

		PROJECT: Document No.			INDICATIVE VENDOR LIST SUB-SYSTEM: ELECTRICAL		DOC NO. : REVISION NO. 00 PAGE : 2
Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE, M/s	PLACE	SC APPL Status	REMARKS
	document w.r.t Preference to Make in India policy.			Ginlong Technologies	China	A	255 KW
5.	String Monitoring Box (SMB)/String Combiner box (SCB)	II	Q-003	Trinity Touch	Palwal	A	Up to 24 In / 1 out
				Hensel	Sriperumbudur	A	Up to 24 In / 1 out
				AEG	Bangalore	A	
				Statcon	Pilkhuwa	A	Up to 22 In / 1 out
				Weidmuller	Spain	A	
				HPL	Sonipat	A	Up to 22 In / 1 out
				Vrinda Nano Technologies Pvt.	Haryana	A	Up to 22 In / 1 out
				Sertel Electronics	Chennai	A	Up to 22 In / 1 out
6.	Inverter Transformer	I	Q-004	Raychem	Pune	A	Up to 16.8 MVA
				Toshiba Transmission & Distribution Systems (India) Pvt. Ltd.	India	A	Up to 12.5 MVA
				Sudhir Power	Silvassa	A	
				Shilchar	Vadodara	A	
				Hammond	Canada	A	
				Ornet Transformer	Kadi, Gujarat	A	Up to 16.8 MVA
				Telawne Power Equipment's	Taloja and Rabale	A	
				Uttam (Bharat)	Jaipur	A	Up to 12.5 MVA
				Danish	Jaipur	A	Up to 16.8 MVA
7.	DC Cable Connector	III		Any make-model which is Type Tested as per EN 50521: 2008 or having marking of VDE/ CE/UL/ CSA/ "BIS with CML no." (Refer Note-1)			
8.	Floor mounted Draw out type indoor/outdoor LT	Ref Note 2D	Q-005	L&T	Mumbai / Coimbatore/ Ahmednagar	A	BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.

CLAUSE NO.	TECHNICAL SPECIFICATIONS		
1.0	B-3(A) INVERTER TRANSFORMER		
	TECHNICAL REQUIRMENTS (OIL FILLED TRANSFORMER)		
	Sr. No.	TRANSFORMER	INVERTER TRANSFORMER
	i)	VA Rating & Quantity	As per system requirement
	ii)	Voltage Ratio (KV)	As per system requirement
	iii)	Duty, Service & Application	Continuous Solar Inverter application and converter duty (Outdoor)
	iv)	Winding	AS per system requirement
	v)	Frequency	50 Hz
	vi)	Nos. of Phase	THREE
	vii)	Vector Group & Neutral earthing	As per system requirement
	viii)	Cooling	ONAN
	ix)	Tap Changer	As per system requirement OCTC +/- 5% (min.)
	x)	Impedance at75°C	As per system requirement and SLD* & as per Inverter manufacturer recommendation.
		a) Principal Tap	
		b) Other Taps	
	xi)	Permissible Temperature rise over an ambient of 50 deg C (irrespective of tap)	50 deg.C
		a) Top Oil	
		b) Each Individual Winding	
	xii)	SC withstand time (thermal)	2 sec.
	xiii)	Fault Level & Bushing CT	As per system requirement
	xiv)	Termination	As per system requirement
	xv)	Bushing rating, Insulation class (Winding & bushing)	As per relevant IS/IEC (However Inverter Transformer LV side winding & bushing insulation class shall be of at least 3.6 kV) Creepage distance : 31 mm/kV
	xvi)	Noise level	AS PER NEMA TR-1
	xvii)	Loading Capability	Continuous operation at rated MVA on any tap with voltage variation of +/-10%, also transformer shall be capable of being loaded in accordance with IS: 6600/ IEC60076-7. As minimum requirement, Transformers shall be designed with 110% continuous thermal overloading capability. The same shall be tested during Temp Rise Type test.
xviii)	Flux density	Not to exceed 1.7 Wb/sq.m. at any tap position with +/-10% voltage variation from voltage corresponding to the tap.	
