red oxide zinc phosphate primer conforming to IS:2074 followed by two coats of fully glossy finishing paint conforming to IS:2932 and yellow in color.
- XII. The outside surface shall be painted with two coats of red oxide zinc phosphate primer conforming to IS: 2074 followed by two coats of fully glossy finishing paint conforming to IS: 2932 of shade 631 of IS 5.
- XIII. Two Lifting hooks (Each having two times capacity) should be provided.
- XIV. OLTC Conservator size to be at least 10% of the OLTC oil capacity.

Sl. No.	Description	20 MVA
1	Diameter	To be furnished by the bidder
2	Length of tank	To be furnished by the bidder
3	Thickness of sheet	To be furnished by the bidder
4	Weight	To be furnished by the bidder
5	Air release valve on top	Required
6	Prismatic oil level indicator with red color float	Required

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7	MOG	Required
8	Bend assembly with two shut off valves	Required
9	Silica gel/Enviroge lbreather with explosion vent assembly	Required
10	Mounting structure	Required
11	Eight nut bolts (S/S) with mounting structure	Required
12	Inside surface finishing	The inside surface of the tank shall be painted with one coat of hot oil resistant varnish with two coats of red oxide zinc phosphate primer conforming to IS:2074 followed by two coats of fully glossy finishing paint conforming to IS:2932 and yellow in color.
13	Outside surface finishing	The outside surface shall be painted with two coats of red oxide zinc phosphate primer conforming to IS: 2074 followed by two coats of fully glossy finishing paint conforming to IS: 2932 of shade 631 of IS 5.
14	Color of tank's external paint	Shade 631 acc. to IS 5
15	Lifting hooks	Required

5.15 ON LOAD TAP CHANGER

- I. OLTC shall have the entire feature to meet the requirement. The equipment shall conform to the latest applicable Indian standard / IEC standard. Equipment complying with any other authoritative standards such as British, VDE etc. shall also be considered if offered.
- II. The OLTC gear shall be designed to complete successfully tap changes for the maximum current to which transformer can be loaded i.e. 120% of the rated current. Devices shall be incorporated to prevent tap change when the through current is in excess of the safe current that the tap changer can handle. The OLTC gear shall withstand through fault currents without injury.
- III. When a tap change has been commenced it shall be completed independently of the operation of the control relays and switches. Necessary safeguards shall be provided to allow for failure of auxiliary power supply or any other contingency which may result in the tap changer movement not being completed once it is commenced.
- IV. OLTC shall be a separate compartment & should be external to transformer tank. Oil in compartments which contain the making and breaking contacts of the OLTC shall not mix with oil

in other compartments of the OLTC or with transformer oil. Gases released from these compartments shall be conveyed by a pipe to a separate oil conservator or to a segregated compartment within the main transformer conservator. A OSR with shut off valves and MOG shall be installed between OLTC and conservator tank. The OLTC conservator shall be provided with prismatic oil level gauges with red color float. The length and alignment of the MOG and OSR pipe shall be such that, the transformer does not trip by the vibration of the pipe.

- V. Oil in compartments of OLTC which do not contain the make and break contacts, shall be maintained under conservator head through valve pipe connections. Any gas leaving these compartments shall pass through the OSR relay before entering the conservator. The cable entry of OSR should be from bottom end instead from side
- VI. Oil filled compartments shall be provided with filling plug, drain valve with plug, air release vent, oil sampling device, inspection opening with gasket and bolted cover with lifting handles.
- VII. The OLTC motor shall be provided with 415 V auto changeover facilities. Tap position indication along with the various alarms of tap changer shall be indicated in the marshaling box.
- VIII. Separate OLTC tank should be provided at a height lower than that of the main conservator tank so that the same is easily accessible for maintenance.
- IX. OLTC driving mechanism and its associated control equipment shall be mounted in an outdoor, weather proof cabinet, which shall include:
 - a) Driving motor (415 V - 3 phase, 50 Hz, AC squirrel cage)
 - b) Motor starting contactor with thermal overload relays, isolating switch and HRC fuses.
 - c) Duplicate sources of power supply with automatic changeover from the running source to the stand by source and vice versa.
 - d) End Limit Switch shall be provided to prevent operation beyond extreme taps & Contacts shall be provided for operation through SCADA.
 - e) Limit switch to cut off electrical operation on insertion of manual handle (Contacts shall be provided for operation through SCADA).
 - f) Local/Remote selector switches shall be provided with status indication.
 - g) Control switch: Raise/off/lower (spring return to normal type). (Contacts shall be provided for operation through SCADA).
 - h) Remote/local selector switch (maintained contact type). (Contacts shall be provided for operation through SCADA).
 - i) Mechanical tap position indicator showing rated tap voltage against each position and resettable maximum and minimum indicators.
 - j) Limit switches to prevent motor over travel in either direction & final mechanical stops.
 - k) Brake or clutches to permit only one tap change at a time on manual operation.
 - l) Emergency manual operating device (hand crank or hand wheel).
 - m) Electrically interlocked reversing contactors (preferably also mechanically interlocked).
 - n) 240V, 50 HZ, AC space heaters with switch and MCB.
 - o) Interior lighting fixture with lamp door switch and MCB.
 - p) Gasketed and hinged door with locking arrangement.
 - q) Terminal blocks, internal wiring, earthing terminals and cable glands for power and control

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cables.

- r) Necessary relays, contactors, current transformers etc.
- s) Thermal device or other means shall be provided to protect the motor and control circuit. All relays, switches, fuses etc. shall be mounted in local OLTC control cabinet and shall be clearly marked for the propose of identification.
- t) A five digit counter shall be fitted to the tap changing equipment to indicate the number of operation completed.
- u) The equipment shall be suitable for supervisory control and indication with 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 remote tap position indication.'
- v) 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.
- w) OLTC shall be provided with PRV.
- x) Suitable manholes covers should be provided on the sidewalls to give access to the selector switches of the OLTC. There should be ample access for opening /Reconnecting tap-leads tothe OLTC from all sides.
- y) Suitable valves shall be provided to take sample of oil from the OLTC chamber during operation of the transformer.

X. The following electrical control features shall be provided:

- a) Positive completion of load current transfer, once a tap change has been initiated, without stopping on any intermediate position, even in case of failure of external power supply.
- b) Only one tap change from each tap change impulse even if the control switches or push buttonis maintained in the operated position.
- c) Cut-off of electrical control when manual control is resorted to. It shall not be possible to operate the electric drive when the manual operating gear is in the use.
- d) Cut-off of a counter impulse for a reverse tap change until the mechanism comes to restand resets the circuits for a fresh operation.
- e) Cut-off of electrical control when it tends to operate the tap beyond its extreme position. Mechanical limit s witches shall be provided for this purpose to achieve suitable interlocking.

XI. Automatic / Parallel Operation with OLTC

OLTC shall be able to do automatic / parallel operations through Transformer Monitoring Unit (TMU).

XII. ALARMS:

The following alarms shall be provided with the additional contact arrangement for connectionto SCADA.

- End Limit Switch
- Manual Operation Insertion
- A.C. supply failure
- Drive motor auto tripped

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- Tap Stuck up change delayed
- OSR trip
- SPR trip
- MOG Alarms
- PRV Trip
- TC in Progress.
- Any other protective feature, if considered essential by the Bidder.

XIII. Tap Changer Control panel or Transformer Monitoring Unit (TMU): This equipment is not required to be supplied by the bidder of the transformer.

XIV. Auxiliary Power Supply of OLTC, and Power Circuit :

- a) Two auxiliary power supplies, 415 volt, three phase four wire shall be provided by the Purchaser for OLTC and power circuit.
- b) All loads shall be fed by one of the two feeders through an electrically interlocked automatic transfer switch housed in the marshalling box for on load tap changer control.
- c) Design features of the transfer switch shall include the following:
 1. Provision for the selection of one of the feeder as normal source and other as standby.
 2. Upon failure of the normal source, the load shall be automatically transferred after an adjustable time delay to standby sources.
 3. Indication to be provided at marshalling box for failure of normal source and for transfer to standby source and also for failure to transfer.
 4. Automatic re-transfer to normal source without any intentional time delay following re-energization of the normal source.
 5. Both the transfer and the re-transfers shall be dead transfers and AC feeders shall not be paralleled at any time.

XV. **Manual Control:**

The cranking device for manual operation of the OLTC gear shall be removable and suitable for operation by a man standing at ground level.

The mechanism shall be complete with the following:

- a. Mechanical tap position indicator which shall be clearly visible from near the transformer.
- b. A mechanical operation counter.
- c. Mechanical stops to prevent over-cranking of the mechanism beyond the extreme tap positions.
- d. The manual control considered as back up to the motor operated load tap changer control shall be interlocked with the motor to block motor start-up during manual operation. The manual operating mechanism shall be able to show the direction of operation for raising the HV terminal voltage and vice-versa.

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5.16 OIL SURGE RELAY

Oil Surge Relay should be according to the following general technical parameters as mentioned in below table.

Sl. No.	Description	Unit	Requirements
1	Type of relay		Magnetic reed switch type OSR suitable for 25 mm nominal pipebore with 1 set of potential free contact to be used for station control Voltage.
2	No. of Switching systems		1
3	Suitable for		OLTC
4	Nominal Pipe Bore	mm	25
5	Type of Flange		Square
6	Diameter of flange	mm	78 square
7	Diameter of bolt circle	mm	72
8	Number of the bolts		4
9	Size of the bolts		M10
10	Flange Thickness	mm	6 mm
11	Surge Test (TRIP)	cm/s	70 to 130
12	Velocity Test	cm/s	70 to 130
13	Relay operating range: Oil Temperature		10°C to 100°C
14	Relay operating range: Oil Viscosity		66 to 75 centistokes at 10°C, 2 to 3.5 centistokes at 100°C
15	Element Test		With oil, at 1.75Kg/cm ² for 15 minutes,
16	High Voltage Test		Shall be able to withstand 2000 V at 50 Hz for 1 minute
17	Insulation Resistance Test		Shall be Greater than 10 Megaohms with 500V megger

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5.17 PRESSURE RELEASE VALVE

- I. Spring-loaded Pressure Relief Device (PRV) with mechanical flag indicator shall be provided on the main tank top of the transformer.
- II. Oil splashguard along with draining arrangement (with wire net on both side) up to ground level to be provided for prevention of oil splashing.
- III. Arrangement for air-release through a gate valve should be provided at the base of the PRV.
- IV. The PRV shall not be located in the vicinity of the Marshalling Box or OLTC Box for safety of operating personnel.
- V. A pair of potential free contacts shall be provided to trip the transformer on action of the pressure relief device.
- VI. PRV shall be tested for all the applicable test such as Leakage Test, Switch operation, break down test.

