

NTPC LTD**CC-OS****EOC NOIDA****Sub: Qualifying Requirement for Vendor Enlistment for supply of Transformers > 12kV-145kV**

A)	MEG DETAILS		
	1.0	MEG NO.	87MEC-3C
	2.0	MEG DESCRIPTION	Transformers > 12kV-145kV
	3.0	RESPONSIBILITY CENTRE	CC
B)	Technical Criteria of QR: <ol style="list-style-type: none">1. The Vendor should have designed manufactured, installed/supervised installation and commissioned/supervised commissioning of at least two (2) numbers (one each at two different installations) of 132kV or above class Transformers of at least 80MVA capacity which should have been in successful operation for at least two years prior to the date of application for enlistment. <p style="text-align: center;">And</p>2. Vendor should have its own testing facilities for conducting all Routine and Type Tests as per IS:2026 (except Short Circuit Test) <p style="text-align: center;">And</p>3. 80MVA, 132kV or higher rated Oil Filled Transformer manufactured by Vendor should have been successfully short circuit tested. <p>NOTE: Two different installations means two different project sites or two different contracts.</p>		
C)	Other Documents to be submitted: In addition to the documents required in support of meeting technical requirements as stated above, following documents are required to be submitted by the Applicants applying for enlistment:- <ol style="list-style-type: none">1. Three POs of the highest executed values of similar work during previous five years from the date of application. Copy of Invoice / Completion certificate from the concerned buyer/s in support of successful execution of supply against the POs to be submitted.2. Audited balance sheet including Profit & Loss statement for the previous three completed financial years reckoned from the date of application. In case the audited documents are not ready / available, then certified copy by a registered practicing Chartered accountant may be submitted.3. Latest annual report OR NSIC / SSI / MSME registration certificate / BIS license / ISO certificate / Certificate of registration from the concerned excise department / any other statutory document as a proof of being manufacturer of the required material.4. Any other documents in addition to the above which the applicant wants to submit.		
D)	NOTE-1	Similar works means: Supply of 132kV or above class Transformers	
	NOTE-2	The executed value means Basic value of quantity of similar works executed/supplied against the reference PO(also applicable to partly executed POs as on date of application).Where PO value is composite(i.e. including Taxes etc.),the applicant to give item-wise break-up of Composite PO value mentioning Basic Value, Taxes etc.	

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Sub: Technical Specifications for Vendor Enlistment for supply of supply of Transformers > 12kV-145kV

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B)	Technical Specifications: As per attached annexure below		

Clause No.	Technical Data Requirements																																												
	<p>GENERAL INFORMATION TO BIDDER</p> <p>The offered transformer should be suitable for replacing the existing Transformer.</p> <p>The bidder is advised to visit site and get detail information /drawings and make comparative study of HV & LV side connection, existing fire water connection(if any), orientation of marshalling box & conservator, existing foundation plan and location of fire wall & sprinkler system.</p> <p>The bidder shall offer the Transformer for one to one replacement of existing transformer i.e. there will be no need to change the existing foundation, LV side busduct connection and external cable connection etc. The cooler & conservator shall be tank mounted.</p> <p>The bidder shall also furnish necessary drawings such as busduct adopter pieces, flexible for connecting busduct & LV bushing, foundation etc. required for replacement of existing transformer. NTPC intends to use these drawings for procurement of necessary hard wares if required for replacing existing with offered one.</p> <p>NOTE: NECESSARY MODIFICATION TO BE DONE AS PER SITE REQUIREMENTS BEFORE TENDERING</p>																																												
1.00.00	TECHNICAL PARAMETERS																																												
1.01.00	<table border="0"> <thead> <tr> <th colspan="2">Unit Transformer (UT)</th> <th></th> </tr> <tr> <th><u>S.N.</u></th> <th><u>Technical Parameters</u></th> <th><u>Unit Transformer</u></th> </tr> </thead> <tbody> <tr> <td>(a.)</td> <td>Rated output</td> <td>--- MVA</td> </tr> <tr> <td>(b.)</td> <td>Cooling</td> <td>ONAN / ONAF</td> </tr> <tr> <td>(c.)</td> <td>ONAN Rating</td> <td>Min. 80% of rated MVA</td> </tr> <tr> <td>(d.)</td> <td>ONAF Rating</td> <td>Rated MVA</td> </tr> <tr> <td>(e.)</td> <td>Type</td> <td>Two winding</td> </tr> <tr> <td>(f.)</td> <td>Voltage Ratio</td> <td>----- kV</td> </tr> <tr> <td>(g.)</td> <td>Vector group</td> <td>Site to fill</td> </tr> <tr> <td>(h.)</td> <td>Frequency</td> <td>50 Hz</td> </tr> <tr> <td>(i.)</td> <td>Phase</td> <td>Three (3)</td> </tr> <tr> <td>(j.)</td> <td>Service</td> <td>Outdoor</td> </tr> <tr> <td>(k.)</td> <td>Duty</td> <td>Continuous</td> </tr> <tr> <td>(l.)</td> <td>Overload capacity</td> <td>As per IEC 60076-7 and as specified</td> </tr> </tbody> </table>			Unit Transformer (UT)			<u>S.N.</u>	<u>Technical Parameters</u>	<u>Unit Transformer</u>	(a.)	Rated output	--- MVA	(b.)	Cooling	ONAN / ONAF	(c.)	ONAN Rating	Min. 80% of rated MVA	(d.)	ONAF Rating	Rated MVA	(e.)	Type	Two winding	(f.)	Voltage Ratio	----- kV	(g.)	Vector group	Site to fill	(h.)	Frequency	50 Hz	(i.)	Phase	Three (3)	(j.)	Service	Outdoor	(k.)	Duty	Continuous	(l.)	Overload capacity	As per IEC 60076-7 and as specified
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Clause No.	Technical Data Requirements				
	elsewhere in the specification.				
(m.)	Permissible Temperature rise over an ambient temp. of 50°C				
(i)	Winding (by resistance method)		55°C		
(ii)	Top oil (by thermometer)		50°C		
(n.)	Impedance at 75 deg.C on ---- MVA base				
(i)	On Principal Tap			----% (Tolerance as per IEC)	
	- HV-LV				
(ii)	On Extreme Taps			Impedance variation in extreme taps shall be less than +/- 10 % of impedance value specified in principal tap.	
(o.)	System fault level			----- kArms fault level on HV side	
(p.)	Short circuit withstand time		8 sec.		
(q.)	Noise Level			As per NEMA TR- 1	
(r.)	Winding Details				
S.N.	Parameter	Unit	HV	LV	LVN
i)	Highest System Voltage	kV	36	12	-
ii)	Lightning impulse withstand voltage	kVp	170	75	75
iii)	One min power frequency withstand voltage	kV	70	28	28
iv)	Winding connection	-	Delta	Star	Grounding through NGR.
v)	Insulation	-	uniform	uniform	-
(s.)	Bushing Details				
S.N.	Parameter	Unit	HV	LV	LVN
i)	Rated Voltage	kV	36	12	12
ii)	Rated Current	A	Site to fill	Site to fill	Site to fill
iii)	Lightning impulse withstand voltage	kVp	170	75	75
iv)	One min power frequency	kV	77	30	30
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Clause No.	Technical Data Requirements					
1.02.00	withstand voltage					
	v)	Minimum total creepage distances	mm	900	300	300
	vi)	Mounting	-	Tank Cover	Tank Cover	Tank Cover
	(t) Tap changer Details					
	i)	Tap Changer Type & Control	Full capacity On Load Tap Changer suitable for local/remote electrical/manual operation.			
	ii)	Tap range	+/- --% in steps of ----% on HV winding			
	(u.) Termination Details					
	HV (phase)		Site to fill			
	LV (phase)		Site to fill			
	LVN (Neutral)		Site to fill			
	(v.)	Bushing Current Transformer (Site to fill)				
			LV Neutral Bushings			
			No. of Core	2		
	i)	Core No.	1 st		2 nd	
	ii)	Service	Protection		Protection	
iii)	Ratio					
iv)	Accuracy class					
v)	Knee point voltage					
vi)	C.T. Sec. resistance (ohm)					
vii)	Mag. Current					
viii)	Burden					
<i>This does not include CT's for WTI parameters, which are to be decided by manufacturer.</i>						
Neutral Grounding Resistors (if applicable") 11 KV NGR						
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Clause No.	Technical Data Requirements	
	i)	Resistance Value at 50 deg. C. --- ohms
	ii)	Rated current --- A for 10 seconds
	iii)	Application Neutral Grounding of Star connected LV winding.
	iv)	Service Outdoor
	v)	Resistor material & connection Punched stainless steel grid element type
	vi)	Maximum allowable temperature rise over ambient 50 °C 350 deg. C
	vii)	Mounting 12KV grade insulators.
	viii)	Power frequency test level 28 KV rms.