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			Transformer shall also withstand following over fluxing conditions due to combined voltage and frequency fluctuations: a) 110% for continuous rating. b) 125% for at least one minute. c) 140% for at least five seconds. Bidder shall furnish over fluxing char. up to 150%
	xix)	Air Clearance	As per CBIP
	xx)	Foundation	All the foundation shall be designed as per highest rating Transformer in case different capacity transformer are offered.
<u>Note (common for Oil filled and dry type transformer):</u> • Inverter Transformer shall have copper/Aluminum Shield winding between LV & HV windings. Each LV winding must be capable of handling non-sinusoidal voltage with voltage gradient as per relevant applicable standards and Inverter manufacturer recommendation. Also each shield winding shall be taken out to tank with two separate connection from shield to bushing with proper support with 2 nos. 3.6 kV shield bushings and same shall be brought down along with support insulator from tank & copper flat up to the bottom of the tank for independent grounding. • If Inverter transformer is provided indoor, it shall be necessarily dry type. • Harmonic Factor as per Inverter manufacturer recommendation must be taken into account while designing the transformer. The extra no load loss due to voltage harmonics and load and stray load loss due to current harmonics (as applicable) and must be taken into consideration in transformer design. In addition, the dc bias component of 0.5% of rated Inverter output current is to be accounted for its effect on the transformer design. • The adverse effect on life of transformer due to cloud intermittency and solar generation loading cycle must be compensated through suitable design (as applicable). • The thermal design of Inverter Transformer needs to consider the temperature dependent performance of the Inverter. It is to in accordance with Inverter output and under worst condition it should not limit Inverter output. • The multi-winding transformer needs to be designed for long term operating conditions with asymmetrical load on LV side i.e., in case three			
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2.0	winding design, the transformer needs to operate reliable with only one Inverter supplying power to only one LV winding. - For multi winding transformer, it is recommended to have close coupling and equal impedances on each of LV winding to HV winding and to have high enough impedance (8% min. based on one LV winding rating between two LV windings in order to decouple these windings. - In case of inverter transformer, it shall be proven and of successfully type tested design - Contacts from Inverter transformer fittings/protection devices shall be wired for tripping of Inverter transformer Circuit Breaker. Detailed scheme regarding same shall be finalized during detailed engineering. - Single Line Diagram (SLD) will be finalized during detailed engineering however kVA rating of inverter transformer shall not be less than kVA capacity of respective Inverters connected to it.												
	2.1												
	CODES AND STANDARDS												
	<table><tr><td>Transformers</td><td>IS:2026, IS:6600, IEC:60076</td></tr><tr><td>Bushings</td><td>IS:2099, IEC:60137,IS 3347 ,IS 12676</td></tr><tr><td>Insulating oil</td><td>IEC 60296 ,IEC 61099/IS16081</td></tr><tr><td>Bushing CTs</td><td>IS:2705, IEC 60185</td></tr><tr><td colspan="2">Indian Electricity Act 2003, BEE Guideline & CEA notifications</td></tr></table>			Transformers	IS:2026, IS:6600, IEC:60076	Bushings	IS:2099, IEC:60137,IS 3347 ,IS 12676	Insulating oil	IEC 60296 ,IEC 61099/IS16081	Bushing CTs	IS:2705, IEC 60185	Indian Electricity Act 2003, BEE Guideline & CEA notifications	
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	General Construction												
Transformer shall be constructed in accordance to IS: 2026 and IS: 3639 or equivalent to any other international standard. Transformer shall be complete & functional in all respect and shall be in scope of supplier. The other important construction particulars shall be as below. a. The Transformer tank and cover shall be fabricated from high grade low carbon plate steel of tested quality. The tank and the cover shall be of welded construction and there should be provision for lifting by crane. b. A double float type Buchholz relay conforming to IS: 3637 shall be provided. c. Suitable 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. d. All bolted connections to the tank shall be fitted with suitable oil-tight gaskets which shall give satisfactory service under the operating													
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	conditions for complete life of the transformer if not opened for maintenance at site e. The transformer shall be provided with conventional single compartment conservator. The top of the conservator shall be connected to the atmosphere through indicating type cobalt free silica gel breather (in transparent enclosure). Silica gel shall be isolated from atmosphere by an oil seal. f. Transformer shall have adequate capacity Conservator tank to accommodate oil preservation system and volumetric expansion of total transformer oil. g. Transformer shall have Oil Temperature Indicator and Winding temperature Indicator with accuracy class of +/-2 deg. h. Radiators shall be detachable type, mounted on the tank with shut off valve at each point of connection to the tank, lifts, along with drain plug/valve at the bottom and air release plug at the top. i. M. Box shall be of sheet steel, dust and vermin proof provided with proper lighting and thermostatically controlled space heaters. The degree of protection shall be IP 55. Marshalling Box of all transformers shall be preferably Tank Mounted. One dummy terminal block in between each trip wire terminal shall be provided. At least 20% spare terminals shall be provided on each panel. The gasket used shall be of neoprene rubber. Also Marshalling Box, shall be at least 450 mm above ground level. Wiring scheme (TB details) shall be engraved in a stainless steel plate with viewable font size and the same shall be fixed inside the Marshalling Box door.