Sl. No.	DESCRIPTION	UNIT	REQUIREMENT
1	Operating pressure		0.56 Kg/sq.cm
2	Port opening diameter		150 mm
3	Operating time		Instantaneous
4	Contact rating		3A at 24V/48V/110/220V DC magnetic blowout micro switch
5	Operating temperature		0 to 100 degree Celsius
6	Valve resetting		Automatic
7	Switch		Limit switch DPDT
8	Accuracy class		+ - 1 %
9	Switch resetting		Manual
10	Number of switch		1 limit switch
11	Mechanical protection degree		IP67
12	Suitable for transformer rating	MVA	As per tender
13	Cable Entry		1" conduit
14	Packing		Supplier shall ensure that the equipment covered by this specification shall be prepared for rail/road transport (local equipment) and be packed in such a manner so as to protect the equipment from damage in transit.
15	Marking		The unit shall be appropriately marked as TATA POWER DISCOM and with the name of the vendor, Manufacturer type/ serial no. and year of manufacturing at suitable location.

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16	Warranty		2 years from the date of purchase of Transformer. In case any defects are found, the vendor shall replace the product free of cost.
17	Test Reports		Test certificates to be provided: 1) Protection Class. 2) Cold & Dry Test 3) Vibration Test 4) Salt spray Test 5) Micro switch rating Test
18	Acceptance test		Following tests shall be carried out: 1) Physical Test- Dimensions 2) Switch operation test 3) Valve operation test 4) Leakage Test 5) Insulation Test

5.18 BUCHHOLZ RELAY

One double float gas detector relay (Buchholz relay) with alarm and tripping contacts to detect accumulation of gas and sudden changes of oil pressure complete with shut off valves between Relay and Conservator Tank flange-couplings to permit easy removal without lowering oil level in the main tank, a bleed valve for gas venting and test valve. The installation shall be weather proof to avoid any water seepage inside the relay. The cable entry should be from bottom end of Buchholz relay instead from side. **Marking of Magnetic reed type switches shall be available on Buchholz Relay.**

Gas collection device (GCD): Connected to the Buchholz relay gas collection petcock, and is used to collect samples of gas and oil from the Buchholz relay easily from ground level. The colour of collected gas is also very clearly visible in the GCD. SS pipes to connect the GCD to the Buchholz relays to be provided.

Buchholz Relays should be according to the following general technical parameters as mentioned in below table.

Sl. No.	Description	Unit	Requirements
1	Type of relay		Magnetic reed switch type Buchholz relays suitable for nominal pipe bore of 80 mm with 2 sets of potential free contacts suitable for 24V/ 48V/ 110V/ 220V.
2	No. of Switching systems		2
3	Suitable for Transformer Rating	MVA	As per tender
4	Nominal Pipe Bore	mm	80
5	Type of Flange		Round

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6	Diameter of flange	mm	185
7	Diameter of bolt circle	mm	145
8	Number of the bolts		4
9	Size of the bolts		M16
10	Flange Thickness	mm	16
11	Surge Test (TRIP)	cm/s	90 to 160
12	Gas Volume (ALARM)	cc	200 to 300
13	Velocity Test	cm/s	90 to 160
14	Relay operating range: Oil Temperature		10°C to 100°C
15	Relay operating range: Oil Viscosity		65 to 75 centistokes at 10°C, 2 to 3.5 centistokes at 100°C
16	Element Test		With oil, at 1.75Kg/cm ² for 15 minutes,
17	High Voltage Test		Shall be able to withstand 2000 V at 50 Hz for 1 minute
18	Insulation Resistance Test		Shall be Greater than 10 Mega ohms with 500 V megger
19	Porosity Test		With oil, at 1.5 kg/cm ² for 4 hours - There shall not be any leakage or mechanical damage
20	Mechanical Strength Test		With oil at 8 kg/cm ² for 1 minute
21	Resistance of the Switch		Not to exceed 0.1 ohm across the electrodes of magnetic switch
22	Cable entry in terminal box		From bottom side

5.19 OTI

A dial-type indicating thermometer of robust pattern mounted on the side of the transformer at a convenient height to read the temperature in the hottest part of the oil and fitted with alarm and trip contacts and contacts for switching in and switching out the cooling system at predetermined temperatures.

5.20 WTI

There shall be 2 WTIs: One on LV & One on HV Side

- I. It shall be indicating type, responsive to the combination of top oil temperature and winding current, calibrated to follow the hottest spot temperature of the transformer winding.
- II. The winding temperature detector shall operate a remote alarm in the event the hottest spot temperature approaches a dangerous level and in the case of ONAN (Oil Natural and Air Natural) Thus WTI shall have 4 independent NO contacts for alarm and trip and spare.

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Note:

- I. **Equipment for remote winding and oil temperature Indicators** including these to be installed in the TATA POWER DISCOM control room shall be provided. Pocket with heater coil and CT for RTD for winding hot spots shall be provided.
- II. **For purpose of remote recording and data acquisition system**, Top oil temperature detector along with suitable transducer and other necessary devices to provide two sets of 4-20 mA signals with PT-100 type of sensors.
- III. Tap changer indicator of OLTC along with suitable transducer and other necessary devices to provide two sets of 4-20 mA signals along with one set of 1-16K resistance output shall be provided.
- IV. All digital outputs for remote annunciation/control/DAS shall be provided with two changeover (NO) contacts for alarm condition and two changeover (NO) contacts for trip condition. The OTI & WTI shall be provided with micro switches, instead of mercury switches for alarm and trip purpose. All the interconnected wiring between TJB, Marshalling box and OLTC etc. shall be done by the bidder and schematics drawings of the same shall be supplied.
- V. **Digital OTI & WTI is preferable.**

5.21 VALVE

- I. All valves up to and including 100 mm shall be of gun metal or of cast steel. Larger valves may be of gun metal or may have cast iron bodies with gun metal fittings. They shall be of full way type with internal screw and shall open when turned counter clockwise when facing the hand wheel.
- II. Suitable means shall be provided for locking the valves in the open and close positions. Provision is not required for locking individual radiator valves.
- III. Each valve shall be provided with the indicator to show clearly the position of the valve.
- IV. All valves flanges shall have machined faces.
- V. All valves in oil line shall be suitable for continuous operation with transformer oil at 100°C.
- VI. The oil sampling point for main tank shall have two identical valves to be put in series. Oil sampling valve shall have provision to fix rubber hose of 10 mm size to facilitate oil sampling.
- VII. A valve or other suitable means shall be provided to fix the on line dissolved gas monitoring system to facilitate continuous dissolved gas analysis. The location & size of the same shall be finalized during detail engineering stage.
- VIII. After testing, inside surface of all cast iron valves coming in contact with oil shall be applied with one coat of oil resisting paint/varnish with two coats of red oxide zinc phosphate primer followed by two coats of fully glossy finishing paint conforming to IS: 2932 and of a shade (preferably red or yellow) distinct and different from that of main tank surface.
- IX. Outside surface except gasket setting surface of butterfly valves shall be painted with two coats of red oxide zinc phosphate conforming to IS: 2074 followed by two coats of fully glossy finishing paint.
- X. All hardware used shall be cadmium plated/hot dip galvanized.

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5.22 MOG:

One magnetic-type oil-level gauge each in Main Tank and OLTC Tank with low and high level alarm contacts for main tank MOG and low level alarm for OLTC tank MOG and a dial showing minimum, maximum and normal oil levels. The gauge shall be readable from the transformer base level. It should have cable disconnecting facility at top of MOG, to facilitate testing of MOG. Along with MOG, prismatic type oil level indicator (glass window) shall also be provided on conservator.

Sl. No.	DESCRIPTION	UNIT	REQUIREMENTS
1	Mounting Pad Diameter	Mm	150
2	Electric Switch		Two no.s Micro Switches / Mercury switch
3	Contact Rating		5 Amps 240V AC, 0.25 Amp 24V/48V/110/220V DC.
4	Switch Operation		Normally open, closes when oil level drops to near empty condition. Switch recovers automatically on rising of oil level
5	Mounting of indicator		Vertical
6	Dial Marking		Maximum, Minimum, 1/4, 1/2 & 3/4
7	Movement of float arm		In the plane perpendicular to seating face
8	Conservator dia.	Mm	900 mm
9	Air cell in conservator		Yes
10	Switches for		Low Oil level Alarm, High oil level Alarm.
11	Color		Black marking with white/yellow background.
12	Readable from transformer base level		Yes
13	Cable disconnecting facility at top of MOG to facilitate testing of MOG		Yes
14	Mechanical Protection degree		IP55
15	Suitable for transformer rating	MVA	As per tender requirement
16	Packing		Supplier shall ensure that the equipment covered by this specification shall be prepared for rail/road transport (local equipment) and be packed in such a manner so as to protect the equipment from damage in transit.

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17	Marking	The unit shall be appropriately marked as "TATA POWER DISCOM " and with the name of the vendor, Manufacturer type / serial no. and year of manufacturing at suitable location.
18	Warranty	2 years from the date of purchase of Transformer. In case any defects are found, the vendor shall replace the product free of cost.
19	Test Reports	Test certificates to be provided : 1) Specified levels. 2) Switch operation 3) HV Test 4) Leakage Test 5) Insulation Test
20	Acceptance test	Following tests shall be carried out: 1) Specified levels 2) Switch operation 3) HV Test 4) Leakage Test 5) Insulation Test

5.23 Marshalling Box

- I. Marshalling Box suitable for distribution of 3 phase 4 wire, 415V power to various equipment shall be provided. Separate ground mounted marshalling box shall be provided for radiator banks, WTI, OTI, transducers, at least two (2) sets of 4-20mA converter cum indicator etc. and similarly tank mounted marshalling box shall be provided for HV/LV CT cable terminals. Two point earthing provision should be provided with 50X6mm GI flat with pad type connector, length should be of min. 80 mm. The marshalling box should include indication circuit with DC supply. All cables and conduits between the transformer and control cabinet shall be included in the scope of supply by bidder. All the wiring shall have provision for connection to SCADA. All control cables shall be of FRLS type.
- II. The auxiliary voltage for alarm/ trip circuit shall be 4/48/110/220VDC. DC system is required for
 - a. Buchholz alarm
 - b. OTI alarm
 - c. WTI alarm (HV/LV based on WTI CT available)
 - d. MOG (main) alarm
 - e. MOG (OLTC) alarm
 - f. Buchholz trip

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- g. OTI trip
- h. WTI trip (HV/LV based on WTI CT available)
- i. OSR trip
- j. SPR trip
- k. PRV trip
- l. AC supply fail
- m. Motor Auto Trip
- n. Air-cell Leakage detector

One sets of spare potential free contacts shall be provided for all alarms for remote annunciation through Tata Power DISCOM SCADA panels suitable Transducers shall be provided for 4-20mA signals for tap position indication to the Tata Power DISCOM SCADA panel. The variation in output signals shall be linear for the complete tapping range.

