

Model Technical Specifications

For

PCS / IDT Transformer

Rev – 00

May 2026

SECTION – PCS / IDT Transformer

1. Technical Requirements (Oil Filled) Transformers

Sr. No.	Parameter	Value
i.	VA Rating & Quantity	As per system requirement
ii.	Voltage Ratio	As per system requirement
iii.	Duty, Application	Continuous Solar/ BESS Inverter application and converter duty Outdoor
iv.	Winding	As per system requirement
v.	Frequency	50
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 at 75°C	As per system requirement & as per PCS manufacturer recommendation.
	a) Principal Tap	
	b) Other Taps	
xi.	Permissible Temperature rise over an ambient of 50 deg C irrespective of tap	
	a) Top Oil	50 deg .C
	b) Each Individual Winding	55 deg.c
xii.	SC withstand time (thermal)	2 sec.
xiii.	Fault Level & Bushing CT	As per system requirement
xiv.	Termination	AS per system requirement (Cable/busduct)
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-I
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

Sr. No.	Parameter	Value
		the tap. 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	

Note (common for Oil filled and dry type transformer):

- Inverter Transformer shall have copper/Aluminum Shield winding between LV & HV windings. Each LV winding must be capable of handling nonsinusoidal voltage with voltage gradient as per relevant applicable standards and PCS 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 PCS 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 loading cycle must be compensated through suitable design (as applicable).
- The thermal design of PCS/Inverter Transformer needs to consider the temperature dependent performance of the PCS. It is to in accordance with PCS/Inverter output and under worst condition it should not limit PCS/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 winding design, the transformer needs to operate reliable with only one PCS/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 PCS/inverter transformer, it shall be proven and of successfully type tested design
- Contacts from PCS/Inverter transformer fittings/protection devices shall be wired for tripping of PCS/Inverter transformer Circuit Breaker.
- Detailed scheme & rating of transformer shall be finalized during detailed engineering.
- kVA rating of PCS/inverter transformer shall not be less than kVA capacity of respective PCS/Inverters connected to it.

1.1. Codes and Standard

Transformers	IS:2026, IS: 6600, IEC: 60076
Bushings	IS:2099, IEC: 60137, IS: 3347, IS 12676

Insulating oil	IEC 60296, IEC 61099/1S16081
Bushings CTs	IS:2705, IEC 60185
Indian Electricity Act 2003, BEE Guideline & CEA notifications	

1.2. 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 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.

1.3. 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 Aluminium 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.

1.4. 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.

1.5. Insulating Mineral Oil

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.

Sr. No.	Property	Permissible Values
a)	Kinematic Viscosity, mm ² /s	≤ 12 at 40 ° C ≤ 1800.0 at (-)30 ° C
b)	Flash Point, ° C	≥ 140° C
c)	Pour point, ° C	≤ (-)40 ° C
d)	Appearance	Clear, free from sediment and suspended matter
e)	Density kg/m ³ at 20 ° C	≤ 0.895
f)	Interfacial Tension N/m at 25° C	≥ 0.04
g)	Neutralisation value, mgKOH/g	≤ 0.01
h)	Corrosive sulphur	Non Corrosive
i)	Water content mg/kg	≤ 30 in bulk supply ≤ 40 in drum supply
j)	Anti-oxidants additives	Not detectable
k)	Oxidation Stability -Neutralization value, mgKOH/g -Sludge, % by mass	≤ 1.2 ≤ 0.8
l)	Breakdown voltage As delivered, kV After treatment, Kv	≥ 30 ≥ 70
m)	Dissipation factor, at 90° C And 40 Hz to 60 Hz	≤ 0.005
n)	PCA content	≤1%
o)	Impulse withstand Level, kVp	≥ 145
p)	Gassing tendency at 50 Hz after 120 min, mm ³ /min	≤ 5

Subsequently oil samples shall be drawn at:

Sr. No.	Parameters	Before filling in main tank & tested for	Prior to energization for Applicability following	Applicability

			properties & acceptance norms:	
i.	BDV	60 kV (min)	60 kV (min)	Applicable for all Transformers.
ii.	Moisture	10 ppm (max.)	10 ppm (max.)	