2.2	Windings a) The Bidder shall ensure that windings of all transformers are made in dust proof & conditioned atmosphere. b) The conductors shall be of electrolytic grade copper/electrolytic grade Aluminum free from scales & burrs. c) All windings of the transformers shall have uniform insulation. d) Tapping shall be so arranged as to preserve the magnetic balance of the transformer at all voltage ratio.
2.3	Core a) The core shall be constructed from non-ageing, cold rolled, super grain oriented silicon steel laminations equivalent to M4 grade steels or better. b) Core isolation level shall be 2 kV (rms.) for 1 minute in air. c) Adequate lifting lugs will be provided to enable the core & windings to be lifted.
2.4	Insulating Mineral oil
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CLAUSE NO.	TECHNICAL SPECIFICATIONS																																																			
	No inhibitors shall be used in the transformer oil. The oil supplied with transformers shall be new and previously unused and must conform to following while tested at supplier's premises and shall have following parameters.																																																			
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2.5	Bushings																																																			
	i. Bushing below 52 kV shall be oil communicating type with porcelain insulator.																																																			
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	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 radiators)	Chemical resistant epoxy zinc phosphate primer, MIO (Micaceous iron oxide) as intermediate paint followed by polyurethane finish paint (RAL 5012 Blue) or (RAL6018 yellow green for ester filled)	One coat each	Atleast 100 micron	
	External Radiator surface	Anticorrosive primary paint followed by high quality full glossy outer finish paint (RAL 5012 Blue) or (RAL6018 yellow green for ester filled)	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	
2.10	Neutral Earthing Arrangement Neutral earthing shall be done as per system requirement and SLD. In case of solidly earthed neutral of Transformers, it shall be brought through insulated support from tank to the ground level at a convenient point with 2 nos. copper flat, for connection to ground network (as applicable).Neutral of Transformer if not used should be taken out through bushing and covered by insulating cap.				
2.11	Cable boxes & disconnecting chamber (Disconnecting chamber applicable 3.3 kV and above & for Inverter Transformer both side) (a) HV 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 (for 3.3 kV and above side) (b) Cable boxes shall have bus bars / suitable terminal connectors of adequate size & bolt holes to receive cable lugs. The degree of protection of cable boxes shall be IP 55. (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 (d) The support from base for the cable box (for 3.3 kV and above side) shall be of galvanized iron (e) The contractor shall provide earthing terminals on the cable box, to suit Employer's GI flat. (f) The minimum length provided for terminating 33 kV, 11KV & 3.3 KV XLPE cable shall be 1000 mm (for 33 kV) 650 mm (for 3.3 kV and 11 kV) from				
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2.12	cable gland plate to the cable lug) for the cable boxes, for 433V side suitable length shall be provided (shall be discussed during detail engineering). The final cable size, number & length of terminating XLPE cable shall be furnished during detailed engineering. (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 (as applicable). (h) Cable boxes shall have removable top cover (for transformer above 100 KVA) & ample clearance shall be provided to enable either transformer or each cable to be subjected separately to high voltage test.																						