2.00.00
2.01.00

GENERAL STANDARDS

All equipment provided under the specification shall in general, conform to the latest issue of the following standards:

Indian Standards No.	Title	International & internationally recognized standards
IS: 2026	Power transformers	IEC: 60076
IS: 3639	Fittings & accessories for power transformers	
	Insulating oils for transformer and switchgear	IEC: 60286, BS:148
IS: 2099	Bushing for alternating voltages above 1000 V	IEC: 60137, BS: 223
IS: 2705	Current transformers	IEC: 60186
IS: 325	Three phase induction motors	IEC: 60034
IS: 3637	Gas operated relays	
IS: 10028	Code of practice for selection installation & maintenance of transformers	
IS: 4691	Degree of protection provided by enclosure for rotating electrical machinery	
IS: 8478	On-load tap changer application guide	
IS: 13947	Specification for low voltage switchgear & control gear Part - I	IEC: 144
IS : 5	Colours for ready mix paints	
IS: 1866	Code of practice for maintenance & Supervision of mineral insulating oil in equipment.	
IS: 6272	Industrial cooling fans	
IS: 6600	Guide for Loading of oil immersed transformers	IEC: 60076-7

Technical Specification

Technical Specifications

Unit Transformer

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Air forced cooled transformers shall be capable of operating under natural cooled condition up to the specified load(80%) as indicated. The forced cooling equipment shall come into operation by preset contacts of winding temperature indicator & the transformer shall operate as a forced cooled unit initially as ONAN up to specified load and then as ONAF.</p> <p>(b.) Total cooling system of transformer with oil natural & air forced (ONAF) cooling shall be so designed 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 the calculated winding hot spot temperature exceeding 140 deg. C. Also stopping of one of the cooling fan should not have any effect on the cooling system of transformers</p> <p>(c.) The maximum flux density in any part of the core & yoke at the rated MVA, voltage & frequency shall be such that under 110% continuous voltage condition it does not exceed 1.9 Tesla as per design.</p>
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	<p>(d.) The transformer & all its accessories including CT's etc, shall be designed to withstand without injury the thermal & mechanical effects of any external short circuit to earth & of short circuits at the terminal of any winding for a period as follows:</p> <p>Unit transformer - 8 sec</p> <p>Contractor shall submit the short circuit withstands calculations.</p> <p>(e) Transformers shall withstand, without injurious heating, combined voltage & frequency fluctuations, which produce the following over fluxing condition:</p> <ol style="list-style-type: none"> 1) 110 %- continuous 125%- for one minute 140%- for five seconds 2) Bidder shall indicate 150% & 170% over voltage withstand time. 3) Over fluxing characteristics up to 170 % shall be submitted. <p>(f.) The air core reactance of HV winding of Unit Transformers shall not be less than 20% as per design.</p> <p>(g.) The transformers shall be capable of being operated continuously without danger on any tapping at the rated MVA with voltage variation of $\pm 10\%$ corresponding to the voltage of tapping.</p> <p>(h.) The transformers shall be capable of being loaded in accordance with IS: 6600 / IEC: 60076-7 up to load of 150 %. There shall be no limitation imposed by bushings, tap changers etc. or any other associated equipment.</p>		
4.00.00	<p>CONSTRUCTION</p>		
	<p>The features & construction details of each transformer shall be in accordance with the requirement stated hereunder.</p>		
4.01.00	<p>TANK AND TANK ACCESSORIES</p> <p>(a.) Tank shall be of welded construction & fabricated from tested quality low carbon steel of adequate thickness. The welding procedure specification (WPS), procedure qualification record (PQR), shop welding schedule, welder's qualification shall be subject to Employer's approval. After completion of welding, all joints shall be subjected to visual examination. In case of doubt particular weld shall be checked by D.P.Test. However weld joints of load bearing member shall be left unpainted till carrying out of jacking test followed by DP Test during final inspection of transformer. Details of acceptance norms of welding shall be submitted for Employer's approval which shall include permissible undercut, overlap, surface crack, porosity, out of alignment of plate surface in butt joints, maximum gap due to incorrect fit up of fillet joint etc.</p> <p>(b.) Each tank shall be provided with :</p> <ol style="list-style-type: none"> (1.) Lifting lug suitable for lifting the equipment complete with oil. 		
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Clause No.	Technical Data Requirements		
4.02.00	<p>(2.) A minimum of four jacking pads in accessible position to enable the transformer complete with oil to be raised or lowered using hydraulic or mechanical screw jacks.</p> <p>(3.) Suitable haulage holes shall be provided for transformer wheeling in all four directions.</p> <p>(c.) The transformers are to be provided with flanged bi-directional wheels & axles & shall be mounted on wheels on foundation. Suitable locking arrangement shall be provided for the wheels to prevent accidental movement of transformer. The rail track gauge shall be 1676 mm along longer axis as well as along shorter axis. Other transformers shall be provided with four no. of bi-directional flat rollers of detachable type. For all transformers, suitable bi-directional skids with pre-drilled holes shall be provided integral with the tank body for fixing the transformer tank on foundation. These skids shall be such that the bottom of the tank body is at a sufficient height above foundation for cleaning purposes.</p> <p>(d.) At least two adequately sized inspection openings one at each end of the tank shall be provided for easy access to bushing & earth connections. The inspection covers shall not weight more than 25 Kg. Handles shall be provided on the inspection cover to facilitate lifting.</p> <p>(e.) magnetic.</p> <p>(f.) All bolted connections shall be fitted with weather proof & hot oil resistant of 'O' ring of Nitrile rubber in between for complete oil tightness. If gasket is compressible, metallic stops shall be provided to prevent over compression.</p> <p>(g.) The tank shall be designed in such a way that it can be mounted on the plinth directly.</p> <p>(h.) Wherever possible the transformer tank & its accessories shall be designed without pockets wherein gas may collect. Where pockets can not be avoided, pipes shall be provided to vent the gas into the main expansion pipe.</p> <p>(i.) The main tank body including tap changing compartment, radiators shall be capable of withstanding full vacuum.</p>		
	<p>Core</p> <p>(a.) The core shall be constructed from high-grade non-aging, cold rolled, super grain oriented, silicon steel laminations, known as HI-B steel trade name or equivalent.</p> <p>(b.) The insulation of core to tank, clamp to tank & core to clamp shall be able to withstand a voltage of 2 kV (rms.) for 1 minute in air.</p> <p>(c.) The core earthing for Transformers has to be done outside the tank with suitable bushing to facilitate core isolation test during pre-commissioning stage.</p> <p>(d.) Adequate lifting lugs will be provided to enable the core & windings to be lifted.</p>		
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4.03.00	<p>Windings</p> <p>(a.) The contractor shall ensure that windings of all transformers are made in dust proof & conditioned atmosphere. The bidder shall furnish details of the facilities available at his works along with the bid.</p> <p>(b.) The conductors shall be of electrolytic grade copper free from scales & burrs.</p> <p>(c.) All windings of the transformers having voltage less than 66 kV shall be fully insulated.</p> <p>(d.) In case of three winding transformer, the HV, LV1 & LV2 windings shall be so arranged and designed that :</p> <ol style="list-style-type: none"> (1.) The impedance between the LV1 & LV2 windings is as high as is reasonably achievable, but not less than the value indicated under 'Technical Parameters'. (2.) There are no limitations on the individual loading of the LV1 & LV2 windings, which may vary from zero to full load. Load variations on either of these windings shall have the minimum effect on voltage of the other windings (3.) The transformer can withstand without damage full short circuit current in the system connected to the LV windings. The bidder shall describe the proposed winding configuration in his offer. (4.) Delta connected stabilizing tertiary winding (if provided) shall be adequately sized and insulated. One end of the delta shall be brought out for grounding. If no tertiary delta winding is provided, the bidder shall explain how the third harmonic voltage is suppressed. <p>(e.) Tapping shall be so arranged as to preserve the magnetic balance of the transformer at all voltage ratio.</p>																													
4.04.00	<p>Insulating Oil</p>																													
4.04.01	<p>No inhibitors shall be used in the transformer oil. The oil supplied with transformers shall conform to following while tested at supplier's premises and shall have following parameters.</p>																													