1.6. Bushings

- a) Bushing below 52 kV shall be oil communicating type with porcelain insulator.
- b) LV Bushing below 3.6 kV used within transformer cable box, epoxy type bushing confirming to IS 2099/IEC 60137 also allowed as alternate to porcelain type
- c) No arcing horns to be provided on the bushings.
- d) Inverter Transformer LV bushing palms shall be silver/tin plated.

1.7. Bushings CTs

- a) Shall be of adequate rating for protection (differential and others if any) as required, WTI etc. All CTs (except WTI) shall be mounted in the turret of bushings, mounting inside the tank is not permitted.
- b) All CT terminals shall be provided as fixed type terminals on the M. Box to avoid any hazard due to loose connection leading to CT opening. In no circumstances Plug In type connectors shall be used for CT.

1.8. Valves

- a) All valves up to 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.
- b) Sampling & drain valves should have zero leakage rate.

1.9. Gaskets

- a) Gasket shall be fitted with weather proof, hot oil resistant, nitrile rubber based gasket.
- b) If gasket is compressible, metallic stops shall be provided to prevent over compression.
- c) The gaskets shall not deteriorate during the life of transformer if not opened for maintenance at site. All joints flanged or welded 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.

1.10. Painting

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	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

1.11. Neutral Earthing Arrangement

- a) Neutral earthing shall be done as per system requirement. 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).
- b) Neutral of Transformer if not used should be taken out through bushing and covered by insulating cap.

1.12. Cable boxes & disconnecting chamber (Disconnecting chamber applicable 3.3 kV and above & for PCS/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 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.

1.13. Fittings

Following fittings shall be provided with Transformers covered under this sub section.

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 as collectin 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 rovided.
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 markin lates, two nos. earthin 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.
The fittings listed above are only indicative and other fittings, which generally are required for satisfactory operation of the transformers are deemed to be included.	

2. Dry Type Transformers

2.1. Parameters

Sr. No.	Parameters	Value
1.	Type	Epoxy cast resin/resin encapsulated
2.	Duty, Service & Application	Continuous Solar/BESS Inverter application and converter dut Indoor
3.	MVA & Voltage ratio	As per system requirement
4.	Vector group	

5.	Termination & Bushing CT	
6.	Fault Level & Earthing	
7.	Tap changer type & range	As per system requirement. OCTC +/-5% (min.)
8.	Number of Phases	Three (3)
9.	Impedance	As per system requirement & as per Inverter manufacturer recommendation.
10.	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.
11.	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)
12.	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)
13.	SC withstand time (thermal)	2 sec
14.	Noise Level	Not to exceed values specified in NEMA TR-1
15.	PD Level (max. Allowable)	10 pc
16.	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 IEC 60076-12/IS: 6600.
17.	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. c) 140% for at least five seconds.

2.2. Codes & Standard

Dry type transformers	IS: 11171, IEC 60076-11
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2.3. Design & Constructional Features

- a) 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.
- b) 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.
- c) Winding conductor shall be electrolytic grade Copper/ Aluminum. Windings shall be of class F insulation or better. All windings are to be uniformly insulated.
- d) 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.
- e) Bushing CTs shall be provided in the LV neutral side of adequate rating for REF protection, WTI, etc (as applicable).
- f) 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.
- g) 3.02.07 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.

2.4. Painting

- a) 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.
- b) 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.
- c) 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.

2.5. Fitting

Winding temperature indicator (WTI)	Shall be Platinum resistance type temperature detector in each limb.
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	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 oC or better. 1 no. 4-20 mA signal shall be provided for 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.	

3. Testing & Inspection

In case the bidder/contractor has conducted type test within last ten years (Dynamic short circuit report shall be valid till the design is changed and transformer supplier shall give affidavit stating that there is no change in the design), 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 conducted within above specified period from the date LOA by POWERGRID, or in case the type test report 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.