	FITTINGS Following fittings shall be provided with Transformers covered under this sub section.																						
	<table><tr><td>a)</td><td>-Conservator for main tank shall be provided with MOG with low oil level alarm contact, drain valve & indicating type free Cobalt free breather with transparent enclosure (maximum height 1400 mm above ground level) etc.</td></tr><tr><td>b)</td><td>- Buchholz relay, double float type with alarm and trip contacts, along with suitable gas collecting arrangement.</td></tr><tr><td>c)</td><td>- It shall be provided with minimum two numbers of spring operated PRD (with trip contacts) with suitable discharge arrangement for oil shall be provided.</td></tr><tr><td>d)</td><td>OTI & WTI shall be 150 mm dial type with alarm and trip contacts with max. reading pointer & resetting device (maximum height 1500 mm above ground level). For Inverter Transformers, WTI shall be provided at least for all LV windings.</td></tr><tr><td>e)</td><td>Top & bottom filter valves with threaded male adapters, bottom sampling valve, drain valve/sludge removal valve at the bottom most point of the tank.</td></tr><tr><td>f)</td><td>Air release plug, bushing with metal parts & gaskets, terminal connectors on bushings (as applicable).</td></tr><tr><td>g)</td><td>Prismatic/toughened glass oil gauge for transformers.</td></tr><tr><td>h)</td><td>Bi-directional wheel/skids, M.Box, OCTC, Bushing CTs (as applicable), Insulating Oil, Cooling equipment.</td></tr><tr><td>i)</td><td>Cover lifting eyes, transformer lifting lugs, jacking pads, towing holes and core and winding lifting lugs, inspection cover, Bilingual R&D Plate, Terminal marking plates, two nos. earthing terminals etc.</td></tr><tr><td>j)</td><td>Bolts & nuts (exposed to atmosphere) shall be galvanized steel/SS.</td></tr><tr><td>k)</td><td>Rain hoods to be provided on Buchholz, MOG & PRD. Entry points of wires shall be suitably sealed.</td></tr></table>	a)	-Conservator for main tank shall be provided with MOG with low oil level alarm contact, drain valve & indicating type free Cobalt free breather with transparent enclosure (maximum height 1400 mm above ground level) etc.	b)	- Buchholz relay, double float type with alarm and trip contacts, along with suitable gas collecting arrangement.	c)	- It shall be provided with minimum two numbers of spring operated PRD (with trip contacts) with suitable discharge arrangement for oil shall be provided.	d)	OTI & WTI shall be 150 mm dial type with alarm and trip contacts with max. reading pointer & resetting device (maximum height 1500 mm above ground level). For Inverter Transformers, WTI shall be provided at least for all LV windings.	e)	Top & bottom filter valves with threaded male adapters, bottom sampling valve, drain valve/sludge removal valve at the bottom most point of the tank.	f)	Air release plug, bushing with metal parts & gaskets, terminal connectors on bushings (as applicable).	g)	Prismatic/toughened glass oil gauge for transformers.	h)	Bi-directional wheel/skids, M.Box, OCTC, Bushing CTs (as applicable), Insulating Oil, Cooling equipment.	i)	Cover lifting eyes, transformer lifting lugs, jacking pads, towing holes and core and winding lifting lugs, inspection cover, Bilingual R&D Plate, Terminal marking plates, two nos. earthing terminals etc.	j)	Bolts & nuts (exposed to atmosphere) shall be galvanized steel/SS.	k)	Rain hoods to be provided on Buchholz, MOG & PRD. Entry points of wires shall be suitably sealed.