In addition to above, following potential free contacts/signals shall be provided in the marshalling box, for its interfacing with TMU (Transformer Monitoring Unit) or other approved make by Tata Power DISCOMs.

Sl. No.	Item	Provision
1	Supply of ON lamp 3 nos. R,Y,B	To be provided
2	Secondary of Control Transformer from the OLTC	Terminals shall be provided in Marshalling box
3	Tap Position Indicator	4-20 MA Signal in Marshalling box
4	Over Current Relay contact	Potential Free Contact in Marshalling box
5	Local remote Switch in OLTC	Potential Free Contact in Marshalling box
6	Raise Lower Switch	Potential Free Contact in Marshalling box
7	Hand interlocking Switch	Potential Free Contact in Marshalling box
8	Tap Change in progress	Potential Free Contact in Marshalling box
9	Odd even Switch	Potential Free Contact in Marshalling box
10	Maximum position reached	Potential Free Contact in Marshalling box
11	Minimum position reached	Potential Free Contact in Marshalling box
12	OTI	4-20mA Signal in Marshalling box

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13	Annunciation - Oil level low & High (Main) - Oil level low (OLTC) - Winding Temp. High (HV+ LV) - Oil Temp High - B' relay Alarm - Winding temp trip (HV+LV) - Oil temp trip - B' relay trip - PRV trip for main & OLTC both - OSR trip - SPR trip - Air Cell leakage detection	Potential Free Contact in Marshalling box
14	Auto manual selector switch	Potential Free Contact in Marshalling box
15	Supply ON lamp 3 nos. (R,Y,B)	To be provided
16	Secondary of Control Transformer from the OLTC	TBs shall be provided
17	Fan ON GR-I	Potential Free Contact in Marshalling box
18	Fan ON GR-II	Potential Free Contact in Marshalling box
19	WTI, OTI, TPI, transducers & 4-20mA converter /indicator unit for each of these indicators. (two sets of 4-20mA signal to be provided for each indicator)	Equipment and TBs shall be provided. OTI & WTI temp. Probe shall be suitable to fit in to the existing arrangement on top of transformer main tank. The capillary length of OTI & WTI shall be minimum 25 mtrs.
20	Over load Relay (for fan motor and its potential free contacts.	Relay, Contactors & TBs shall be provided. (Relay suitability should be confirmed for the various rating of motors)
21	All Wiring from OLTC to Marshalling box	Separate set of TBS shall be provided
22	Power Contactor for radiator fans / Pumps Control.	Contactors & TBs shall be provided.
23	PRV of Main Tank and OLTC Trip	Contactor shall be provided

- III. The Enclosure shall be weather proof, sheet steel construction, not less than 3 mm thick. Degree of protection shall be IP55 minimum with Canopy. It shall be provided with two hinged doors one at front and one at back with locking knobs facilities. The doors shall open through 1800. Doors shall have glass window for viewing of OTI & WTI from outside when door is closed. Doors and glass windows shall have proper gaskets for vermin proof and dust tight arrangement. Proper extended rain shed shall be provided.
- IV. Accessories: All accessories shall be mounted properly in suitable channel inside the box. The MCBs shall be mounted on a DIN channel by a MS plate with cut out for MCBs knobs. This shall be

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covered by a hinged door on the front. Power cable wiring of MCBs to individual contactors shall be done through good quality copper cable of suitable rating with ferrule marking and suitable lugs at both ends. 2.5sqmm stranded copper cable with ring type lugs shall be used for control cabling purpose. All instrument and wiring shall be completely accessible.

- V. 20% spare terminals to be provided.

Sl. No.	Item	Make	Rating	Quantity
1	Main Incomer MCB 3 Pole	Siemens/ABB/L&T	63 A	02 Nos.
2	3 Pole MCB	Siemens/ABB/L&T	6 A	12 Nos.
3	3 Pole MCB	Siemens/ABB/L&T	10A	10 Nos.
4	3 Pole MCB	Siemens/ABB/L&T	16 A	10 Nos.
5	Connector /Terminals	Wago or Phoenix, (Suitable for ring type lugs)	Suitable for 2.5 sq.mm. control cable	To accommodate all the wiring as mentioned below. Additional 10% terminals shall be provided as spare
6	Contactors, starter and relays	Siemens, L&T, English Electric		

VI. Following Tests shall be carried out on the Marshalling Box:

- Functional tests / 2kV withstand.
- Dimensional checks.
- Make and operation of contactors, relays.
- Factory test report attached for bought out items.
- Test for Enclosure Protection.

5.24 Nitrogen Injection Drain & Stir System

- Fire prevention and extinguishing system shall work on the oil drain, nitrogen injection and stir method. The system shall operate during internal fault in transformer or external fire on transformer, which includes fire due to bursting of transformer bushing and Fire in OLTC tank.
- Fire detector provided on the transformer shall take minimum time for detection of fire and initiate the fire protection system on receipt of other required signals.
- System shall operate on station's DC auxiliary supply (24/48/110/220 VDC). The system shall be capable of working in Auto/Remote Electrical/Local manual modes.
- Provision shall be available to keep the system "ISOLATED" / "OUT OF SERVICE" which is necessary for preventing any mal-operation during transformer maintenance.
- The protection system shall be compatible of being hooked on to the SCADA or fire alarm system. Suitable spare contacts shall be made available for operation of fire

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system. System using PLC shall be only considered.

- VI. Fire protection system shall operate in Auto mode under two logic:
 - a) In Transformer Explosion prevention Logic it shall operate on receipt of minimum three positive feedback signals, namely differential relay, pressure relief valve or rapid pressure rise relay or Buchholz relay and electrical isolation of transformer through master trip relay or HV& LV circuit breaker in series to avoid any mal- operation of system .
 - b) In Transformer Fire Prevention logic, Fire protection system shall operate in Auto mode on receipt of minimum three positive feedback signals, namely fire detector, pressure relief valve or rapid pressure rise relay or Buchholz relay / OSR (in case of fire in OLTC and electrical isolation of transformer through master trip relay or HV &LV circuit breaker in series to avoid any mal-operation of system.
 - c) Provision shall be made in system so that any of the above two logic can be disabled by operator from local panel only.
 - d) Supply and installation of Rapid Pressure Rise Relay shall be in the scope of the bidder.
- VII. Fire protection system shall operate in Remote electrical mode on receipt of signal for electrical isolation of transformer and by operating switch provided in a box which shall be accessible only after breaking the glass cover on control panel.
- VIII. The Local manual operating system shall be used only in case if the system fails in Auto mode/Remote electrical mode/ power failure. System if kept in manual mode must be clearly visible by a different alarm / LED.
- IX. The system shall start operation in auto or remote electrical or local manual, initially draining a pre- determined quantity of oil from the tank top through outlet valve to reduce the tank pressure and simultaneously closing Isolation valve in the conservator line and then inject nitrogen gas with appropriate flow rate at high pressure from lower side of the tank through inlet valves to create stirring action and reduce the temperature of top oil surface below flash point to extinguish the fire.
- X. Isolation valve in the conservator line shall operate mechanically on transformer oil flow rate with electrical signal for monitoring on control panel. However in case of bursting of transformer bushing conservator oil should be isolated from main transformer tank without any additional signal to operate isolation valve.
- XI. Provision shall be available so that in case of accidental leakage of Nitrogen, the same should not affect the operation of Transformer
- XII. The system shall have built in facility for monitoring or display of the following.
 - a) Open /Close status of valves.
 - b) Healthiness of all sensors.
 - c) Operation of PRV
 - d) Healthiness of control cable
 - e) Healthiness of control supply

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- XIV. Provision shall be available for annunciation (along with audible alarm) and a mimic panel of the following.
- a) Detection of fire due to external causes
 - b) Low nitrogen pressure.
 - c) System initiated
 - d) Tank pressure beyond the set limit
 - e) Operating signal cable faulty.
 - f) Operation of conservator isolation valve (PNRV)
 - g) Supply Failure
- XV. However, bidder shall confirm whether it is advisable to initiate the system even when transformer is not electrically isolated due to stuck breaker problem etc.
- XVI. The system shall have built-in-on-line testing facility, which will be operable without affecting the functioning of the transformer.
- XVII. All valves used in system shall be stainless steel ball / butterfly type and of Legris make or equivalent as per the purchaser's approval. Limit switches shall be provided wherever required.
- XVIII. The connecting cables shall be fire retardant low smoke (FRLS) armored cable. Cables passing along the top of the transformer shall be the fire survival (FS) type.
- XIX. The Pipe Line used for the system shall be of Class 'C' type.
- XX. All the hardware used in the system shall be stainless steel.
- XXI. Limit switches used in the panel shall be of Schmersal make or equivalent as per the purchaser's approval.
- XXII. Control cable gland used in system shall be of Lapp, Germany make or equivalent as per the purchaser's approval.
- XXIII. Fire extinguishing cubicle shall be of 3mm thick CRCA sheet with PU painting and IP 55 enclosure protection class and shall accommodate nitrogen gas cylinder of adequate capacity and associated accessories like regulator, high pressure tubing etc.
- XXIV. The remote control panel, to be mounted inside the control room shall accommodate the necessary control units, operating switches push buttons etc. and also alarm annunciation unit.
- XXV. The bidder shall, furnish the complete details including bill of materials of the fire prevention and extinguishing system offered. The list of all accessories including FRLS, fire survival cable, pipes, valves, sensors, control cubicle, nitrogen gas cylinder etc. shall be listed out and furnished in the offer.
- XXVI. The bidder shall ensure that fire prevention and extinguishing system offered is full proof and reliable. Installation, testing and commissioning of the fire protection system shall also be in the successful bidder's scope.
- XXVII. Bidder shall ensure that fire prevention and extinguishing system shall not affect the normal operation of power transformer.
- XXVIII. Fire protection scheme to the power transformer should have authentic certification regarding performance similar to one issued by LAPEM (MEXICO)/TAC/RDSO /any other

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approved standard laboratory.

- XXIX. Similar units offered by bidder shall be in successful operation for a minimum period of two years.
- XXX. The bidder shall also furnish performance certificate for similar systems in proof of the satisfactory operation.
- XXXI. NIDS is to be supplied with transformer unless specified elsewhere in the Bidding Document.
- XXXII. Drawing shall be prepared as per the layout and OGA of the transformer to avoid any major fabrication at site. Complete drawing and GTP should be submitted for approval.
- XXXIII. Bidder shall also ensure overall product & installation quality.
- XXXIV. In all conditions transformer shall have provision for future implementations of NIDS.
- XXXV. In any condition OEM (PTR) guarantee shall remain the same as mention in clause no.11 of this specification.