Short Circuit Test:- 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 similar design 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;

Option-1:- 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.

Option-2: In case of Short Circuit test already carried out on similar design, report shall be provided for approval (Dynamic short circuit report shall be valid till the design is changed and transformer supplier shall give affidavit stating that there is no change in the design). The details shall be as per guidelines given in Annexure-A with applicable tables of the IEC 60076-5 is to be followed. The reference transformer chosen shall be of same application, winding configuration, conductor current density and as per Annexure-B of latest IEC-60076-5. Necessary Design document and reference transformer test reports related to theoretical comparative evaluation must be submitted by Manufacturer/Bidder as required by Employer in this case.

S. No.	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 (before and after dielectric test).	√
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	√
16.	Marshalling Box/Cable box: It shall not be possible to insert a thin sheet of paper under gaskets and through enclosure joints.	√
17.	IR measurement on wiring of Marshalling Box.	√

S. No.	Type Test # (To be carried out on one transformer of each rating)	
	Lightning impulse(Full and chopped wave) test on windings(as per IEC 60076-3) (Not applicable for LV)	√
1)	Short circuit test (special test) as per IEC 60076-5 (if	√
2)	Temperature Rise test at a tap corresponding to maximum losses as per IEC 60076. Gas Chromatography shall be conducted on oil sample taken before & immediately after temp. rise test. Gas analysis shall be as per IS: 9434 (based on IEC: 60567), results will be interpreted as per IS: 10593 (based on IEC: 60599).	√
3)	Measurement of harmonics of no load current (special test)	√
4)	Measurement of acoustic noise level as per NEMA TR-1 (special test)	√
5)	Tank Vacuum & Pressure Test (as per CBIP norms)	√

(#) Note:-

- a) 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.
- b) 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.
- c) All Type tests should be done as per Employer's approved procedure.

3.1. 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 POWERGRID 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 thickness of RCC wall or 355 mm thick fire resisting brick wall subject to POWERGRID 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.

3.2. Routine / Type Tests (Dry Type Transformers)

Transformer shall be short circuit tested after conducting the routine tests. Rest of the type tests shall be conducted after successful short circuit testing. All routine tests in accordance with IS: 11171 / IEC 60076-11 shall be carried out on each transformer and all type tests should be done as per Employer's approved procedure.

Sr. No.	Test Name	Type of Test
1.	Measurement of winding Resistance for each tap position.	Routine
2.	Measurement of voltage ratio at each taps position.	Routine
3.	Vector group and polarity check	Routine
4.	Measurement of impedance voltage/short circuit impedance & load loss at principal tap and extreme taps	Routine
5.	Measurement of no load losses and magnetising current at rated frequency and 90%, 100% and 110% rated voltage.	Routine
6.	Measurement of insulation resistance	Routine
7.	Measurement of capacitance and tan delta	Routine
8.	Dielectric Tests 1) PF/Separate source AC withstand voltage test. 2) Chopped wave lightning impulse voltage test on windings(as per IEC 60076-3) (Not applicable for LV) 3) Induced over voltage withstand test	Routine Type Routine
9.	Partial discharge measurement	Routine
10.	Measurement of iron loss & IR (repeat after induced voltage test)	Routine
11.	Short Circuit test as per IEC (if applicable)	Type

12.	Noise Level Measurement	Type
13.	Temperature rise test as per IEC (HV & LV winding)	Type

4. Control/monitoring (Dry Type and Oil filled Transformers)

The supervision, control and communication of various parameters (including fan/pump controls as applicable, alarm, trips, all monitoring/control signals, as applicable etc.) for monitoring and control of PCS/Inverter Transformers shall be done at BESS SCADA. All required hardwares, softwares, protocols, cables etc. for above supervision, control and communication of various operating conditions, control and monitoring shall be carried out by contractor and the same will be in contractor's scope. The same is in addition to the local monitoring and control.