	<table border="1"> <thead> <tr> <th>S.No.</th> <th>Property</th> <th>Permissible values</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Kinematic Viscosity, mm²/s</td> <td>≤ 12 at 40 ° C ≤ 1800.0 at (-)30 ° C</td> </tr> <tr> <td>2.</td> <td>Flash Point, ° C</td> <td>≥ 140° C</td> </tr> <tr> <td>3.</td> <td>Pour point, ° C</td> <td>≤ (-)40 ° C</td> </tr> <tr> <td>4.</td> <td>Appearance</td> <td>Clear , free from sediment and suspended matter</td> </tr> <tr> <td>5.</td> <td>Density kg/dm³ at 20 ° C</td> <td>≤ 0.895</td> </tr> <tr> <td>6.</td> <td>Interfacial Tension N/m at 25° C</td> <td>≥ 0.04</td> </tr> <tr> <td>7.</td> <td>Neutralisation value, mgKOH/g</td> <td>≤ 0.01</td> </tr> <tr> <td>8.</td> <td>Corrosive sulphur</td> <td>Non Corrosive</td> </tr> </tbody> </table>			S.No.	Property	Permissible values	1.	Kinematic Viscosity, mm ² /s	≤ 12 at 40 ° C ≤ 1800.0 at (-)30 ° C	2.	Flash Point, ° C	≥ 140° C	3.	Pour point, ° C	≤ (-)40 ° C	4.	Appearance	Clear , free from sediment and suspended matter	5.	Density kg/dm ³ at 20 ° C	≤ 0.895	6.	Interfacial Tension N/m at 25° C	≥ 0.04	7.	Neutralisation value, mgKOH/g	≤ 0.01	8.	Corrosive sulphur	Non Corrosive
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4.04.02	S.No.	Property	Permissible values	
	9.	Water content mg/kg	≤ 30 in bulk supply ≤ 40 in drum supply	
	10.	Anti oxidants additives	Not detectable	
	11.	Oxidation Stability Neutralisation value, mgKOH/g Sludge, % by mass	≤ 1.2 ≤ 0.8	
	12.	Breakdown voltage As delivered, kV After treatment, kV	≥ 30 ≥ 70	
	13.	Dissipation factor, at 90° C And 40 Hz to 60 Hz	≤ 0.005	
	14.	PCA content	$\leq 1\%$	
	15.	Impulse withstand Level, kVp	≥ 145	
	16.	Gassing tendency at 50 Hz after 120 min, mm ³ /min	≤ 5	
	Subsequently oil samples shall be drawn at:			
	1) Before filling in main tank at site & tested for			
	i) BDV 60 kV (min) ii) Moisture content 10 ppm (max.) iii) Tan delta at 90 deg. C 0.005 (max.) iv) Interfacial tension 0.04 N/m(min)			
	2) Prior to energization at site for following properties & acceptance norms:			
	i) BDV 60 kV (MIN) ii) Moisture content 10 ppm (max.) iii) Tan delta at 90 deg. C 0.05 (max.) iv) Interfacial tension 0.035 N/m (min)			
	Oil Preservations System			
	Bidder shall offer air cell type oil sealing in the conservator to prevent oxidation and contamination of oil due to contact with water. The requirement of air cell type constant oil preservation system are given below:			
1) Contact of the oil with atmosphere is prohibited by using a flexible urethane or nitrile rubber reinforced with nylon cloth air cell. 2) The connection of air cell to the top of reservoir is by air proof seal preventing entrance of air into the conservator. 3) The temperature is likely to rise upto 110 Deg C when the transformer is in operation. As such air cell used shall be suitable for operating continuously at 100 deg. C. 4) A silicagel breather (Cobalt free) shall be provided in the air side vent line.				
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Clause No.	Technical Data Requirements		
<p>4.05.00</p> <p>4.05.01</p> <p>4.05.02</p>	<p>Terminal Arrangements</p> <p>Bushings</p> <p>(a.) The electrical & mechanical characteristics of bushings shall be in accordance with IS: 2099, IS: 3347 & IS: 12676.</p> <p>(b.) Bushing for 52 KV & above shall be of Resin Impregnated Paper (RIP) with composite insulator. Bushing for rating below 52 KV, shall be solid porcelain/ condenser/ RIP (Resin impregnated Paper) type. All condenser bushings shall be non-communicating type.</p> <p>(c.) All composite resin impregnated bushings (RIP) shall be provided with provision for long term storage to protect from moisture and rodents. The oil side shall be provided with tank which can be filled with oil. Tank shall have necessary provision for oil filling, level gauge etc. Suitable covering to be provided on air side to protect from any damage. The arrangement shall be suitable for storage in horizontal/ vertical direction in outdoor location.</p> <p>(d.) The oil end dimension of RIP bushing shall be same for all bushings of similar voltage rating.</p> <p>(e.) Condenser type bushings shall be provided with:</p> <ul style="list-style-type: none"> <li>i) Oil level gauge <li>ii) Oil filling plug <li>iii) Tap for capacitance and Tan delta test <p>(f.) Clamps & fittings shall be of hot dip galvanized steel.</p> <p>(g.) Bushing & fittings shall be provided with vent pipes that shall be connected to route any gas collection through the Buchholz relay.</p> <p>(h.) No arcing horns shall be provided on the bushings.</p> <p>(i.) LV Bushing palm shall be Silver/Tin plated.</p> <p>(j.) Wherever cable termination is specified, bushing terminals shall be provided with suitable terminal connectors of approved type and size for cable termination.</p> <p>(k.) Where current transformers are specified, the bushings shall be removable without disturbing the current transformer.</p> <p>(l.) Neutral CT's shall be located in the lead coming out of the winding and location of these CT's shall not be inside the tank.</p> <p>Bus Duct Terminations</p> <p>(a.) A flanged throat or equivalent connection shall be provided for termination of busduct enclosure. The winding termination shall be on outdoor type of bushings. The Employer would provide necessary flexible connection between the bushing</p>		
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	<p>terminal & the bus duct conductor. The material of the busduct termination shall be non-magnetic.</p> <p>(b.) The HV terminal of UT shall be terminated by isolated phase busducts. HV side of unit transformers shall have suitable terminal pads to facilitate the termination with the generator bus duct conductor. The shape of the bus duct conductor shall be informed during detailed engg. The bushing pads shall be silver/tin plated. A drain with stopcock arrangement shall be provided at flange to drain leakage of oil/water at termination. As bus duct will be pressurized stopcocks shall be airtight.</p> <p>(c.) For LT terminals of UT, phase segregated busducts shall be provided. Phase segregation shall be achieved by metallic barriers.</p> <p>(d.) Tolerance permissible for the height of the terminal connected to busduct over rail top level is ± 10 mm. Contractor has to ensure that radiator & conservator does not obstruct the path of the bus ducts in position & during movement of transformer. The contractor shall co-ordinate final design of terminal arrangement to suit bus duct arrangement during detailed engineering.</p> <p>(e.) The transformer bushing enclosed in bus duct enclosure shall be designed for satisfactory operation in the high ambient temperature existing inside the bus duct enclosure. The temperature inside the bus duct enclosure may be of the order of 90 – 100 deg. C. The bus duct conductor temperature may be as high as 105 deg. C & temperature in the bus duct enclosure will be of the order of 80 deg. C.</p> <p>4.05.03 Cable boxes & Disconnecting chamber(as applicable)</p> <p>(a.) Cable boxes shall be of phase segregated air insulated type & shall be of sufficient size to accommodate Employer's cable & termination. Phase segregation shall be achieved by insulating barriers.</p> <p>(b.) Cable boxes shall have bus bars / terminal connectors of adequate size & bolt holes to receive cable lugs.</p> <p>(c.) A suitable removable gland plate of non-magnetic material drilled as per the Employer's instruction shall also be provided in the cable box.</p> <p>(d.) The support from base for the cable box shall be of galvanized iron.</p> <p>(e.) The contractor shall provide earthing terminals on the cable box, to suit Employer's GI flat.</p> <p>(f.) The minimum length provided for terminating 11KV/33 KV XLPE cable shall be 650 mm/850mm (from cable gland plate to the cable lug) for the cable boxes. The final cable size, number & length of terminating XLPE cable shall be furnished during detailed engg.</p> <p>(g.) Cable boxes shall be designed such that it shall be possible to move away the transformer without disturbing the cable terminations, leaving the cable box on external supports. Cable box shall have IP-55 protection as per IS:13974.</p>		
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<p>4.05.04</p>	<p>(h.) Cable boxes shall have removable top cover & ample clearance shall be provided to enable either transformer or each cable to be subjected separately to high voltage test.</p> <p>Terminal Connectors (as applicable)</p> <p>(a.) Bushing terminal shall be provided with terminal connectors of approved type & size for connection to external part. Terminal connectors must have been successfully type tested as per IS: 5561</p> <p>(b.) Terminal connectors for transformers shall be suitable for moose ACSR. These shall be suitable for either horizontal or vertical take off.</p> <p>(c.) Aluminum alloy if used shall conform to designation 4600 M of IS: 617 or of better quality.</p> <p>(d.) No current carrying part of a clamp shall be less than 10 mm thick.</p> <p>(e.) All ferrous parts shall be hot dip galvanized conforming to IS: 2633.</p> <p>(f.) For bi-metallic clamp, copper alloy liner of minimum 2-mm thickness shall be cast integral with aluminum body. Alternatively Bidder may offer bimetallic connector with loose bimetallic sleeve.</p> <p>(g.) Flexible connectors shall be made from tinned copper sheets.</p> <p>(h.) Size of terminal/conductor for which the clamp is suitable & rated current under the conditions shall be embossed / punched on each component of the clamp, except hardware.</p> <p>(i.) Rated current of the terminal connectors shall be same as that of corresponding bushing.</p>		
<p>4.06.00</p>	<p>Bushing Current Transformer</p> <p>(a.) Current transformer shall comply with IS: 2705</p> <p>(b.) It shall be possible to remove turret mounted current transformers from the transformer tank without removing the tank cover. Necessary precautions shall be taken to minimize eddy currents & local heat generated in the turret.</p> <p>(c.) All secondary leads shall be brought to a weatherproof terminal box near each bushing. These terminals shall be wired out to transformer marshalling box using separate cables for each core.</p>		
<p>4.07.00</p>	<p>Terminal Marking</p> <p>The terminal marking & their physical position shall be as per IS: 2026 unless specified otherwise.</p>		
<p>4.08.00</p>	<p>Neutral Earthing Arrangement</p>		
<p>Technical Specification</p>	<p>Technical Specifications</p>	<p>Unit Transformer</p>	<p>Page 12 of 33</p>