5.25 CENTRE OF GRAVITY & CENTRE LINE MARKING

CENTRE OF GRAVITY

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

CENTRAL LINE MARKING

Central line of the transformer, tank, etc. shall be marked properly with indication to avoid any confusion during installation of the transformer.

5.26 ANTI RUSTING CORROSION TREATMENT

- I. The bidder shall ensure that all fabrication i.e. transformer tank, radiators, marshalling boxes and other accessories are treated for highest quality performance for the entire life of the transformer. The Bidder shall submit plan for extra measures he is taking for prevention of corrosion, along with the offer.
- II. Finishes on transformer and appurtenant parts, edges (exposed to atmosphere)
- III. NO GAS CUT EDGE OR SURFACE shall be acceptable unless smoothly ground to plane surface without irregular projections and corners (which cannot be blasted to the required roughness).
- IV. For all radiators the following painting procedure shall be followed. The metal spray (99.95% assay zinc) to a thickness about 100 microns with surface roughening and two coats of paint with proper supervision and quality checks. Bidder shall indicate separate price for metal spray of radiators.
- V. In this corrosion prevention measure it is imperative that the job is fully monitored for optimizing the proper conduct of the procedure as given in the various national standards. The coating shall be as per BS: 2569 (latest revision). The coating requirement shall be to BS: 5493 Gr. SC10Z.
- VI. The Bidder shall submit a Quality Plan, giving the parameters and checking methods, (major, critical, minor).

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VII. The paint shade used shall be shade 631 as per IS: 5.

The following shall be the check points for the metal spray of Radiators:-

- Metal Spray
- Surface preparation
- Chemical analysis of actual material used for spray (batch wise identification)
- Coating Process (the first trial job will be witnessed to see if the written procedure is followed)
- Coating thickness test, adhesion test as per BS.
- Repair area classification major or minor and accordingly the repair from blasting onwards otherwise.

VIII. Bidder may quote for galvanized radiators instead of metal spray radiators as an alternative

5.27 MAKE OF MAJOR COMPONENTS & RAW MATERIALS

The BA shall procure the following constituent items from the designated vendors as follows:

	RAW MATERIAL/EQUIPMENT	MAKE
a)	Copper	M/S Sterlite, M/S Hindustan Copper, M/S Hindalco ,M/s NALCO
b)	Core	M/S AK Steels, POSCO, Kawasaki/ JFE,Nippon Steel, Thyssenkrup
c)	Insulation paper and Pressboards	ITC paper, ABB, Raman Boards- Mysore, Senapathy Whiteley – Bangalore
d)	Transformer Oil (Mineral oil)	Savita, Apar, Gandhar ,IOCL, Columbia petrochem etc.
e)	Gaskets & Corks	Nu Cork, Anchor Corks
f)	Steel For Tank	M/s, TATA Steel, M/s SAIL, M/s. JSW Steel, M/s. IISCO, M/s. RINL/Vizag Steel, M/s. Jindal Steel,Bhushan Steel
g)	Dehydrating Breather	Yogya, Anushree, Electrical engineers
h)	Buchholz, PRD, SPR, OTI , WTI, and other devices	Reputed make to be approved by TATA POWER DISCOM during detailed engineering.
i)	Bushing	GE,CJI,JP etc.

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Also, Bidder has to provide all test certificates from original manufacturers & relevant sourcing documents. BA shall also have shot blasting facility.

5.28 Cooling Arrangement

1. The transformer shall be provided with ONAF cooling system, which shall be designed to give 80% output at ONAN and 100% at ONAF. The cooling system shall comprise of two Nos.
(2) 50% capacity radiator banks, to the sides of the tank.
2. The radiators shall have one (1) spare fan for each bank with the automatic switching scheme. In case of separately mounted radiator banks, it shall be possible to completely isolate each bank for maintenance and both the banks shall be interchangeable with each other. Bidder shall provide adequate number of fans of rating each for cooling of the radiator.
3. Cooling fans shall not be directly mounted on radiator bank which may cause undue vibration. These shall be located vertically at the sides radiators but on separate support structure so as to prevent ingress of rain water. Each fan shall be suitably protected by galvanized wire guard to prevent accidental contact with the blades, the mesh being not greater than 25mm. The exhaust air flow from cooling fan shall not be directed towards the main tank in any case.
4. Cooling fan must be provided with metal net cover arrangement so that direct contact of birds and rodents can be avoided with fan blades.
5. Radiator's fans motors shall be suitable for operation from 415 volts, three phase 50 Hz power supply and shall conform to IS: 325. Each cooling fan shall be provided with starter thermal overload and short circuit protection. The motor winding insulation shall be conventional class 'B' type. Motors shall have hose proof enclosure equivalent to IP55 as per IS: 4691.
6. Expansion joint shall be provided, one each on top and bottom cooler pipe connections. Air release device and oil plug shall be provided on oil pipe connections. Drain valves shall be provided in order that each section of pipe work can be drained independently.
7. Terminal covers and greasing cups of fan motors shall be accessible without removing the guard. The air blower shall be removable without dismantling supporting framework. The cooler and its accessories should be hot dip galvanized or corrosion resistant paint should be applied to it.
8. Radiators shall be designed to withstand the vacuum and pressure conditions specified for the tank. Coolers shall be so designed as to be accessible for cleaning and painting, to prevent accumulation of water on the outer surface, to completely drain oil into the tank and to ensure against formation of gas pockets when the tank is being filled.
9. Radiators shall be connected to the tank by machined steel flanges welded to the cooler units and to the tank and provided with gaskets. Each cooler unit connection shall be provided on the

tank and an indication for shut off valve which can be fastened in either open or closed position shall be provided. A separate oil tight blank flange shall be provided for each connection for use when the cooler unit is detached. Each cooler unit shall have a lifting eye.

10. Automatic operation control of fans shall be provided (with temperature change) from contacts of winding temperature indicator. The Bidder shall recommend the setting of WTI for automatic changeover of cooler control from ONAN to ONAF. The setting shall be such that hunting i.e. frequent start-up operations for small temperature differential do not occur.

11. Suitable manual control facility for cooler fans shall be provided. The changeover to standby fans in case of failure of service fans shall be automatic. Selector switches and pushbuttons, shall also be provided in the cooler control cabinet to disconnect the automatic control and start/stop the fans and manually.

General Technical Requirements for Cooling Fan:			
Sl. No.	DESCRIPTION	UNITS	Requirement
1	Sweep	mm	450 mm
2	RPM		As per manufacture's design
3	Rated Current	A	0.75A
4	Rated Voltage	v	415
5	Phase		3 phase
6	Power rating	watt	370 watt
7	Bird guard		To be provided
8	Colour		631 as per IS 05
9	Rubber vibration damper		To be provided
10	Motor frames		Shall not get damaged during operation
General Technical Requirements for Blower:			
1	Rated voltage	v	415
2	Power supply		3 phase 50 Hz AC Supply
3	Sweep	Mm/in	900 (36)
4	Speed	RPM	960
5	Motor HP		2
6	Bird guard		To be provided
7	Colour		631 as per IS 05
8	Suitable starter for motor		To be provided
9	Rubber vibration damper		To be provided
10	Motor stand		Shall not get damaged during operation
11	Appropriate stand		To be provided
12	Packing		Supplier shall ensure that the equipment covered by this specification shall be prepared for rail/road transport (local equipment) and be packed in such a manner so as to protect the

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			equipmentfrom damage in transit.
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13	Marking	The unit shall be appropriately marked as "PROPERTY OF TATA POWER DISCOM "" and with the name of the vendor, Manufacturer type-Serial no .and year of manufacturing at suitable location. Following details shall be included in the name plate a) Rated voltage b) Guarantee/Warranty details. c) Purchase order with date. d) Inputs in watt. e) Size of fan. f) Rated speed of fan in rev/min. g) Rated frequency. h) Rated current. i) Direction of rotation.
14	Warranty	2years from the date of purchase of Transformer. In case any defects are found, the vendor shall replace the product free of cost.
15	Test Reports	Test certificates to be provided : a) High voltage. b) Insulation resistance. c) Earthing continuity. d) Electrical input. e) Fan speed. f) Power factor. g) Leakage current. h) Cord grip. i) Starting. j) Air delivery. K) Temperature rise.
16	Acceptance test	Following tests shall be carried out: a) High voltage. b) Insulation resistance. c) Earthing continuity. d) Electrical input. e) Fan speed.

Following lamp indications shall be provided in Marshalling Box :

- Control Supply failure.
- Cooling fan failure for each bank.
- Common thermal overload trip.
- One potential free initiating contact for all the above conditions shall be wired independently to the terminal blocks of marshalling box cabinet

8. COOLER CONTROL & WIRING

1. Cooling Fans shall be suitable for operation with 415 volts, 3 phase, 4 wire, 50 Hz supply. Auto changeover facility shall be provided to an alternate power supply. The auto changeover scheme shall be designed based on under-voltage relay logic, to take care voltage dips on 415V supply. Similarly, 2 separate control transformers 415V/220V with auto changeover facility shall be provided 220V control circuits for light and heaters in marshalling box.

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2. Control equipment for fan motors shall be mounted in a marshalling cabinet adjacent to the transformer and shall include the necessary connections with automatic control and annunciator equipment and provision for manual control.

3. The main and starter control circuit and each feeder shall be provided with fuses at both ends so that in case of fault on any contactor coil only that particular fan will be cut out and other fans can remain in service. Each feeder shall also be provided with double pole

6. NAME PLATE AND MARKING RATING PLATE

- I. A stainless steel rating plate, of at least 1 mm thickness, shall be fitted to each transformer in a visible position and shall carry all the information as specified in the standards. QR code shall be provided on name plate. QR code shall contain the name plate details, approved GTP/Drawing and a video of overall functionality of transformer & associated components.
- II. Sign writing shall also be provided as per the format attached with this specification.
- III. The letters on the rating plate shall be engraved black on the white/silver background.
- IV. Fixing screws for outdoor use shall be of stainless steel or any other corrosion resistant metals.
- V. The Name plate shall be embossed with "PO no. with date" & "TATA POWER DISCOM".
- VI. Danger notice shall have red lettering on a white background or they may be pictorial as approved by the TATA POWER DISCOM
- VII. The name plate shall contain following information:
 - a. Type of transformer (Two Winding Transformer)
 - b. Relevant standard.
 - c. Manufacturer's Name
 - d. Manufacturer's Serial No.
 - e. Year of Manufacture (MM/YYYY)
 - f. No. of phases
 - g. Rated kVA
 - h. Rated frequency
 - i. Rated Voltage
 - j. Rated current
 - k. Connection symbol
 - l. Percentage impedance voltage at rated current.
 - m. Type of cooling (ONAN/ONAF).
 - n. Total Mass
 - o. Mass and Volume of insulating Oil.
 - p. Connection diagram showing the internal connections.
 - q. Temperature rise
 - r. Insulation levels of the windings, including neutral end of windings with non-uniform insulation.
 - s. Transportation weight
 - t. Un-tanking weight.
 - u. Core and windings weight
 - v. Table giving the tapping voltage, tapping current and tapping power for each tapping.
 - w. Values of short circuit impedance on the extreme tapings and on the principal tapping and indication of the winding to which the impedance is related.
 - x. A table of all guaranteed particulars.
 - y. Quantity of oil required for normal filling.
 - z. HV and LV phase to phase clearances.
 - aa. Vector diagram

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- bb. Indication of the winding which is fitted with tapping.
- cc. Table giving the tapping voltage, the tapping current and the tapping power of each winding, for each tap.
- dd. Value of short circuit impedance on the extreme tapping and on the principal tapping and indication of the winding to which the impedance is related.
- ee. Information of the ability of the transformer to operate at a voltage exceeding 110% of the tapping voltage or for the principal tapping and 110% of the rated voltage.
- ff. Tan delta value of insulating oil and Kraft paper of transformer.