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3.0	DRY TYPE INVERTER TRANSFORMER																						
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	ii)	Duty, Service & Application	Continuous Solar Inverter application and converter duty (Indoor)
	iii)	MVA & Voltage ratio	As per system requirement and SLD.
	iv)	Vector group	
	v)	Termination & Bushing CT	
	vi)	Fault Level & Earthing	
	vii)	Tap changer type & range	As per system requirement and SLD. OCTC +/-5% (min.)
	viii)	Impedance	As per system requirement and SLD & as per Inverter manufacturer recommendation.
	ix)	Number of phases	Three (3)
	x)	Type of cooling	AN Transformer shall be provided with suitable ventilation system to ensure the temperature rise limits under most severe condition while in service however all tests and performance guarantee shall correspond to air natural (AN) cooling.
	xi)	Bushing rating, Insulation class (Winding & bushing)	As per relevant IS/IEC (However Inverter Transformer LV side winding & bushing insulation class shall be of at least 3.6 kV)
	xii)	Maximum Temperature rise of winding over 50 deg. C ambient. (by resistance method) with Air Natural (AN) cooling.	90 deg.C. (class F) 115 deg.C. (class H)
	xiii)	SC withstand time (thermal)	2 sec
	xiv)	Noise Level	Not to exceed values specified in NEMA TR-1.
	xv)	PD Level (max. Allowable)	10 pc
	xvi)	Loading Capability	Continuous operation at rated KVA on any tap with voltage variation of +/-10% corresponding to the voltage of the tap as well as in accordance with IEC60076-12/IS: 6600.
	xvii)	Flux Density	Not to exceed 1.9 Wb/sq.m. at any tap position with +/-10% voltage variation from voltage corresponding to the tap. Transformer shall also withstand following over fluxing conditions due combined voltage and frequency fluctuations: a) 110% for continuous rating. b) 125% for at least one minute.
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3.1	c) 140% for at least five seconds.		
	CODES AND STANDARDS		
	Dry type transformers IS: 11171, IEC 60076-11 Indian Electricity Act 2003 and Indian Electricity Rules, BEE notification & CEA guidelines		
	DESIGN AND CONSTRUCTIONAL FEATURES		
	3.2.1	The core shall be constructed from high grade non-ageing cold rolled grain oriented silicon steel laminations of M4 grade or better quality. The insulation of core to clamp-plates shall be able to withstand a power frequency voltage of 2 kV (rms) for one (1) minute.	
	3.2.2	The transformers shall be housed in a metal protective housing, having a degree of protection of IP-23.In case it is placed outdoor, IP for enclosure shall be minimum IP-42 or higher. Enclosure shall be of a tested quality sheet steel of minimum thickness 2mm & shall also accommodate cable terminations. The housing door shall be interlocked such that it should be possible to open the door only when transformer is off. The enclosure shall be provided with lifting lugs and other hardware for floor mounting. Suitable bi-directional skids with pre-drilled holes shall be provided integral with the enclosure or bi-directional rollers shall be provided with suitable locking arrangement.	
	3.2.3	Winding conductor shall be electrolytic grade Copper/ Aluminum. Windings shall be of class F insulation or better. All windings are to be uniformly insulated.	
	3.2.4	Transformer HV bushings and LV bushings can be either solid porcelain or epoxy type. Bushing shall be suitable for satisfactory operation in the high ambient temperature inside Bus Duct enclosure (if applicable). LV flange area shall be of non-magnetic material.	
	3.2.5	Bushing CTs shall be provided in the LV neutral side of adequate rating for REF protection, WTI, etc (as applicable).	
	3.2.6	For Marshalling Box the sheet steel used shall be at least 1.6 mm thick cold rolled. The box shall be tank mounted type. The degree of protection shall be IP-54 in accordance with IS-13947. Wiring Scheme shall be engraved in a stainless steel plate with viewable font size and the same shall be fixed inside the Marshalling Box door.	
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3.2.7	Transformer shall be provided with suitable ventilation system to ensure the temperature rise limits under most severe condition while in service however all tests and performance shall correspond to air natural cooling.		
3.3	PAINTING		
3.3.1	The inside of enclosure and accessories (except M. Box) shall be painted with two coats of fully glossy white colour with total DFT of 25 to 60 microns. The external paint colour of transformer & accessories shall be blue corresponding to RAL 5012. The external surface of transformer & accessories shall have two coats of chemical resistant epoxy zinc phosphate primer and two coats of polyurethane finish paint with total DFT of 80 to 150 microns. The internal surface of M.Box shall have two coats of chemical resistant epoxy zinc phosphate primer and two coats of chemical & thermal resistant epoxy enamel white paint with total DFT of 80 to 150 microns.		