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4.09.00	<p>(a) <u>For Solidly Grounding Arrangement:</u></p> <p>Neutral shall be brought through insulated support from tank to the ground level at a convenient point through two nos. of copper flat. The same will be connected to ground network through Two (2) suitable size galvanised steel flats (owners). The connection shall be made by using two (2) bolted neutral grounding terminals with necessary accessories.</p> <p>(b) <u>For Low Resistance Grounding Arrangement:</u></p> <p>The neutral shall be brought to an outdoor bushing, away from the busduct termination arrangement (wherever applicable). It shall be connected to associated neutral grounding resistor by a copper flat, which shall be supplied & installed by the contractor along with the necessary intermediate supporting insulators & supporting structure.</p>		
	<p>Marshalling Box(M. BOX) Unit</p> <p>(a) Each transformer shall be provided with one Marshalling Box housing all the cooler control, OTI & WTI etc. Each transformer with OLTC shall also be provided with OLTC control cabinet, which will house the OLTC controls & indications.</p> <p>(b) The sheet steel used for all the cabinet boxes shall be at least 2.5 mm thick. The gasket used shall be of neoprene rubber. A space heater & cubicle lighting with on – off switch shall be provided in each cabinet. A circuit breaker/contactor with thermal overload device for controlling the AC auxiliary supply shall be provided.</p> <p>(c) Terminal Blocks</p> <p>(1.) The terminal blocks to be provided shall be fully enclosed with removable covers & made of molded, non-inflammable plastic material with blocks & barriers molded integrally. The terminal blocks shall be of 650V grade & have 10 A continuous rating. Terminal blocks for current transformer secondary leads shall be provided with test links & isolating facilities. Also current transformer secondary leads shall be provided with short circuiting & earthing facilities. At least 20% spare terminals shall be provided on each panel & these spare terminals shall be uniformly distributed on all terminal blocks.</p> <p>(2.) Terminal blocks shall be suitable for connecting the following conductors on each side :</p> <p>i- Current transformer circuits – minimum of two No. of 2.5 sq. mm copper wires each side</p> <p>ii- Other circuits— minimum of one No. of 2.5 sq. mm copper wire each side</p> <p>(d.) All CT terminals shall be provided as fixed type terminals on the Marshalling Box to avoid any hazard due to loose connection leading to CT opening or any other</p>		
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	<p>loose connection. In no circumstances Plug In type connectors shall be used for CT connection. Ring type connectors to be used.</p> <p>(e.) Where apparatus is mounted on panels, all metal cases shall be separately earthed by means of copper wires or strips having a cross section of not less than 2 sq mm where strip is used, joints shall be sweated.</p> <p>(f.) Terminal block rows shall be spaced adequately not less than 100mm apart to permit convenient access to wires and terminations.</p> <p>(g.) The temperature indicators shall be so mounted that the dials are not more than 1500 mm from ground level. Glazed door of suitable size shall be provided for convenience of reading.</p> <p>(h.) All incoming cables shall enter the marshalling box from the bottom. A removable undrilled gland plate shall be provided at the bottom of the box for accommodating glands for Employer's incoming and outgoing cables, which shall not be less than 450 mm from finished floor level.</p> <p>(i.) All devices and terminal blocks inside the marshalling box shall be clearly identified by symbols corresponding to those used on applicable schematic or wiring diagram.</p> <p>(j.) It shall be located in such a way that, the same shall not face towards the transformer.</p> <p>(k.) The gland plate shall be made into two detachable halves, for facilitating the termination of Employer's cable and Contractor's cables separately. The gland plate and the associated compartment shall be sealed in a suitable manner to prevent the ingress to moisture, rodents, insects etc.</p> <p>(l.) One dummy terminal block in between each trip wire terminal shall be provided.</p> <p>(m.) Wiring scheme shall be engraved in a plate (MS) and the same shall be fixed inside Marshalling box.</p> <p>(n.) M. Box shall preferably be Tank Mounted.</p>		
4.10.00	Auxiliary Power Supply For Coolers & OLTC		
4.10.01	Two Auxiliary Power Supplies at 415 V three phase four wire shall be provided by the Employer at M. Box.		
4.10.02	<p>All loads shall be fed by one of the two feeders through an electrically interlocked automatic transfer switch housed in the M. Box for transformers.</p> <p>Design features of the transfer switch shall include the following:</p> <p>(a.) Provision for the selection of one of the feeder as normal source & other as standby</p> <p>(b.) Upon failure of the normal source, the loads shall automatically transfer, after an adjustable time delay, to standby source.</p>		
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	<p>(c.) Indication to be provided for failure of normal source & for transfer to standby source & also for failure to transfer.</p> <p>(d.) Automatic re-transfer to normal source without any intentional time delay following re-energization of the normal source.</p> <p>(e.) Both the transfer & the re-transfer shall be dead transfers & AC feeders shall not be paralleled at any time.</p>						
4.10.03	<p>The supplier shall derive AC feeders for OLTC cabinet after suitable selection at M. Box for which description is given above. The supplier shall derive AC supply for control circuitry from the AC feeder as mentioned above by using appropriately rated dry type transformer. If the control circuit is operated by DC supply, then suitable main & standby converters shall be provided by the supplier to be operated from AC feeder.</p>						
4.11.00	<p>Control Wiring & Cabling.</p> <p>Supply, laying & termination of all cables & accessories required of proper termination from the M. Box except for those stated under next clause below so as to make equipment complete & functional shall be in scope of supplier. The cable between the M. Box & transformer shall be laid by the supplier through GI conduits/ pipes. Cable box / sealing end shall be suitable for following types of cables:</p> <table border="0"> <tr> <td>1)</td> <td>415 V power:</td> <td>1100 V grade PVC insulated aluminum conductor cable with armour.</td> </tr> <tr> <td>2)</td> <td>Control:</td> <td>1100 V grade PVC insulated 2.5 sq. mm stranded copper conductor with armour.</td> </tr> </table> <p>Supplier shall furnish the total auxiliary power requirement for the ONAF/OFAF cooled transformer.</p>	1)	415 V power:	1100 V grade PVC insulated aluminum conductor cable with armour.	2)	Control:	1100 V grade PVC insulated 2.5 sq. mm stranded copper conductor with armour.
1)	415 V power:	1100 V grade PVC insulated aluminum conductor cable with armour.					
2)	Control:	1100 V grade PVC insulated 2.5 sq. mm stranded copper conductor with armour.					
4.12.00	<p>Following cabling are specifically excluded from the scope of the Bidder, however interconnection drawings for the same are to be submitted by the contractor:</p> <p>(a.) Cabling between unit control panel to M. Box.</p> <p>All the control cables for Employer's unit control panel shall be wired by the contractor up to M. Box, from M. Box of respective transformer.</p>						
4.13.00	<p>PAINTING</p> <p>Painting of transformer and its accessories shall be in accordance with the following</p>						
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	chart.			
	PARTS NAME	TYPE OF PAINT	NO.OF COATS	TOTAL DFT
	Inside of tank and accessories (except M Box)	Oil & heat resistant fully glossy white	One coat	Atleast 30 micron
	External surface of transformer and accessories including M Box (except radiator)	Chemical resistant epoxy zinc phosphate primer, MIO (Micaceous iron oxide) as intermediate paint followed by polyurethane finish paint (RAL 5012 Blue)	One coat each	Atleast 100 micron