VALVE SCHEDULE PLATE

The name plate shall contain information of all the valves, their locations, quantities and schematic for the valves

OLTC PLATE

The name plate shall contain following information:

- I. Type
- II. Sl. No.
- III. Year of Manufacturing (MM/YYYY)
- IV. Motor
 - a. Operating Voltage
 - b. Normal Working Current
 - c. Max. rated Though current
- V. Phase
- VI. Frequency (Hz)
- VII. Steps (Numbers)
- VIII. Step Voltage
- IX. Weight / Volume
 - a. Tap Changer without Oil (Kg)
 - b. Oil (Kg)
 - c. Total
- X. Control Voltage (V)
- XI. Transition Resistance (Ohms)

MARSHALLING BOX & OLTC BOX:

- I. Manufacture's Name
- II. Manufacture's Serial No.
- III. Year of Manufacturing (MM/YYYY)
- IV. Purchase Order No.

The following shall be clearly mentioned / Engraved on the Plate: "TATA POWER DISCOM". Engraved drawing of control circuit, CT / PT circuit and TB shall be available on Marshalling Box and OLTC Box.

OIL FILLING INSTRUCTION PLATE FOR CONSERVATOR

The name plate shall contain

- I. Step wise process for filling oil in conservator
- II. Table of fittings with functions

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- III. Conservator diagram with oil filling process
- IV. Precautions in detail

7. TESTS:

All routine, acceptance & type tests shall be carried out in accordance with the IS 2026 relevant standards, & TATA POWER DISCOM approved QAP. All routine & acceptance tests shall be witnessed by the TATA POWER DISCOM /his authorized representative. All the components and fittings shall also be type tested as per the relevant standards.

Following tests shall be necessarily conducted on the Power Transformers in addition to others specified in IS/IEC standards. Test for the OLTC shall be done as per the IS 8468.

7.1 ROUTINE TESTS

Transformer routine tests shall include tests stated in latest issue of IS: 2026 (Part –1). These tests shall also include but shall not be limited to the following:

- 1) Measurement of Winding Resistance.
- 2) Measurement of voltage ratio, polarity and vector group check.
- 3) Measurement of short impedance and load loss at 50% and 100% load.
- 4) Measurement of no load losses and magnetizing current at rated frequency and 90%, 100% and 112.5% of rated voltage
- 5) Measurement of insulation resistance.
- 6) Dielectric Test.
- 7) Paint thickness test & cross adhesion test.
- 8) Test on On-Load Tap Changer.
- 9) Measurement of Zero-sequence impedance on three phase transformer.
- 10) Bushing shall be tested for Capacitance and Power factor and shall meet the manufacture's requirement.
- 11) All CTs and resistance of image coil for winding temperature indicator shall be checked for ratio test, polarity and knee point voltage test.
- 12) Determination of Capacitances and dissipation factor winding-to-earth and between windings.
- 13) Magnetic balance test.
- 14) Measurement of Magnetizing current at low voltage.
- 15) Vacuum withstand test on tanks and radiators.
- 16) The total Losses shall comprise of the No Load Losses, Load Losses (I^2R loss + stray loss) and Auxiliary Losses at rated output duly converted at 75 °C average winding temperature and shall also be indicated in the test report. Load losses shall be that corresponding to rated load on HV, LV windings.
- 17) Physical Verification of complete Transformer with all assembly including test rollers, radiators etc.
- 18) Voltage Regulation at rated load and at unit, 0.9, 0.8 lagging power factor.
- 19) Measurement of Acoustic Noise Level.
- 20) Measurement of the power taken by the fans
- 21) Functional tests on auxiliary equipment:-
 - a. Test on OTI and WTI
 - b. High Voltage test on insulation test for Auxiliary Wiring

- c. High Voltage test on insulation test for Auxiliary Wiring
- 22) Test on Oil filled in Transformer:-
 - d. Dielectric strength of oil
 - e. Water content
 - f. Dielectric dissipation factor (tan delta at 90° Celsius)
 - g. Resistivity.
- 23) Induced over voltage withstand test.
- 24) Separate Source voltage withstand test.
- 25) Oil Pressure test on completely assembled transformer at 0.35kg/sq.cm for 8 hrs.
- 26) BDV and moisture content of oil in transformer
- 27) Neutral Unbalance current test
- 28) Measurement of Neutral current during load loss test which shall not be more than 2% of the rated current of the transformer

7.2 TYPE TESTS

The type tests to be carried out by the Bidder shall include but not limited to the following:

- 1) Measurement of winding resistance.
- 2) Measurement of voltage ratio and check of voltage vector relationship.
- 3) Measurement of impedance voltage / short-circuit impedance (Principal tapping) and load loss.
- 4) Measurement of no load loss and current.
- 5) Measurement of insulation resistance.
- 6) Dielectric Test.
- 7) Temperature rise for determining the maximum temperature rise after continuous full load run.
The ambient temperature and time should be stated in the test certificate.
- 8) Tests on on-load tap-changer.
- 9) Short Circuit withstand test.
- 10) Test to verify IP55 of Marshalling and cable boxes(if applicable)
- 11) Lightning Impulse voltage test with chopped wave.

Note: The bidder shall submit the test report from CPRI or ERDA for the tests mentioned above.

Following type tests shall be carried out on one transformer of each rating, at the works of the bidder, in presence of Tata Power DISCOM representative.

- a. Temperature rise test including DGA (DGA shall be done before & after the heat run test)
- b. Impulse Test (Including chopped wave on all the three limbs of HV & LV)

TYPE TESTS, ROUTINE TEST & ACCEPTANCE TEST OF MOG, OSR, SPR (RPR):

All routine, acceptance & type tests shall be carried out in accordance with the relevant IS/IEC. All routine & acceptance tests shall be witnessed by the Tata Power DISCOM /his authorized representative. All the components shall also be type tested as per the relevant standards. Following tests shall be necessarily conducted on the Joint and Termination Kits in addition to others specified in IS/IEC standards.

Type Test

- a) Porosity test
- b) High voltage and insulation resistance test
- c) Elements test

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- d) Gas Volume test
- e) Loss of oil and surge test
- f) Mechanical strength test
- g) Velocity calibration test

Routine Tests

- a) Porosity test
- b) High voltage and insulation resistance test
- c) Elements test
- d) Gas Volume test
- e) Loss of oil and surge test

Acceptance Tests

- a) Visual Inspection
- b) Porosity test
- b) High voltage and insulation resistance test
- c) Elements test
- d) Gas Volume test
- e) Loss of oil and surge test
- f) Mechanical strength test
- g) Velocity calibration test

TYPE TEST ON NITROGEN INJECTION DRAIN AND STIR SYSTEM (NIDS):

The NIDS shall be subjected to the operational test at manufacturing works of Nitrogen Injection Fire Prevention and extinguishing system in presence of TATA POWER DISCOM's representative. The manufacture's test certificates of various accessories of NIDS shall be furnished at the time of Inspection to the inspecting officer. Complete GTP & Drawing including mounting, support structure, earthing provision should be submitted for approval. NIDS valve opening should not create any hindrance to other parts operation.

SPECIAL TEST:

The following tests shall be carried out by mutual agreement between the TATA POWER DISCOM and the bidder. All Tests shall be done as per the relevant standard. Test certificates shall be submitted for bought out items. High voltage withstand test shall be performed on auxiliary equipment and wiring after complete assembly.

- a. Measurement of the harmonics of the No-Load Current
- b. Determination of transient voltage transformer characteristics
- c. Measurement of insulation resistance to earth of the windings, and / or measurement of Dissipation factor ($\tan \delta$) of the insulation system capacitances. (These are reference values for comparison with later measurement in the field. No limitation for the values are given here.)
- d. Lightning impulse test on Neutral terminals
- e. Long duration induced AC voltage test (ACLD) transformer winding $72.5 < U_m \leq 170kV$
- f. Magnetic circuit (isolation) test
- g. SFRA Test.

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7.3 ACCEPTANCE TEST:

- 1) At least 10% transformer of the offered lot (minimum of one) shall be subjected to all the tests mentioned under the section 'ROUTINE Test" in presence of TATA POWER DISCOM representative at the place of manufacture before dispatch without any extra charges. The testing shall be carried out in accordance with IS: 2026.
- 2) Oil Leakage test for acceptance shall be conducted at pressure of 0.35kg/sq.cm for one hour as per IS2026.
- 3) Temperature Rise Test (on one unit of first lot against every Rate contract / PO for each rating, for further lots against the same RC, TATA POWER DISCOM reserves the right to perform Temperature rise if required) [As per IS 2026 (Part 2) Clause no.4]
- 4) The painted surface shall pass the Cross Adhesion Test (IS1180 part 1 clause no. 21.4.d).
- 5) At stage inspection: Checking of weight, dimensions, fitting and accessories, tank sheet thickness, oil quantity, material finish and workmanship, physical verification of core coil assembly and measurement of flux density on one unit of each rating of the offered lot with reference to the GTP and contract drawings.
- 6) At Final inspection, the incoming raw material and its movement/consumption record in the related jobs of TATA POWER DISCOM will be verified by inspecting officer. In case of any deviation or non-availability of such records, the offered lot may get rejected.

8. TYPE TEST CERTIFICATES:

The Bidder shall furnish the type test certificates of the Two Winding Power Transformer for the tests as mentioned above as per the corresponding standards. All the tests shall be conducted at CPRI/ERDA/Government Labs as per the relevant standards. Type tests should have been conducted in during the period not exceeding 5 years from the date of opening the bid. In the event of any discrepancy in the test reports, i.e. any test report not acceptable or any/all type tests (including additional type tests, if any) not carried out, same shall be carried out without any cost implication to the TATA POWER DISCOM.