3.4	FITTING		
	Winding temperature indicator (WTI)	Shall be Platinum resistance type temperature detector in each limb. Single Indicating meter may be provided for display of temperature of all limbs. Accuracy class of Indicating meter shall be +/- 1% or better and it shall have least count of 0.1 °C or better. 1 no. 4-20 mA signal shall be provided for remote monitoring of winding Temperature.	
	RTD/Thermistors	1 No. PT-RTD shall be embedded in each limb with alarm and trip contacts for remote annunciation. Additional 1 No. thermistor/RTD shall be embedded in each limb.	
	Fittings which are generally required for satisfactory operation of the transformers are deemed to be included, in the scope of supply of the Contractor.		
4.0	TESTS AND INSPECTION		
	In case the bidder/contractor has conducted type test(s) within last ten years, he may submit 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. In case the Bidder is not able to submit report of the type test(s) conducted within last ten years from the date LOA by OWNER, or in case the type test report(s) are not found to be meeting the specification requirements, the Bidder shall conduct all such tests under this contract at no additional cost to the Employer and submit the reports for approval <u>Short Circuit Test:-</u>		
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	In case short circuit test has not been conducted or the test report not meeting the specification requirement for the offered transformer manufacturer, Bidder /Sub-vendor shall establish" Ability to withstand the dynamic effects of short circuit "for the offered transformer as per latest IEC 60076-5.The ability to withstand the dynamic effects of short circuit can be established either by performing actual short circuit test or by method of calculation with reference to short circuit tested reference transformer as per IEC-60076-5/Annexure-A&B. Bidder shall choose any one the two options mentioned below; <u>Option-1:-</u> Performing actual short circuit test as Type Test. In order to meet project schedule, Bidder/Sub vendor shall take suitable steps quite in advance to ensure successful conduction of short circuit test within three months time from date of LOA failing which the offered make of the transformer shall not be considered. <u>Option-2:</u> By theoretical evaluation of the ability to withstand dynamic effect of short circuit based on 'Calculation and Design and Manufacture Consideration'. In this regard the guidelines given in Annexure-A with applicable tables of the IEC 60076-5 is to be followed. <u>The reference transformer chosen shall be of same application, winding configuration, conductor current density and as per Annexure-B of latest IEC-60076-5.</u> Necessary Design document and reference test reports related to theoretical comparative evaluation must be submitted by Manufacturer/Bidder as required by Employer in this case. <table><tr><th>S.N.</th><th colspan="2">ROUTINE TESTS</th></tr><tr><td>1.</td><td>All routine test shall be carried out in accordance with IEC 60076.</td><td>√</td></tr><tr><td>2.</td><td>Measurement of Voltage Ratio & phase displacement (as per IEC 60076-1)</td><td>√</td></tr><tr><td>3.</td><td>Measurement of winding resistance on all the taps (as per IEC 60076-1)</td><td>√</td></tr><tr><td>4.</td><td>Vector group and Polarity Check (as per IEC 60076-1)</td><td>√</td></tr><tr><td>5.</td><td>Magnetic Balance and Magnetising Current Test</td><td>√</td></tr><tr><td>6.</td><td>Measurement of no load current with 415 V, 50 Hz AC supply</td><td>√</td></tr><tr><td>7.</td><td>Measurement of no load losses and current at 90%, 100% & 110% of rated voltage (as per IEC 60076-1)</td><td>√</td></tr><tr><td>8.</td><td>Load Loss & Short Circuit Impedance Measurement on principal & Extreme Taps</td><td>√</td></tr><tr><td>9.</td><td>IR measurement (As per IEC 60076-1)</td><td>√</td></tr><tr><td>10.</td><td>Measurement of capacitance & tan delta to determine capacitance between winding & earth.</td><td>√</td></tr><tr><td>11.</td><td>Separate Source Voltage Withstand Test /Applied voltage test (as per IEC 60076-3)</td><td>√</td></tr><tr><td>12.</td><td>Induced overvoltage test/Induced voltage withstand(IVW) test as per IEC60076 part 3</td><td>√</td></tr><tr><td>13.</td><td>Repeat no load current/loss & IR after completion of all electrical test</td><td>√</td></tr><tr><td>14.