	External radiator surface.	Anticorrosive primary paint followed by high quality full glossy outer finish paint (RAL 5012 Blue)	Two coats each	Atleast 100 micron
	Internal radiator surface	Hot oil proof, low viscosity varnish and subsequent flushing with transformer oil	---	---
	Internal surface of M Box	Chemical resistant epoxy zinc phosphate primer followed by chemical and heat resistant epoxy enamel white paint	Two coats each	Not less than 100 micron
4.14.00	Cooling Equipment for ONAF/OFAF Cooled Transformer (UT)			
4.14.01	Cooling equipment shall conform to the requirement stipulated below: (a.) The cooler shall be designed using 2x50% radiator banks. Design of cooling system shall satisfy the requirements as stipulated under Cl. 3.00.00 (performance). (b.) Each radiator bank shall have its own cooling fans, shut off valves at the top and bottom & blanking plate on each radiator, lifting lugs, top and bottom oil filtering valves, air release plug at the top, a drain plug, sampling valve and thermometer pocket fitted with captive screw cap on the inlet and outlet. (c.) The cooling fan shall be so mounted that they do not impose any adverse loading on radiator tubes. The location & configuration of radiators shall be subject to Employer's approval & shall be such as not to direct warm air towards busduct or any other equipment. Cooling fans shall not be directly mounted on radiator bank which may cause undue vibration. These shall be located so as to prevent ingress of rain water. Each fan shall be suitably protected by galvanized wire guard. The no. & capacity of cooler fans associated with each radiator bank shall be such that			
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	<p>outage of any fan does not reduce the continuous rating of the transformer. In case the standby fans are separately identified & are not in continuous operation, they shall be arranged to automatically come into operation on tripping of working fan.</p> <p>(d.) Cooling fan motor shall be suitable for operation on 415 ±10% V, three phase, 50 Hz +3% to -5% power supply & shall conform to IS: 325. Each cooling fan motors shall be provided with starter with thermal overload & short circuit protection. The motor winding insulation shall be conventional class B type. Motor shall have enclosure with degree of protection equivalent to IP 55 as per IS: 4691. The temperature rise of the motor shall be limited to 70 deg. C above ambient of 50 deg by winding resistance method & shall comply with IS: 325.</p> <p>(e.) The cooler & its accessories shall preferably be hot dip galvanised or corrosion resistant paint should be applied to it.</p> <p>(f.) Fault Indicating device</p> <p>For each transformer, an alarm contact shall be furnished to indicate the unintended stoppage of a fan. The contractor shall also indicate if any additional alarm/indication lamp is required to be provided in Central control room.</p> <p>(g.) Following lamp indications shall be provided in M. Box:</p> <ol style="list-style-type: none"> (1.) Cooler supply failure (main) (2.) Cooler supply failure (standby) (3.) Cooler supply changeover (4.) Control supply failure (5.) Common thermal overload trip (6.) Cooling fan failure for each bank <p>One potential free initiating contact for all the above conditions including alarm for "failure of supply changeover" shall be wired independently to the terminal blocks of M. Box exclusively for Employer's use.</p> <p>4.14.02 Cooling Equipment Control</p> <p>(a.) Automatic operation control fans shall be provided (with temp. change) from contacts of winding temp. indicator. The Contractor shall recommend the setting of WTI for automatic change over 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.</p> <p>(b.) Suitable manual control facility for cooler fans shall be provided.</p> <p>(c.) Selector switches and push buttons shall also be provided in the Marshalling Box to disconnect the automatic control and start/stop the fans manually.</p>		
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Clause No.	Technical Data Requirements		
<p>4.15.00</p>	<p>Cooling Equipment for ONAN Cooled Transformer (as applicable)</p> <p>The radiators shall be detachable type, mounted on the tank. Each radiator shall be provided with the following:</p> <ul style="list-style-type: none"> (a.) A drain plug at the bottom (b.) An air release plug at the top (c.) Shut off valve at each point of connection to the tank. The location and configuration of radiators shall be subject to Employer's approval. 		
<p>4.16.00</p>	<p>On Load tap changing Gear (OLTC)</p> <ul style="list-style-type: none"> (a.) OLTC used shall be compatible with tapping winding. The selection criteria for OLTC w.r.t. rated current, rated voltage, rated short circuit current, overload withstand capability & dielectric withstand levels shall be submitted by the supplier for Employer's approval. Recovery voltage calculations shall also be furnished in case OLTC is provided with reversing switch. (b.) The current diverting contacts shall be housed in a separate oil chamber not communicating with oil in main tank of transformer. The OLTC oil chamber shall have oil filling/ drain plug, relief vent & level glass. (c.) The equipment shall be suitable for local & remote electrical control & local manual control. The features to be provided with these controls are detailed below: <ul style="list-style-type: none"> (1.) Manual control <p>The cranking device for manual operation of OLTC gear shall be removable & suitable for operation by a man standing on ground level. The mechanism shall be complete with the following</p> <ul style="list-style-type: none"> - Mechanical tap position indicator which shall be clearly visible from near the transformer - Mechanical operation counter. - Mechanical stops to prevent over cranking of the mechanism beyond the extreme positions. - The manual control considered as backup to the motor operated tap control shall be interlocked with the motor startup during manual operation. The manual operating mechanism shall be labeled to show the direction of operations for raising the secondary voltage & vice versa. (2.) Electrical control <p>This includes the following:</p> 		
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Clause No.	Technical Data Requirements		
4.17.00	<ul style="list-style-type: none"> - Electrical local control from M. BOX/Drive Mechanism. - Electrical remote control from remote control board. <p>The control scheme shall have following features:</p> <ul style="list-style-type: none"> - An interlock to cutoff electrical control automatically upon recourse being taken to manual control - Selection of point of control local or remote. It shall not be possible for any two electrical controls to be in operation at the same time. - Reinforcement of the initiating impulse for a tap change, ensuring a positive completion once initiated. - Step by step operation, ensuring only one tap change for each tap changing command - An interlock to cut off the electrical control when it tends to operate the gear beyond either of the extreme tap positions. - An interlock to block a command for reverse tap change during a tap change until the mechanism comes to rest & resets the circuit for a fresh operation. <p>The equipment shall be so arranged as to ensure that when a tap change has commenced, it shall be completed independent of the control relays and switches.</p> <p>(3.) The auxiliary devices for electrical controls of the OLTC shall be housed either in the OLTC driving mechanism box or in the transformer M. BOX. OLTC shall be equipped with a time delayed INCOMPLETE STEP alarm consisting of a normally open contact, which closes, if the tap changer fails to make a complete tap change. The alarm shall not operate for momentarily loss of auxiliary power. Each transformer's on load tap changer shall be equipped with a fixed resistor network capable of providing discrete voltage step for input to the supervisory system. A 4-20 mA signal for tap position indicator to be provided for Employers use.</p> <p>(d.) Measurement for Tan delta values of OLTC to be done before installing in the 132 kV & above class transformer.</p> <p>(e.) Interposing relays for remote operation of OLTC through DDCMIS to be provided.</p> <p>Off Circuit Tap change Switch(as applicable)</p> <ul style="list-style-type: none"> (a.) The tap change switch shall be three phase, hand operated for simultaneous switching of similar taps on the three phases by operating on external handwheel. (b.) The tap changing shall be possible without disturbing the transformer in any way except de-energising. (c.) Arrangement shall be made for securing and pad-locking the tap changer in any of the working positions, and it shall not be possible for setting or padlocking it in any 		