Note: Type Test validity will be as per CEA guidelines.

Further Tests:

The Tata Power-DISCOM reserves the right of having any other reasonable tests carried out at his own expense either before shipment, or at site to ensure that the transformer complies with the requirements of this specification.

9. PRE-DISPATCH INSPECTION:

1. Equipment shall be subject to inspection by a duly authorized representative of the Tata Power DISCOM. Inspection may be made at any stage of manufacture at the option of the Tata Power DISCOM and the equipment if found unsatisfactory as to workmanship or material, the same is liable to rejection.
2. Bidder shall grant free access to the places of manufacture to Tata Power DISCOM's representatives at all times when the work is in progress.
3. Inspection by the Tata Power DISCOM or its authorized representatives shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specifications.

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4. Material shall be dispatched after specific MDCC (Material Dispatch Clearance Certificate) is issued by Tata Power DISCOM.

Following documents shall be sent along with material:

- a. Test reports
- b. MDCC issued by Tata Power DISCOM
- c. Invoice in duplicate
- d. Packing list
- e. Drawings & catalogue
- f. Guarantee / Warrantee card
- g. Delivery Challan
- h. Other Documents (as applicable)

5. In respect of raw material such as core stampings, winding conductors, insulating paper and oil, bidder shall use materials manufactured/supplied by standard manufacturers and furnish the manufacturers' test certificate as well as the proof of purchase from these manufacturers (excise gate pass) for information of the Tata Power DISCOM. The bidder shall furnish following documents along with their offer in respect of the raw materials:

- a. Invoice of supplier
- b. Mill's certificate
- c. Packing List
- d. Bill of Landing
- e. Bill of entry certificate by custom

6. After the main raw-material i.e. core and coil material and tanks are arranged and transformers are taken for production on the shop floor, to ensure the quality of transformers, the inspection shall be carried out by the Tata Power DISCOM's representative at following stages:

a. Stage Inspection I – Bidder has to facilitate for stage inspection of Tank, HV and LV windings and Core of the offered transformers. Bidder has to facilitate for stage inspection of Tank, HV and LV windings in one inspection call without any extra charges. Multiple inspections calls for stage inspection-I will not be considered and the delay will be accountable at bidder end. At this stage checking of weights, dimensions, tank sheet thickness, Pressure and vacuum test and quality of material, finish & workmanship as per GTP/QA Plan and approved drawings. During stage inspection Tata Power DISCOM reserves the rights to dismantle the assembled core to ensure that the CRGO laminations used are of good quality. DP test on welding of tank to be conducted to ensure good quality of tank welding.

b. Stage inspection II – Bidder has to facilitate for stage inspection -II for Core coil assembly of the offered transformers in without any extra charges. The testing shall be carried out in accordance with IS: 2026 and as per GTP/QA plan/Drawing.

Note: For Stage inspection, Annexure -I will be referred.

c. Final Inspection - Bidder has to facilitate for final inspection once the offered transformer is ready for dispatch. Inspection will be done as per w.r.t tests mentioned in Clause 7.2 and inspection test plan format in Annexure-II.

7. To ascertain the quality of the transformer oil, the original manufacturer's tests report shall be submitted at the time of inspection. Arrangements shall also be made for testing of transformer oil, after taking out the sample from the manufactured transformers and tested in the presence of

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Tata Power DISCOM's representative.

8. The Bidder shall intimate the Tata Power DISCOM in advance for inspection, so that an officer for carrying out inspection could be deputed, as far as possible within 07days (Local)/ 12Days (Outstation) from the date of intimation.

9. Further, about the readiness of the transformers, for final inspection for carrying out tests as per relevant IS/IECs shall be sent by the Bidder along with routine test certificates. The inspection shall normally be arranged by the Tata Power DISCOM at the earliest after receipt of offer for pre-delivery inspection.

10. In case of any defect/ defective workmanship observed at any stage by the Tata Power DISCOM's Inspecting officer, the same shall be pointed out to the Bidder in writing for taking remedial measures. Further processing shall only be done after clearance from the inspecting officer / Tata Power DISCOM.

11. All tests and inspection shall be carried out at the place of manufacture unless otherwise specifically agreed upon by the manufacturer and Tata Power DISCOM at the time of purchase/tender.

12. The manufacturer shall offer the inspector representing the Tata Power DISCOM all reasonable facilities, without charges, to satisfy him that the material is being supplied in accordance with this specification. This will include Stage Inspection during manufacturing stage as well as during Acceptance Tests.

13. The bidder shall provide all services to establish and maintain quality of workmanship in his works and to ensure the mechanical / electrical performance of components, compliance with drawings, identification and acceptability of all materials, parts and equipment as per latest quality standards of ISO 9000.

14. The Tata Power DISCOM has the right to have the test carried out at his own by an independent agency wherever there is a dispute regarding the quality supplied. Tata Power DISCOM has right to test 1% of the supply selected either from the stores or field to check the quality of the product. In case of any deviation Tata Power DISCOM have every right to reject the entire lot or penalize the bidder, which may lead to blacklisting, among other things.

10. INSPECTION AFTER RECEIPT AT SITE/STORE:

Inspection at site:

After erection at site, the transformers shall be subjected to the following tests and the bidder shall guarantee results of test certificates under service conditions.

- a. Measurement of winding resistance
- b. Measurement of voltage ratio and check of voltage vector relationship
- c. Measurement of magnetizing current.
- d. Magnetic balance test on three phase transformer
- e. Magnetic circuit (isolation) test
- f. Measurement of short circuit Impedance at low voltage
- g. Insulation resistance measurement
- h. Dielectric Test on oil.
- i. Determination of Capacitances and dissipation factor winding-to-earth and between windings.
- j. Bushing Capacitance and tan δ
- k. Test on other Auxiliaries
- l. No-Load and Excitation current

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This is for bidder's information that tests at site may be in bidder's scope based on mutual agreement between bidder and Tata Power DISCOM's. However, in any case bidder shall be required to send their engineer to confirm that the erection & commissioning is done in a satisfactory manner.

Tata Power DISCOM holds the discretion to obligate the bidder to carry out certain additional tests (e.g. SFRA, HV tan delta etc.) on transformer, for cross-checking and confirming the quality of incoming equipment owing to damages/deterioration that might have been caused during transportation/handling etc.

Inspection at Store:

- a) The material received at Tata Power DISCOM store shall be inspected for acceptance and shall be liable for rejection, if found different from the reports of the pre-dispatch inspection and one copy of the report shall be sent to Project Engineering department.
- b) In case the transformers proposed for supply against the order are not exactly as per the tested design, the Bidder shall be required to carry out the short circuit test and impulse voltage withstand test at its own cost in the presence of the representative of the Tata Power DISCOM. The supply shall be accepted only after such test is done successfully, as it confirms on successful withstand of short circuit and healthiness of the active parts thereafter on un-tanking after a short circuit test. Apart from dynamic ability test, the transformers shall also be required to withstand thermal ability test or thermal withstand ability will have to be established by way of calculations.
- c) Tata Power DISCOM reserves the right to conduct all tests on Transformer after arrival at site /stores and the manufacturer shall guarantee test certificate figures under actual service conditions.
- d) Tata Power DISCOM reserves the right to conduct short circuit test and impulse voltage withstand test in accordance to IS, afresh on each ordered rating at Tata Power DISCOM cost, even if the transformer of the same rating and similar design are already tested. This test shall be carried out on a transformer to be selected by the Tata Power DISCOM either at the manufacturer's works when they are offered in a lot for supply or randomly from the supplies already made to Tata Power DISCOM stores. The findings and conclusions of these tests shall be binding on the bidder.
- e) Test at Tata Power DISCOM store/Site: after receipt of transformers at Tata Power DISCOM stores/Site, following minimum tests will be carried out.
 1. Total weight of the transformer. (It should be as per the offer, subjected to tolerance as per approved drawings & GTPs)
 2. Oil level in the transformer
 3. Verifications of all the fittings
 4. Physical verification of all the transformers for any damages, oil leakage, quality of painting etc.
- f) Test at site: The Tata Power DISCOM reserves the right to conduct all tests on Transformer after arrival at site/stores and the manufacturer shall guarantee test certificate figures under actual service conditions.
- g) Shock/impact recorder data analysis to be submitted by bidder to ascertain the concealed damage. SFRA to be done before energizing the PTR at site.

11. GUARANTEE:

- I. Bidder shall stand guarantee towards design, materials, workmanship & quality of process/ manufacturing of items under the contract for due and intended performance of the same, as an

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integrated product delivered under this contract.

- II. In the event any defect is found by the Tata Power DISCOM up to a period of 60 months from the date of commissioning or 66 months from the date of last supplies made under the contract, whichever is earlier.
- III. Bidder shall be liable to undertake to replace/rectify such defects at his own costs, within mutually agreed timeframe, and to the entire satisfaction of the Tata Power DISCOM, failing which the Tata Power DISCOM will be at liberty to get it replaced/rectified at Bidder's risks and costs and recover all such expenses plus the Tata Power DISCOM's own charges (@ 20% of expenses incurred), from the Bidder or from the "Security cum Performance Deposit" as the case may be.
- IV. In case of Two Winding Power Transformer fails within the guarantee period the Tata Power DISCOM will immediately inform the Bidder who shall take back the failed Two Winding Power Transformer within 15 days from the date of intimation at his own cost and replace / repair the transformer within forty five days of date of intimation with a roll over guarantee.
- V. The outage period i.e. period from the date of failure till unit is repaired / replaced shall not be counted for arriving at the guarantee period. Bidder shall further be responsible for 'free replacement' for another period of THREE Years from the end of the guarantee period for any 'Latent Defects' if noticed and reported by the Tata Power DISCOM.

12. PACKING AND TRANSPORT:

- I. Bidder shall ensure that all the equipment covered under this specification shall be prepared for rail/road transport in a manner so as to protect the equipment from damage in transit.
- II. The packing may be in accordance with the bidder's standard practice but he should give full particulars of packing for the approval of the Tata Power DISCOM. Special arrangement should be made to facilitate handling and to protect the projecting connections from damage in transit.
- III. The transformer shall be shipped filled with oil up to transport oil level gauge. If transformer is transported without Oil or partially filled, the tank shall be filled with Nitrogen under pressure complete with gas cylinder reducer, connection and pressure gauges. (After testing dew point of the Nitrogen filled. Dispatch clearance will be given only after achieving satisfactory dryness i.e. dew point measurement results). These accessories will be part of purchase. However, if neutral grounding transformer and reactors are included in the scope, these can be transported with oil. (Whichever way desired by the Tata Power DISCOM depending on the size etc.)
- IV. Provisions for monitoring of oil and gas pressure during transport and storage and a make-up Nitrogen cylinder shall be made.
- V. A shock recorder also shall be provided during transport. Data of the same shall be shared during execution.
- VI. Bushings shall be packed in proper containers for transport.
- VII. All parts shall be adequately marked to facilitate field erection.
- VIII. Boxes and crates shall be marked with the contract number and shall have a packing list enclosed showing the parts contained therein.
- IX. Unloading, dragging of transformer up to 50mtrs & keeping it on foundation at Tata Power DISCOM site/stores will be in the scope of supplier. The bidder shall take care of this point while quoting the rates for Freight & Insurance charges.