</td><td>Oil leakage test on completely assembled transformer along with radiators (as per relevant clause of this sub section)</td><td>√</td></tr><tr><td>15.</td><td>Jacking test followed by D.P. test</td><td>√</td></tr></table>			S.N.	ROUTINE TESTS		1.	All routine test shall be carried out in accordance with IEC 60076.	√	2.	Measurement of Voltage Ratio & phase displacement (as per IEC 60076-1)	√	3.	Measurement of winding resistance on all the taps (as per IEC 60076-1)	√	4.	Vector group and Polarity Check (as per IEC 60076-1)	√	5.	Magnetic Balance and Magnetising Current Test	√	6.	Measurement of no load current with 415 V, 50 Hz AC supply	√	7.	Measurement of no load losses and current at 90%, 100% & 110% of rated voltage (as per IEC 60076-1)	√	8.	Load Loss & Short Circuit Impedance Measurement on principal & Extreme Taps	√	9.	IR measurement (As per IEC 60076-1)	√	10.	Measurement of capacitance & tan delta to determine capacitance between winding & earth.	√	11.	Separate Source Voltage Withstand Test /Applied voltage test (as per IEC 60076-3)	√	12.	Induced overvoltage test/Induced voltage withstand(IVW) test as per IEC60076 part 3	√	13.	Repeat no load current/loss & IR after completion of all electrical test	√	14.	Oil leakage test on completely assembled transformer along with radiators (as per relevant clause of this sub section)	√	15.	Jacking test followed by D.P. test	√
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CLAUSE NO.	TECHNICAL SPECIFICATIONS																							
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	(#) NOTE:- i) All the type and 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. ii) Inverter Transformer LV winding Di-electric tests (except for lightning impulse test for LV winding) shall be carried out corresponding to levels (as per IEC 60076) for 3.6 kV class. iii) All Type tests should be done as per Employer’s approved procedure.																							
	Leakage test on assembled Oil filled Transformer (ROUTINE TEST) 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. Bidder can perform this test at site depending upon urgency subject to OWNER approval. Suitable Fire Fighting arrangements for Oil filled Transformers shall be provided if applicable as per Tariff Advisory Committee (TAC)/statutory requirements. In case Nitrogen based fire protection system is used, CBIP manual shall be followed for compliance. Firewall & soak pit as applicable (as per statutory requirement/TAC/IS 10028 / IS 1646) shall be provided of minimum 230 mm																							

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4.2	thickness of RCC wall or 355 mm thick fire resisting brick wall subject to OWNER approval. However for all oil filled outdoor a pit shall be provided all around at a distance of 1.0 meter (min.) from transformer outer edge, a sump pit shall be provided for each pit. Transformer efficiency shall be as per Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electrical Lines) regulation, 2010.																																																			
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	13) TRANSFORMER													
	Oil Filled Transformer													
	Attributes / Characteristics													
	Items/Components Sub Systems	Visual & Dimensional Checks	Mechanical properties	Electrical strength	Thermal properties	Chemical Composition	Compatibility with oil	NDT / DPT / MPI / UT	Ageing Test.	Voltage Ratio, Vector Group & Polarity, Magnetic Balance Test	Make / Type / Rating / Model / TC / General Physical Inspection.	Functional check	WPS & PQR	Routine Test as per relevant standard / EMPLOYER Specification
	Tank, H.V. & L.V. Cable Box / Flange throat	Y	Y					Y					Y	
	Conservator / Radiator / Cooler / Pipes	Y	Y					Y						
	Copper Conductor (IS:191)	Y	Y	Y		Y								
	Insulating Material	Y	Y	Y	Y	Y	Y							
	CRGO Lamination & Built Core	Y	Y	Y		Y	Y				Y			
	Bushing / Insulator (IS:2544 / 5621)	Y	Y								Y			Y
	Gasket	Y	Y			Y	Y		Y		Y			Y
	Transformer Oil (IEC296)			Y										Y
	OLTC / Off-Circuit Tap Changer	Y									Y			Y
	Core Coil Assembly & Pre-tanking	Y								Y	Y			
	Marshalling Box	Y									Y	Y		Y
	WTI, OTI, MOG, PRD, Breather, Terminal Connector, Bucholz Relay, Valves	Y									Y	Y		
	Welding (ASME Sect-IX)	Y						Y					Y	
	Complete Transformer (IS:2026/ IEC-60076)	Y												Y
	Note: 1) This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents. 2) All major Bought Out Items will be subject to EMPLOYER approval.													