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Clause No.	Technical Data Requirements		
4.18.00	<p>intermediate position. An indicating device shall be provided to show the tap in use.</p> <p>(d.) The Cranking device for manual operation of the off circuit tap changing gear shall be removable and suitable for operation by a man standing on ground level. The mechanism shall be complete with the following:-</p> <ol style="list-style-type: none"> (1.) Mechanical tap position indicator which shall be clearly visible from near the transformer. (2.) Mechanical stops to prevent over cranking of the mechanism beyond the extreme tap positions. (3.) The manual operating mechanism shall be labeled to show direction of operation for raising the secondary voltage and vice versa. (4.) A warning plate indicating "The switch shall be operated only when the transformer has been de-energised" shall be fitted. <p>(e.) Measurement for Tan delta values of OCTC to be done before installing in transformer.</p> <p>VALVES</p> <p>(a.) All valves upto and including 50 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</p> <p>(b.) Suitable means shall be provided for locking the valves in the open and close positions. Provision is not required for locking individual radiator valves.</p> <p>(c.) Each valve shall be provided with the indicator to show clearly the position of the valve.</p> <p>(d.) Gland packing/gasket material shall be of "O" ring of nitrile rubber for all the valve's flanges. All the flanges shall be machined.</p> <p>(e.) Oil sampling shall have provision to fix rubber hose of 100mm size to facilitate oil sampling.</p> <p>(f.) 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 chromate 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. Outside surface except gasket setting surface of butterfly valves shall be painted with two coats of red oxide zinc chromate conforming to IS:2074 followed by two coats of fully glossy finishing paint.</p> <p>(g.) All hardware used shall be cadmium plated/electro galvanised.</p> <p>(h.) Sampling & drain valves should have zero leakage rate.</p>		
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Clause No.	Technical Data Requirements		
<p>4.19.00</p>	<p>Neutral Grounding Resistors</p> <p>The earthing resistors are required for LV neutral point earthing of the transformers.</p> <p>(a.) Resistor Elements</p> <p>The resistors shall be of punched stainless steel grid element type. The grids shall be securely supported at sufficient number of points so that no damage is caused to the grids due to vibrations and no mechanical stresses are developed. The resistor element shall be insulated from supporting base by mica tubes. The insulating material used in the construction shall be heat resistant such as mica.</p> <p>(b.) Stacking</p> <p>Various sections comprising the neutral grounding resistor shall be capable of being stacked one above the other. The insulators supporting the resistor assemblies shall be of outdoor type. Connecting links shall be provided to connect adjacent stacks.</p> <p>(c.) Enclosure</p> <p>The neutral grounding resistor shall be housed in a 2.5 mm thick sheet steel enclosure. The enclosure shall be weather proof having IP 33 degree of protection in accordance with IS: 13947. The resistor neutral side terminal shall be brought out on the roof and the ground side terminal at the side of the enclosure through porcelain bushings. The ground side terminal shall be brought to ground level by a copper flat supported from the mounting structure by porcelain insulators. The copper bar shall have two (2) bolted neutral grounding terminals with hole size suitable for M10 bolt size and necessary accessories for connecting to ground mat through two MS 'flats'. The enclosure shall be supported on insulators placed on the mounting structure.</p> <p>(d.) Mounting Structure</p> <p>The Contractor shall supply and erect a galvanized structure to support the NG resistor enclosure so that the base of the enclosure shall be at a minimum height of 2.4M above ground level.</p> <p>The NG resistor enclosure mounting and the neutral connection shall be such that it does not obstruct the busduct routing in any way.</p> <p>A heating circuit with Thermostat to be provided inside the enclosure to control humidity.</p>		
<p>4.20.00</p>	<p>Bolts & Nuts</p> <p>All bolts & nuts exposed to weather shall be hot dip galvanized steel /stainless steel.</p>		
<p>4.21.00</p>	<p>GASKETS</p> <p>All the gasket shall be of 'O' ring of Nitrile rubber for all valves, flanges, HV, LV & Neutral Turrets, Bushings, Tank rim, etc. For this, all the flanges shall be machined. The gaskets shall not deteriorate during the life of transformer if not opened for maintenance at site. Supplier shall also recommend quality & make of gaskets to be used for replacement during maintenance if required. All joints flanged or welded</p>		
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Clause No.	Technical Data Requirements			
<p>5.00.00</p> <p>5.01.00</p>	<p>associated with oil shall be such that no oil leakage or sweating occurs during the life of transformer. The quality of these joints is considered established, only if the joints do not exhibit any oil leakage or sweating for a continuous period of at least 3 months during the guarantee period. In case any sweating / leakage is observed, contractor shall rectify the same & establish for a further period of 3 months of the same. If it is not established during the guaranteed period, the guaranteed period shall be extended until the performance is established.</p> <p>FITTINGS</p> <p>The following fittings shall be provided with each transformer covered in this specification:</p> <ol style="list-style-type: none"> (1.) Conservator for main tank with oil filling hole and cap, isolating valves, drain valve, magnetic oil level gauge with low level alarm contacts and dehydrating silica gel breather (Cobalt free). (2.) Conservator for OLTC with drain valve, oil level gauge and silica gel breather (Cobalt free). (3.) Breather for conservators shall be mounted not more than 1400 mm above rail top. (4.) Oil preservation system: - as specified elsewhere. (5.) Minimum two Nos. of spring operated pressure relief devices with alarm/trip contacts for transformer. Discharge of PRD shall be properly taken through pipes & directed away from the transformer /other equipment. (6.) Buchholz relay double float type with isolating valves on both sides, bleeding pipe with Gas collecting device at the end to collect gases and alarm and trip contacts. (7.) Air release plug. (8.) Oil surge relay for OLTC chamber (9.) Inspection openings and covers. (10.) Bushing with metal parts and gaskets to suit the termination arrangement. (11.) Cover lifting eyes, transformer lifting lugs, jacking pads, towing holes and core and winding lifting lugs. (12.) Protected type Mercury or alcohol in glass thermometer. (13.) Bottom and top filter valves with threaded male adapters, bottom Sampling valve & drain valve. (14.) Bilingual Rating and diagram plates on transformers and auxiliary apparatus. (15.) Fans and radiator as specified. (16.) Prismatic/toughened glass oil gauge for transformers and OLTC chamber 	Technical Specifications	Unit Transformer	Page 22 of 33