Note: One use plastic not to be used for packing of the material.

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**13. TENDER SAMPLE:
(N/A)**

14. QUALITY CONTROL:

1. The bidder shall submit with the offer Quality assurance plan indicating the various stages of inspection, the tests and checks which will be carried out on the material of construction, components during manufacture and bought out items and fully assembled component and equipment after finishing.
2. As part of the plan, a schedule for stage and final inspection within the parameters of the delivery schedule shall be furnished.
3. Tata Power DISCOM's engineer or its nominated representative shall have free access to the manufacturer's/sub-supplier's works to carry out inspections.
4. The Bidder shall invariably furnish following information along with his bid, failing which the bid shall be liable for rejection. Information shall be separately given for individual type of equipment offered.
 - i. Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards according to which the raw materials are tested.
 - ii. List of tests normally carried out on raw materials in the presence of Bidder's representative, copies of test certificates.
 - iii. Information and copies of test certificates as in (I) above in respect of bought out accessories.
 - iv. List of manufacturing facilities available.
 - v. Level of automation achieved and list of areas where manual processing exists.
 - vi. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspection.
 - vii. List of testing equipment available with the bidder for final testing of equipment along with valid calibration reports shall be furnished with the bid. Manufacturer shall possess 0.1 class instruments for measurement of losses.
 - viii. Quality Assurance Plan (QAP) withholds points for Tata Power DISCOM's inspection.
5. The successful Bidder shall within 30 days of placement of order, submit following information to the Tata Power DISCOM.
 - a. List of raw materials as well as bought out accessories and the names of sub-Suppliers selected from those furnished along with offer.
 - b. Type test certificates of the raw materials and bought out accessories.
6. The successful Bidder shall submit the routine test certificates of bought out accessories and central excise passes for raw material at the time of routine testing.

15. TESTING FACILITIES:

- Bidder shall have adequate in house testing facilities for carrying out all routine tests, acceptance tests and pre-dispatch inspection as per relevant International / Indian standards. The bidder shall have minimum testing facilities in house for following:
- a. Heat run test
 - b. SFRA
 - c. Pre dispatch inspection as per clause no. 9 above

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16. MANUFACTURING FACILITIES:

The successful bidder will have to submit GTP & Drawing with 7 days from placement of outline agreement / RC and complete the approval process within 14 days.

The date of CAT B (manufacturing clearance) approval given by Tata Power DISCOM will be treated as first day for assessment of LD (if applicable).

17. SPARES, ACCESSORIES AND TOOLS

1. Bidder shall provide a list of recommended spares with quantity and unit prices for 5 years of operation after commissioning.
2. Tata Power DISCOM may order all or any of the spare parts listed at the time of contract award and the spare parts so ordered shall be supplied as part of the definite works.
3. Tata Power DISCOM may order additional spares at any time during the contract period at the rates stated in the Contract Document.
4. Bidder shall give an assurance that spare parts and consumable items will continue to be available through the life of the equipment which shall be 25 years minimum.
5. However, the Tata Power DISCOM shall be given a minimum of 12 months' notice in the event that the Bidder or any sub-vendor plans to discontinue manufacture of any component used in this equipment.
6. Any spare apparatus, parts or tools shall be subject to the same specification, tests and conditions as similar material supplied under the Contract. They shall be strictly interchangeable and suitable for use in place of the corresponding parts supplied with the equipment and must be suitably marked and numbered for identification.
7. The bidder shall also provide the following mandatory spares along with the transformer.
 - a. HT Bushing (1no.)
 - b. LT Bushing (1no.)
 - c. Neutral Bushing (1 no.)
 - d. Buchholtz Relay (1 no.)
 - e. Valves (1Set)
 - f. OTI, WTI (1 each)
 - g. PRV (1 no); SPR (1 no); OSR (1 no); MOG (1 no)
 - h. Transducers for OTI, WTI, PTI
 - i. Air cell (1 no.)
 - j. Fan contactor with overload relay (1 no.)
 - k. Cooling fan (1 no.)
 - l. Set of gaskets (1 no.)
 - m. Set of mandatory spares for tap changer (1 no.)
 - n. Oil – 10% extra
 - o. Radiator tube plug – 5 No
 - p. Radiator tube valves – 2 No
 - q. Radiator tube plug oil seals – 12 No
 - r. MCCB (1 no.)
 - s. MCB (1 no.)
 - t. L/R switch (1 no.)
 - u. R/L switch (1 no.)
 - v. OLTC counter (1 no.)
 - w. Space heater & thermostat (1 no.)
 - x. Bushing CT for HV (1 no.)

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- y. Bushing CT for Neutral (1 no.)
- z. Bushing CT for LV (1 no.)

18. DRAWINGS AND DOCUMENTS:

1. Following drawings and documents shall be prepared based on TP DISCOM Specifications and statutory requirements and shall be submitted with the bid:
 - a) Completely filled in Technical Particulars and compliance to each clause of the specification General Technical Requirements to Additional Details.
 - b) Description of the transformer and all components including brochures.
 - c) General arrangement for Transformer.
 - d) Bill of material.
 - e) Experience Certificate and list
 - f) Type test certificates.
 - g) List of makes of major components as listed above.

2. Drawings / documents to be submitted after the award of the contract are as under:

Sl.No.	Description	For Approval	For Review Information	Final Submission
1	Technical Parameters	√	√	√
2	GA Drawing of Transformer	√	√	√
3	HV and LV bushing internal view with terminal connector	√	√	√
4	Internal coil arrangement with dimensions	√	√	√
5	Breather Drawing			
6	Rating Plate	√		
7	Cooling calculation with no. of radiators and fins mentioned specifically	√	√	√
8	Prismatic oil level gauge drawing			√
9	Installation Instruction		√	√
10	QA & QC Plan		√	√
11	Test Certificates	√	√	√
12	Shipping drawings Showing dimensions and weights of each package.	√	√	√
13	Assembly drawings and weight of main component parts.	√	√	√
14	Drawings giving Weights for foundations	√	√	√

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15	Tap changing and nameplate diagram.	√	√	√
16	Schematic control along with logic block diagram and wiring diagram for all auxiliary equipment.		√	√
17	Schematic diagram showing the flow of oil in the cooling system as well as each limb and winding. Longitudinal and cross-sectional views showing the duct sizes, cooling pipes etc.	√	√	√
18	Large scale drawings of high and low tension windings of the transformers showing the nature and arrangement of insulation and terminal connections.	√	√	√
19	Bushing drawing and specifications.	√	√	√
20	Crane requirement for assembly and dismantling.		√	√
21	Overhead Conductor Connections.		√	√
22	Foundation drawing of transformer, radiator supports, etc.		√ √	√
23	Valve Schedule details	√	√	√
24	HV , LV Bushing fixing and connection Details		√	√
25	Radiator drawing and their fixing arrangement.		√	√
26	Marshalling junction box details	√	√	√
27	Cooler Control Drawing	√	√	√
28	Thermo junction box details.			
29	Neutral arrangement	√		√
30	Drawing showing conservator with air bag and oil filling instructions	√	√	√

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In addition to the above, the following drawing / information for each item pertaining to marshalling box and OLTC shall also be supplied.

30	General arrangement drawing of the marshaling box	√	√	√
31	Shipping drawings showing dimensions and weight of each package	√	√	√
32	Drawing giving the weight for its foundation.	√	√	√
33	Schematic control drawing and TB schedule / wiring diagram for all elements	√	√	√
34	Valve Schedule	√	√	√
35	Test report of all bought out elements.	√	√	√
36	The tightening torque chart	√	√	√

3. List of Calculations to be submitted:

1. All the calculations shall be step by step showing the use of formulas and other practical considerations. Concise calculations in table or excel sheet shall not be accepted. Also, the reference (only standard sources as IS, IEC or any such standard is acceptable) of the formulas shall be mentioned.
2. Resistance Calculation (75 deg. C)
3. Load Losses Calculation (at 75 deg. C)
4. No load Losses.
5. Stray Losses.
6. Weight of Copper (Bare and with Insulation also).
7. Weight of Core.
8. BH curve & Loss/Kg graph of core material offered.
9. Flux Density calculations.
10. Current Density Calculations.
11. Short Circuit withstand.
12. Temperature Rise Calculations.
13. Conservator Volume calculations
14. Cooling Calculations showing cooling with tank and radiators separately with no. of radiators and fins mentioned specifically (For both Mineral oil and Ester oil)
15. Calculation sheet for Lifting lug design and mounting lug design to be submitted by Bidder.

4. Additional Documents to be submitted :

- a. List of raw materials as well as bought out accessories and name of sub-suppliers selected from those furnished along with offer.
- b. Type test certificates of the raw materials and bought out accessories.
- c. The successful Bidder shall submit the routine test certificates of bought out accessories and central excise passes for raw material at the time of routine testing.

All the documents & drawings shall be in English language. After the receipt of the order, the successful bidder will be required to furnish all relevant drawings/parameters/calculation to TATA POWER DISCOM for approval.

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5. Instruction Manuals:

Bidder shall furnish softcopies and four (4) hard copies of nicely bound manuals (In English language) covering erection and maintenance instructions and all relevant information and drawings pertaining to the main equipments as well as auxiliary devices.