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CLAUSE NO.	TECHNICAL SPECIFICATIONS									
	LT INDOOR TRANSFORMER (DRY TYPE TRANSFORMER)									
	Attributes / Characteristics	Visual & Dimensional check	Mechanical properties	Electrical strength	Thermal Properties	Chemical Properties	NDT / DP / MPI	Voltage Ratio, Vector Group & Polarity	Make / Type / Rating / Model / TC / General Physical Inspection	Routine Test as per relevant standard / EMPLOYER Specification
	Items/ Components Sub Systems									
	Enclosure door, H.V. & L.V. Cable Box / Flange Throat	Y	Y						Y	
	Copper Conductor	Y	Y	Y		Y				
	Insulating Material	Y			Y	Y				
	CRGO Lamination & Built Core	Y							Y	
	Porcelain Bushing /Insulator (IS:2544 / 5621)	Y	Y	Y					Y	Y
	Gasket (IS 2712)	Y	Y						Y	Y
	Off-Circuit Tap Changer	Y							Y	Y
	Core Coil Assembly	Y						Y		
	Marshalling Box	Y								Y
	WTI, Thermistor, Terminal Connector	Y							Y	
	Complete Transformer (IS:11171 / IEC 60076)	Y								Y
	Notes: 1) This is an indicative List of test/checks. The manufacturer is to furnish a detailed Quality Plan indicating his practice and procedure along with relevant supporting documents during QP finalization for all item. 2) All major Bought out Items will be subject to EMPLOYER approval.									
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CLAUSE NO.	TECHNICAL SPECIFICATIONS												
	AUXILIARY / LT TRANSFORMER												
	Attributes / Characteristics Items /Components Sub Systems	Visual & Dimensional Checks	Mechanical properties	Electrical strength	Thermal properties	Chemical Composition	Compatibility with oil	NDT / DPT / MPI / UT	Ageing Test.	Voltage Ratio, Vector Group & Polarity, Magnetic Balance Test	Make / Type / Rating / Model / TC / General Physical Inspection.	Functional check	WPS & PQR Routine Test as per relevant standard / EMPLOYER Specification
	Tank, H.V. & L.V. Cable Box / Flange throat	Y	Y					Y				Y	
	Conservator / Radiator / Cooler / Pipes	Y	Y					Y					
	Copper Conductor (IS:191)	Y	Y	Y		Y							
	Insulating Material	Y	Y	Y	Y	Y	Y						
	CRGO Lamination & Built Core	Y	Y	Y		Y	Y				Y		
	Bushing / Insulator (IS:2544 / 5621)	Y	Y								Y		Y
	Gasket	Y	Y			Y	Y		Y		Y		Y
	Transformer Oil (IEC296)			Y									Y
	OLTC / Off-Circuit Tap Changer	Y									Y		Y
	Core Coil Assembly & Pre-tanking	Y								Y	Y		
	Marshalling Box	Y									Y	Y	Y
	WTI, OTI, MOG, PRD, Breather, Terminal Connector, Bucholz Relay, Valves	Y									Y	Y	
	Welding (ASME Sect-IX)	Y						Y					Y
	Complete Transformer (IS:2026/ IEC-60076)	Y											Y
	Note: 1) This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents. 2) All major Bought Out Items will be subject to EMPLOYER approval.												
26 MW FLOATING SOLAR PV PROJECT AT RESERVOIR- 1B OF NTPC SIPAT				TECHNICAL SPECIFICATION BID DOC. NO: RE-CS-5807-004-9						E-1		PAGE 35	