Clause No.	Technical Data Requirements		
	<p>(17.) 150 mm dial type oil temp indicator with alarm and trip contacts, maximum reading pointer & resetting device. Accuracy class shall be $\pm 1.5\%$ or better.</p> <p>(18.) 150-mm dial type Winding temp indicator with alarm and trip contacts, maximum reading pointer & resetting device. Accuracy class shall be $\pm 1.5\%$ or better (For three winding transformer, WTI for each winding shall be provided).</p> <p>(19.) Duplex platinum RTD to be provided for remote winding temp. Indication alongwith 2 nos of 4-20 mA signal for DDCMIS system of Employer. Any special cable required for shielding purpose for connection between M. Box & remote WTI to be provided.</p> <p>(20.) Flanged bi-directional wheels.</p> <p>(21.) Marshalling Box.</p> <p>(22.) On load tap changing gear / off load tap changing gear.</p> <p>(23.) Cooling equipment.</p> <p>(24.) Bushing current transformers.</p> <p>(25.) Insulating oil.</p> <p>(26.) Drain valves/plugs shall be provided in order that each section of pipe work can be drained independently. Sludge valve at bottom most point of tank to be provided for easy flush out/removal of sludge during maintenance.</p> <p>(27.) Terminal marking plates.</p> <p>(28.) Valves schedule plates.</p> <p>(29.) Two (2) earthing terminals on all the equipment mounted separately for connection to employer's suitable size GI flat along with 2 Nos. tapped holes. M10 bolts etc.</p> <p>(30.) Rain hoods to be provided on Buchholz, MOG & PRD. Entry points of wires shall be suitably sealed.</p>		
5.02.00	The fittings listed above are only indicative and other fittings, which generally are required for satisfactory operation of the transformer, are deemed to be included		
6.00.00	<p>INSPECTION AND TESTING</p> <p>(a.) The Contractor shall carry out a comprehensive inspection and testing program during manufacture of the transformer. An indication of inspection envisaged by the Employer is given elsewhere in the specification. This is however not intended to form a comprehensive program, as it is Contractor's responsibility to draw up</p>		
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Clause No.	Technical Data Requirements		
6.01.00	<p>and carry out such a program in the form of detailed quality plan duly approved by Employer for necessary implementation.</p> <p>(b.) The Contractor shall carry out all type tests and routine tests on the transformers. The tests are listed elsewhere in the specification.</p> <p>(c.) The charges for conducting each type test to be carried out by the Contractor shall be indicated separately in the bid.</p> <p>(d.) The equipment checks to be carried out by the Contractor are given elsewhere in the specification.</p> <p>(e.) The requirements of site tests are given elsewhere in the specification</p> <p>(f.) The makes of all major bought out items shall be subjected to Employer's approval. The contractor shall also prepare a comprehensive inspection and testing program for all bought out/sub-contracted items and shall submit the same to Employer.</p> <p>(g.) Each transformer shall be completely assembled with all fittings and accessories meant for the particular transformer before offering for inspection and testing by Employer.</p> <p>TYPE & ROUTINE TESTS</p> <p><u>Testing Requirements</u></p> <p>The contractor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The owner may waive conduction of any test subject to availability of test facility anywhere in the world. The bidder shall indicate the charges for each of these type tests separately in the relevant schedule of Section – VII (Forms & Procedures) and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the employer's engineer.</p> <p>The type tests shall be carried out in presence of the employer's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.</p>		
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Clause No.	Technical Data Requirements		
	<p>In case the contractor has conducted such specified type test(s) within last ten years as on the date of Techno-Commercial bid opening, he may submit during detailed engineering the type test reports to the owner for waiver of conductance of such type test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The owner reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor.</p> <p>Following components to be supplied shall be of tested design. During detailed engineering, the contractor shall submit for employer's approval the reports of all the type tests as listed below in specification and carried out within last ten years from the date of Techno-Commercial bid opening. The reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witness by a client. However if the contractor is not able to submit report of the type test(s) conducted within last ten years from date of Techno-Commercial bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the employer either at third party lab or in presence of client/employer's representative and submit the reports for approval.</p> <p>(a.) 132 KV and above Bushings.</p> <p>(b.) On Load Tap Changer (wherever applicable)</p> <p>(c.) Neutral Grounding Resistors (If applicable)</p> <p>(d.) Tank Vacuum and Pressure test.</p> <p>All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.</p> <p>6.01.01 TEST REPORT SUBMISSION CATEGORY</p> <p>Type test reports shall be submitted for following as detailed above:</p> <p>(a.) Tank Vacuum & Tank Pressure Test</p> <p>(b.) All type test on OLTC as per IEC 60214</p> <p>(c.) Neutral Grounding resistors(as applicable)</p> <p>(d.) All type tests on 132kV & above class bushings as per IEC 60137</p> <p>6.01.02 ROUTINE & TYPE TEST</p>		
	ROUTINE TESTS		UT
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Clause No.	Technical Data Requirements	
	Rating (MVA) Voltage (KV)	----
S.N		----
1.	All routine test in accordance with IEC 60076 shall be carried out in all the transformers.	√
2.	Measurement of Voltage Ratio (as per IEC 76-1)	√
3.	Measurement of winding resistance on HV & LV on all the taps (as per IEC 60076-1)	√
4.	Vector group and Polarity Check (as per cl. No. 10.3 of IEC 60076-1)	√
5.	Magnetic Balance and Magnetising Current Test	√
6.	Separate Source Voltage Withstand Test as per IEC60076	√
7.	Measurement of capacitance & tan to determine capacitance between winding & earth.	√
8.	Measurement of no load losses and current at 90%, 100%, 110% rated voltage (as per IEC 60076-1)	√
9.	2KV core isolation (between core-clamp, core-tank & clamp-tank)	√ 2KV
10.	Measurement of no load current with 415 V, 50 h z AC supply	√
11.	IR measurement	√
12.	Dielectric tests shall be carried out as per IEC 60076-3	√
13.	Applied voltage test (IEC 76-3)	√
14.	Induced over voltage withstand test as per IEC 60076-3	√
15.	Load Loss & Short Circuit Impedance Measurement on principal & Extreme Taps.	√
16.	Repeat no load current/loss measurement and IR after completion of all dielectric test (as per IEC 60076-1)	√
17.	Oil leakage test (as per cl 6.02.00 (a) (1) of this sub section)	√
18.	Jacking test followed by D.P. test	√
19.	FRA	√
20.	Marshalling Box/Cable box : It shall not be possible to insert a thin sheet of paper under gaskets and through enclosure joints.	√
21.	IR Measurement on wiring of Marshalling Box.	√
S.N	TYPE TESTS	UT
	Rating (MVA) Voltage (KV)	----
(1.)	Lightning impulse (Full & Chopped Wave) test on HV & LV winding (as per IEC 60076-3)	√
(2.)	Lightning impulse test on Neutral	√
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Clause No.	Technical Data Requirements							
	TYPE TESTS	UT						
	Rating (MVA)	---						
	Voltage (KV)	----						
(3.)	Short circuit test (special test) as per IEC 60076-5. Following shall also be conducted before & after S.C. test: (1). DGA (2). FRA Physical inspection of transformer to be done before S.C. Test in presence of NTPC inspector and photographs to be taken for reference. (To be specified if qty. of transformers being procured are more than one)	√						
(4.)	Temp. rise test at a tap corresponding to maximum losses. DGA shall be conducted on oil sample taken before & immediately after temp. rise test. Gas analysis shall be as per IS: 9434 (based on IEC: 567), results will be interpreted as per IS: 10593 (based on IEC: 599). Infra red thermography shall be done during temp rise test. Result shall be recorded for future reference.	√						
(5.)	Zero sequence impedance measurement test	√						
(6.)	Measurement of power taken by the fans & pumps(if applicable)	√						
(7.)	Measurement of harmonics of no load current (special test) (cl. 10.8 of 60076-1)	√						
(8.)	Measurement of acoustic noise level as per NEMA TR-1 (special test)	√						
6.02.00	<p>NOTE:-</p> <p>i) All the type/special tests shall be conducted after performing Short Circuit Test. If Tank Vacuum & Pressure Test is to be carried out then it shall be conducted before SC test.</p> <p>ii) (√) mark indicates that test to be carried out.</p> <p>TANK TEST</p> <p>(a.) Routine test</p> <p>(1.) Oil leakage test on assembled transformer</p> <p>All tank & oil filled compartment shall be tested for oil tightness by being completely filled with oil of viscosity not greater than that of specified oil at the ambient temperature & applying pressure equal to the normal pressure plus 35 KN/sq. m. measured at the base of the tank. The pressure shall be maintained for a period of not less than 6 hours during which time no sweating shall occur.</p> <p>(b.) Type Tests</p> <p>(1.) Vacuum Test</p> <p>Each type of transformer tank shall be subjected to the specified vacuum. The tank designed for full vacuum shall be tested at an internal pressure of 3.33 KN/sq. m absolute (25 torr) for one hour. The permanent deflection of the plate after the vacuum has been released shall not exceed the values specified below:</p> <table border="1"> <thead> <tr> <th>Horizontal Length of Flat Plate (in mm)</th> <th>Permanent deflection(in mm)</th> </tr> </thead> <tbody> <tr> <td>Upto and including 750</td> <td>5.0</td> </tr> <tr> <td>751 to 1250</td> <td>6.5</td> </tr> </tbody> </table>		Horizontal Length of Flat Plate (in mm)	Permanent deflection(in mm)	Upto and including 750	5.0	751 to 1250	6.5