19. SCHEDULE- "A" GUARANTEED TECHNICAL PARTICULARS:

Sl. No.	Description	Unit	As furnished by Bidder
1.0	Tapings on HV winding ON Load a) Range b) Number of steps c) Principal tap		
2.0	For ON load taps, specify details of OLTC gear (incl. type & make)		
2.1	Manual/automatic control		
2.2	Remote/local control		
2.3	If remote control, whether the remote Control cubicle included in Bidder's scope of supply		
2.4	Voltage class of OLTC		
2.5	Current rating of OLTC		
2.6	a) Location of OLTC with respect to HV winding (attach sketch). b) Location of OLTC (In Tank/Outside Tank)		
2.7	Whether separate tap winding provided for OLTC		
2.8	Whether Selector and diverter chamber are separate		
2.9	Total oil in the OLTC in selector switch -- In diverter switch		
3.0	Winding		
3.1	Maximum current density in winding	Amps/mm ²	
3.2	Use of continuously transposed conductor (CTC) in LV winding.	Yes/No	Yes
3.3	Area of cross section of winding conductor (HV/LV/Reg).	mm ² (Min)	
3.4	Description of winding insulation		
3.5	Nature of insulation	Class	
3.6	Bare weight of copper in windings without paper insulation and leads.	Kg (Minimum)	

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3.7	Details of winding and winding conductor		
3.8	Voltage per turn		
3.9	Percentage impedance at highest and lowest Taps		
3.10	Winding resistance at 20 deg.C		
4.0	Tank :		
4.1	Approximate thickness		
	Sides Bottom Cover	mm mm mm	
4.2	Material of tank		
5.0	Maximum temperature-rise above an ambient of (deg.C) a)Top oil b)Windings c) Temperature Gradient between Oil and Winding	°C °C °C	
6.0	Total loss at rated voltage at principal tapping and rated frequency.	kW	
7.0	Component losses: at 90%, at 100%, andAt 110% :		
7.1	Maximum Guaranteed No load loss at rated voltage on principal tapping and at rated frequency :	kW	
7.2	Calculated No load loss at rated principal tapping & rated frequency. Submit necessary calculations	kW	
7.3	Maximum guaranteed I ² R loss at rated current for the principal tapping at 75°C.	kW	
7.4	Calculated I ² R loss at rated current for the principal tapping at 75°C. Submit necessary calculations.	kW	
7.5	Calculated additional losses (Eddy + stray losses) at rated current for the principal tapping at 75°C.Submit necessary Calculations.	kW	
7.6	Maximum guaranteed additional losses (Eddy + stray losses) at rated current for the principal tapping at 75°C.	kW	
7.7	Maximum Guaranteed auxiliary losses	kW	
7.8	Auxiliary losses at rated current for principal tripping:	kW	
7.9	Maximum Calculated total Losses (sum of sr.no.7.2+7.4+7.5+ 7.7) submit necessary calculation.	kW	

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7.10	Guaranteed Total Losses (sum of sr. no. 7.1+7.3+7.6+7.7) submit necessary calculation.	kW	
8.0	Impedance voltage at rated current for the principal tapping HV LV (Percent) Note: (The above impedance values shall be on full MVA rating of transformer i.e. For 2 winding transformer on 20 MVA base)	%	
9.0	Reactance at rated current and rated frequency (On full MVA rating of transformer i.e. For 2 winding transformer on 20 MVA base) i) HV LV ii) No load current at rated voltage and rated frequency	%	
10.0	a) Partial discharge level : b) Noise level : c) Harmonic content in charging current :		
11.0	Insulation level		
11.1	Separate source power-frequency voltage withstand: i)HV winding ii)LV winding iii)LV neutral	kV rms kV rms kV rms	
11.2	Induced over voltage withstand i)HV winding ii)LV winding iii)LV neutral	kV rms kV rms kV rms	
11.3	Full wave lightning impulse withstand voltage: i)HV winding ii)LV winding iii)LV neutral	kV peak kV peak kV peak	
11.4	Uniform/Graded Insulation: i)HV winding ii)LV winding iii)LV neutral	kV peak kV peak kV peak	
12.0	a) External short circuit withstand capacity b) External short circuit withstand capacity i) for HV side ii) for LV side c) Duration of external short withstand capacity	MVA kA kA In Sec.	
13.0	Efficiencies at 75 deg.C at unity power factor : a) At full load b) At 3/4 full load c) At 1/2 full load d) At 1/4 full load	% % % %	

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14.0	Efficiencies at 75 deg.C at 0.8 power factor : a) At full load b) At 3/4 full load c) At 1/2 full load d) At 1/4 full load	% % % %	
15.0	a) 415 V single phase short circuit impedance b) Percentage variation between phases.		
16.0	Regulation at full load at 75 deg.C a)At unity power factor b)At 0.8 power factor lagging	% %	
17.0	Terminal arrangement: a) High voltage b) Low voltage c) Neutral (LV) d) HV terminal phase spacing e) LV terminal phase spacing f) Any other information		
17.1	Cooling fans a) Type b) Quantity c) Rating		
17.2	a) Rating of each cooler or cooler bank in percent. b) Whether Radiators can be placed on either side of transformers and whether mounted separately c) Whether Reverse flow blocking device and flow indicators provided		
18.0	Approximate masses: a) Core b) Winding c) Bare weight of copper in windings without paper insulation and leads d) Tanks, fittings and accessories. e) Oil f) Total mass	Kg Kg Kg Kg Kg Kg	

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19.0	Approximate quantity of oil required for filling (main tank) OLTC Overall maximum dimensions of the transformer complete with accessories : a) Length b) Breadth c) Height	mm mm mm	
	Un-tanking height Reference standards		
20.	Details of HV Bushings line a) Voltage class, b) Current rating, c) 1.2/50 micro - sec impulse withstand d) Make e) Type f) Creepage distance, total g) Creepage distance, protected. h) Year of manufacture. i) Qty. of oil in oil filled bushing	kV A kV (rms) mm mm MM/YYYY Ltr.	
21	Details of LV Bushings line (LV line end) a) Voltage class, b) Current rating, c) 1.2/50 microsec impulse withstand d) Make e) Type f) Creepage distance, total g) Creepage distance, protected. h) Year of manufacture. i) Qty. of oil in oil filled bushing	kV A kV(rms) mm mm MM/YYYY Ltr.	
22.0	Details of Neutral Bushings a) Voltage class, b) Current rating, c) 1.2/50 s impulse withstand d) Make e) Type f) Creepage distance, total g) Creepage distance, protected. h) Year of manufacture. i) Qty. of oil in oil filled bushing	kV A kV (rms) mm mm MM/YYYY Ltr.	

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23.0	Details of Core Grounding Bushings a) Voltage class, b) Current rating, c) 1.2/50 s impulse withstand d) Make e) Type f) Creepage distance, total g) Creepage distance, protected. h) Year of manufacture. i) Qty. of oil in oil filled bushing	kV A kV (rms) mm mm MM/YYYY Ltr.	
24.0	Details of LV Cable Connection a) Clearances i) Phase to Phase ii) Phase to Earth b) Drawing enclosed c) Length of Each phase Bus Bars. The Bus bars are suitable for how many numbers of 1Cx 1000 sq mm, 11kV, XLPE cable.		
25.0	Designed Fault Levels: a) HV b) LV	MVA MVA	
26.0	Core a) Material & Grade b) thickness in mm c) Type of core d) Operating flux density e) Maximum flux density f) Over fluxing capability for 10% voltage & 3% frequency variation g) Specific No load loss for the grade of core chosen at the specified flux density. h) Net weight of CRGO lamination in core. (Kg minimum). (Please submit copy of graph in support of this)	Yes / No Watts/Kg	

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27.0	Details of CTs on HV Bushings (Line) a) No. of cores b) Ratio for each core c) VA burden - for each core (along with Imag and VK wherever necessary) d) Accuracy class of each core e) Year of manufacture. f) Short time thermal current rating i) Current ii) Rated time	kA	
28.0	Details of CTs on LV Bushings.(Line) a) No. of cores b) Ratio for each core c) VA burden - for each core (along with Imag and VK wherever necessary) d) Accuracy class of each core. e) Year of manufacture. f) Short time thermal current rating i) Current ii) Rated time	kA	
29.0	Rail gauge (along both axis)		
	Whether Cooler control scheme conforms to specified Capability of transformer to remain in operation from hot condition after failure of forced cooling Full load Minutes		
	Overload capacity of transformer for 100% ONAF coolers working simultaneously		
30.0	Whether Neutral end surge diverter recommended by bidder		
31.0	If yes details of surge diverter a) Type b) Make kV class kV rating		
32.0	Tertiary winding if any kept isolated then the bidder to state whether one terminal to be earthed or any other precautions required during service conditions		

33.0	On load tap changer Particulars a) Make b) Type, designation c) Suitable for auto/manual operation d) Rated voltage kV e) Basic insulation level (BIL) of OLTC (kV peak) f) One minute power frequency voltage withstand of OLTC g) Rated current (A) h) No. of steps i) Step voltage (V) j) Rated voltage of drive motor(V) k) Whether diverter and selector chambers are separate. l) Rated voltage of control circuit(V) m) Time to complete tap changing operation from any one step to next higher or lower tap. i) On auto operation - Sec. ii) On manual operation through push button - Sec. n) List of routine tests to be carried out on tap changer o) Location of the taps with terminals of the tapped winding p) Drawing or pamphlet number of the technical and descriptive particulars of the OLTC, enclosed with the bid. q) Separate conservator and Buchholz relay provided for OLTC (Yes/No) r) RTCC (Remote Tap Changer Control Panel) i. List of tap changer Annunciation ii. Two sets of potential free contacts for SCADA provided. iii. Two sets of 0/20 mA output for tap position indication provided. iv. 415 V Auto changeover facility for OLTC motor provided.		
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34.0	Marshalling Box a) Derived control supply Voltage b) 415 V /control supply auto-changeover facility provided. c) Local OTI/WIT provided. d) Remote OTI/WIT provided. e) Two sets of 0/4-20 mA signals for OTI/WIT provided. f) List of annunciations. g) Two sets of potential free contacts for annunciations provided.		
35.0	Whether Marshalling boxes (ground as well as tank) provided as per specifications		
36.0	Surface Preparation/Painting a) Material used fir Adequate rust proofing done on transformer and radiator (Details of measures to be enclosed) b) Type of paint (epoxy/enamel) c) Whether galvanized radiator offered as alternative.		
37.0	Conservator Oil preservation system Details (Air bag) a) Material of separator/Air bag b) Details of air pressure for the separator i. Design pressure ii. Working pressure iii. Bursting pressure (Puncture strength) c) Procedure of oil filling with air bag to be enclosed. d) Any precautions to be taken during maintenance of transformer with air bag to be mentioned here.		
38.0	General arrangement drawing of the transformer indicating details of HV/MV/LV terminals and over all dimensions enclosed		Yes/No
39.0	Neutral Bushing Calculation to be submit.		Yes

Central Engineering Services		TECHNICAL SPECIFICATION FOR 12.5/16, 16/20, 20/25 and 25/31.5MVA Power Transformer (33/11KV & 66/11KV)
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20. SCHEDULE “B” DEVIATIONS:

(TO BE ENCLOSED WITH TECHNICAL BID)

All deviations from this specification shall be set out by the Bidders, clause by Clause in this schedule. Unless specifically mentioned in this Schedule, the tender shall be deemed to confirm the purchaser's specifications:

SL. No	Clause No.	Details of deviation with justifications

We confirm that there are no deviations apart from those detailed above.

Seal of the Company:

Signature

Designation