Horizontal Length of Flat Plate (in mm)	Permanent deflection(in mm)							
Upto and including 750	5.0							
751 to 1250	6.5							
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Clause No	Technical Data Requirements												
6.03.00	<table border="1"> <tr> <td>1251 to 1750</td> <td>8.0</td> </tr> <tr> <td>1751 to 2000</td> <td>9.5</td> </tr> <tr> <td>2001 to 2250</td> <td>11.0</td> </tr> <tr> <td>2251 to 2500</td> <td>12.5</td> </tr> <tr> <td>2501 to 3000</td> <td>16.0</td> </tr> <tr> <td>Above 3000</td> <td>19.0</td> </tr> </table> <p>(2.) Pressure Test</p> <p>Transformer tank of each type shall be subjected to a pressure corresponding to twice the normal head of oil or to the normal pressure plus 35 KN / sq. m whichever is lower, measured at the base of the tank & maintained for one hour. The permanent deflection of the plates after the excess pressure has been released shall not exceed the figure specified above for vacuum test.</p> <p>6.03.00 NGR Testing (if applicable)</p> <p>(a.) The following routine tests shall be conducted on each resistor covered in this package.</p> <ol style="list-style-type: none"> (1.) Ohmic value measurement (For resistance & reactance separately). (2.) Insulation resistance measurement before & after HV test (3) HV test for 1 min. at a voltage corresponding to the insulation level of the resistor. <p>(b.) DOP test on enclosure (routine test) as follows.</p> <p>It shall not be possible to insert a 2.5mm dia steel wire into the enclosure from any direction without using force.</p> <p><u>TYPE TEST</u></p> <ol style="list-style-type: none"> (c.) Short time current test along with temperature rise test (type test). (d.) Degree of protection test for IPX3 on enclosure (type test). <p>6.04.00 Pre-shipment Checks at Manufacture's Works</p> <ol style="list-style-type: none"> (a.) Check for interchangeability of similar transformers for mounting dimensions. (b.) Check for proper packing and reservation of accessories like radiators, bushings, dehydrating breather, rollers, Buchhloz relay, fans, control cubicle, connecting pipes, conservator etc. (c.) Check for proper provision for bracing to arrest the movement of core and winding assembly inside the tank. (d.) Gas tightness test to confirm tightness. (Applicable if transformer is gas filled during transportation) 	1251 to 1750	8.0	1751 to 2000	9.5	2001 to 2250	11.0	2251 to 2500	12.5	2501 to 3000	16.0	Above 3000	19.0
	1251 to 1750	8.0											
1751 to 2000	9.5												
2001 to 2250	11.0												
2251 to 2500	12.5												
2501 to 3000	16.0												
Above 3000	19.0												
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Clause No.	Technical Data Requirements		
	<p>(e.) Derivation of leakage rate and ensure the adequate reserve gas capacity. (Applicable if transformer is gas filled during transportation)</p> <p>(f.) Dew point measurement of Dry air/N2 at the time of filling & after 24 hours in the transformer tank. Dew point of Dry air/N2 at the time of transformer dispatch should be better than (-)30deg.C. Also the Dew point of Nitrogen Cylinders/Dry Air attached for makeup during transportation should be better than (-)50deg.C. (Applicable if transformer is gas filled during transportation)</p> <p>(g.) Minimum two impact recorders shall be provided. Functioning of impact recorder in the works</p> <p>(h.) To avoid pilferage and tampering with the valves and other accessories used while Dry Air/N2 filling, due security arrangements to be ensured during transportation. (Applicable if transformer is gas filled during transportation)</p>		
6.05.00	<p>Inspection and Testing at Site</p> <p>The Contractor shall carry out a detailed inspection and testing program for field activities covering areas right from the receipt of material stage up to commissioning stage. An indicative program of inspection as envisaged by the Employer is given below. This is however</p> <p>not intended to form comprehensive program, as it is contractor's responsibility to draw up and carry out such a program duly approved by the Employer. Testing of oil sample at site shall be carried out as specified elsewhere in this specification.</p>		
6.05.01	<p>Receipt and Storage Checks</p> <p>Following checks are for transformers; checks detailed out in finalized/agreed FQP shall be followed.</p> <p>(a.) Check and Record reading of impact recorder at receipt and verify the allowable limits as per manufacturer's recommendation.</p> <p>(b.) Check and record the gas pressure in the transformer tank as well as in the gas cylinder.</p> <p>(c.) Check and record condition of each package, visible parts of the transformer etc. for any damage.</p> <p>(d.) Visual check for wedging of core and coils before filling up with oil and also check conditions of core and winding in general.</p>		
6.05.02	<p>Installation Checks</p> <p>(a.) Inspection and performance testing of accessories like tap changers, cooling fans etc.</p> <p>(b.) Check the direction of rotation of fans.</p>		
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6.05.03	<p>(c.) Check the bearing lubrication.</p> <p>(d.) Check whole assembly for tightness, general appearance etc.</p> <p>(e.) Oil leakage test on assembled transformer for 24 hrs shall be repeated as a pre commissioning test at site. The gaskets & flanges used shall be capable of meeting the requirement as per cl. 6.02.00.</p> <p>(f.) Check oil sample prior to filling.</p> <p>(g.) Leakage test on bushing before erection.</p> <p>(h.) Capacitance & tan delta measurement of condenser bushing before fixing / connecting to the winding, contractor shall furnish these values for site reference</p>		
	<p>Commissioning Checks</p> <p>(a.) Check the colour of silica gel in silicagel breather.</p> <p>(b.) Check the oil level in the breather housing, conservator tanks, cooling system, condenser-bushing etc.</p> <p>(c.) Check the bushing for conformity of connection to the lines etc. and tan delta test for bushing.</p> <p>(d.) Check for correct operation of protection devices and alarms:</p> <ol style="list-style-type: none"> (1.) Buchholz relay & sudden pressure relay for OLTC. (2.) Excessive winding temperature (3.) Excessive oil temperature (4.) Low oil level indication (5.) Fan failure protection (6.) Pressure relief valve <p>(e.) Check for the adequate protection on the electric circuit supplying the accessories.</p> <p>(f.) Check resistance of all windings on all steps of the tap changer.</p> <p>(g.) Insulation resistance measurement for the following:</p> <ol style="list-style-type: none"> (1.) Control wiring. (2.) Cooling system motor and control (3.) Main windings (4.) Tap changer motor and control (5.) Tank & turret mounted CTs <p>(h.) Check for cleanliness of the transformer and the surroundings.</p>		
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Clause No.	Technical Data Requirements		
	<p>(i) Check the following</p> <ol style="list-style-type: none"> (1.) Direction and overload setting of cooling Accessories (2.) Buchholz, oil level indicator, pressure gauges, temp indicators etc. for fitting & operation. (3.) Earthing of main tank, marshaling Box, tap changer driving gear, cable box, fan motor etc. (4.) Neutral earthing (5.) Calibration of WTI and OTI (6.) Earthing of bushing test tap (7.) Connection of WTI CT with its heater (8.) Tightness of CT secondary connection and shorting of unused CTs (9.) All valves for their correct opening and close sequence <p>(j.) Phase out and vector group test.</p> <p>(k.) Ratio test on all taps.</p> <p>(l.) Magnetizing current test (HV winding & LV winding).</p> <p>(m.) Capacitance and Tan delta measurement of winding</p> <p>(n.) Measurement of noise level.</p> <p>(o.) Oil Dielectric strength test-the various test on oil shall be conducted prior to filling in main tank at site & prior to energization at site as specified elsewhere in this specification. Oil samples are to be drawn from top & bottom of main tank, cooling system & OLTC.</p> <p>(p.) DGA of oil before commissioning</p> <p>(q.) Check on OLTC</p> <ol style="list-style-type: none"> (1.) Visual inspection of equipment (2.) Hand operation at all taps (3.) Complete wiring of circuit (4.) Limit switch (5.) Over running device (6.) Brake system (7.) Remote panel wiring 		
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Clause No.	Technical Data Requirements		
	<p>(8.) O/L device of driving motor</p> <p>(9.) Local operation (electrical)</p> <p>(10.) Remote operation (electrical)</p> <p>(11.) Tap position indicator</p> <p>(12.) Step by step contactor</p> <p>(13.) Out of step relay</p> <p>(14.) OLTC continuity test</p> <p>(r.) Core isolation test</p> <p>(s.) Magnetic balance test</p> <p>(t.) FRA test</p> <p>(u.) Short circuit impedance measurement</p> <p>(v.) Test on tank/turret mounted CTs</p> <p>(1.) IR value between secondary winding & earth and between windings</p> <p>(2.) secondary resistance</p> <p>(3.) Polarity</p> <p>(4.) Ratio test</p> <p>(5.) Magnetization current</p> <p>(w.) Test on cooler fan</p> <p>(1.) IR Value</p> <p>(2.) Starting current</p> <p>(3.) Running current</p> <p>(x.) WTI and OTI setting for alarm/trip, fan start/stop</p> <p>(y.) Final IR Value</p> <p>(1.) HV/E+LV</p> <p>(2.) LV/E+HV</p> <p>(3.) HV/LV</p> <p>(z.) Continuously observe the transformer operation at no. load for 24 hrs. w.r.t. Voltage, no load current, temperature rise and noise.</p>		
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Clause No.	Technical Data Requirements
	<p>(aa.) Gradually put the transformer on load, check and measure increase in temperature in relation to the load and check the operation with respect to temperature rise and noise level etc.</p> <p>(ab.) Infra red thermography shall be done after 12 hours of full load operation and results will be recorded for future reference.</p> <p style="text-align: center;">*****</p>